SECTION 21 01 00

GENERAL FIRE SUPPRESSION PROVISIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work covered by Division 21 sections consist of furnishing all labor, equipment, appliances and material for the piping and plumbing systems in strict accordance with Codes, Specifications and the applicable drawings and subject to the terms and conditions of the contract. Include all appurtenances necessary to the proper operation of the systems and equipment specified.

B. Some equipment may be furnished by other divisions. Fire Suppression Contractor is responsible to check the drawings and specifications for equipment that will be furnished by the others.

C. Construction Manager shall furnish and install all ceiling access panels required to service equipment, valves and controls above gyp board or hidden spline ceilings.

D. Construction Manager shall provide all site drive, sidewalk, and other surfaced areas, saw cutting, and repairs back to preexisting conditions for the required mechanical piping. Fire Suppression Contractor shall provide the trenching, bedding and backfill required for the pipe installation.

1.2 RELATED SECTIONS

A. The General Conditions and Division 1, General Requirements, as bound in the specification preamble, apply to all work under Division 21. Carefully note its contents in performance of the work.

B. The Architectural, Plumbing, Mechanical, Electrical and Structural plans and Specifications, including Information to Bidders and other pertinent documents issued by the Engineer are a part of the Specifications and the accompanying mechanical plans. Comply with them in every respect. Examine all the above carefully. Failure to comply does not relieve the Contractor of responsibility nor may it be used as a basis for additional compensation due to omission of architectural, electrical and structural details from the mechanical drawings.

C. All electrical power wiring is specified under Division 26 of the Specifications. Fire Suppression Contractor shall furnish all motor starters required for the control and protection of all motors furnished for Division 21, any air compressors, or other fire suppression equipment to be wired by a licensed electrician.

D. All concrete pads and bases required for installing equipment are specified in another section of the Specifications. Advise the Construction Manager as to the exact sizes required, location of anchor bolts, etc.

1.3 CODES, FEES AND LATERAL COSTS

A. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations, and the applicable requirements of the following latest nationally accepted codes and standards:

1. Centerton City Building Code, latest accepted edition.
2. 2021 Arkansas Fire Prevention Code.
3. 2022 AFPLB Rules and Regulations.
4. IBC - International Building Code; latest adopted edition.
5. ASA - American Standards Association.
6. ASME - American Society of Mechanical Engineers.
7. ASTM - American Society of Testing Materials.
8. AWWA - American Water Works Association.
9. NBS - National Bureau of Standards.
10. NEMA - National Electrical Manufacturers Association.
11. NFPA - National Fire Protection Association; the edition referenced by the governing Fire Code or else the latest edition.
12. UL - Underwriters' Laboratories, Inc.
13. OSHA - Occupational Safety and Hazard Association.
14. IFC - International Fire Code; latest accepted edition.

B. In case of difference between building codes, Specifications, state Laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent governs. Promptly notify the Engineer in writing of any such difference.

C. Remove any work installed that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility

company regulations, correct the deficiencies, and reinstall all work at no cost to the Owner.

D. The architectural drawings show the general arrangement of all rooms and finishes. Follow as closely as actual building construction and the work of other trades will permit. Final layout will be governed by actual field conditions with all measurements verified at the site. Conform to the requirements shown on all of the drawings. General and structural drawings take precedence over mechanical drawings. Investigate the existing and finish conditions affecting the work and arrange the work accordingly, providing such fittings, valves and accessories as may be required to meet such conditions. Contractor shall verify that all equipment, pipes and all other components will fit in the space provided before fabrication or ordering.

E. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith. Arrange with the serving utility companies for the connections to all utilities and pay all charges for same including inspection fees and meters if required. Refundable deposits will be paid by the Owner.

1.4 GUARANTEE

A. Furnish a written certificate guaranteeing all materials, equipment and labor furnished to be free of all defects for a period of one (1) year from and after the date of final acceptance of the work by the Owner and further guarantee to replace such work without charges if any defects appear within the stipulated guaranty period.

1.5 SOIL CONDITIONS

A. The Specifications and the drawings in no way imply the conditions of the soil to be encountered. When excavating may be required in execution of the work, this Contractor agrees that he has informed himself regarding conditions affecting the work.

1.6 INSPECTION OF PREMISES

A. Before submitting a bid, visit the site of the proposed job and determine the conditions relating to this work.

1.7 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered as a general guide only, without guarantee as to accuracy. Verify the location and elevation of all utilities and their relation to the work before entering into a contract.

B. Identify outdoor underground lines with continuous strip of plastic utility marker tape at regular intervals (maximum of 10 feet) "Caution FIRELINE below". Install one foot directly above pipe before backfilling to grade.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide new materials bearing the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. Furnish the standard product of a manufacturer regularly engaged in the production of the required type of equipment. Provide the manufacturer's latest approved design.

B. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. Store all items subject to moisture damage (such as controls) in dry, heated spaces.

C. Provide equipment and materials of the same general type and of the same make throughout the work to provide uniform appearance, operation and maintenance.

D. Tightly cover equipment and protect against dirt, water and chemical or mechanical injury and theft. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly. Turn over to the Owner in a condition satisfactory to the Engineer. Repair damage or defects developing before acceptance of the work at no expense to the Owner.

E. Insure that items to be furnished fit the space available. Make necessary field measurements to ascertain space requirements, including those for connections. Furnish and install such sizes and shapes of equipment that the final installation suits the true intent and meaning of the drawings and Specifications.

F. Follow manufacturer's directions completely in the delivery, storage, protection and installation of all equipment and materials. Promptly notify the Engineer in writing of any conflicts between any requirements of the Contract Documents and the manufacturers' directions. Obtain the Engineer's written instruction before proceeding with the work. Replace any work that does not comply with the manufacturers' directions or such written instructions from the Engineer, at no cost to the Owner.

G. Support all products by service organizations with adequate spare parts inventory and personnel located within fifty (50) miles of the site.

H. Where multiple units of the same type or class of products are required, provide all units of the same manufacturer.

2.2 EQUIPMENT ACCESSORIES

A. Furnish and install all equipment, accessories, connections and incidental items necessary to fully complete all work, ready for use, occupancy and operation by the Owner.

B. Where equipment requiring different arrangement or connections from those shown is provided, install the equipment to operate properly and in harmony with the intent of the drawings and Specifications.

C. Support, plumb, rigid and true to line, all work and equipment furnished. Study thoroughly all fire sprinkler, general, structural, electrical and mechanical drawings, shop drawings and catalog data to determine how equipment, valves, piping, etc., are to be supported, mounted or suspended and provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper supports whether or not shown on the drawings. When directed, submit drawings showing supports.

D. If accessories are required to complete the work and meet the intent of the specification, it is the responsibility of the Contractor to provide such accessories.

2.3 MATERIAL AND EQUIPMENT SCHEDULE

A. Submit to the Engineer as soon as practical, six (6) complete sets of the schedule of materials and equipment proposed for the installation. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data and submit under one cover with an index sheet in front. Also, provide a CD containing PDFs of the materials and equipment proposed, fire sprinkler drawings, and all RFI correspondence. Use the following folders: Product Manual, FP Drawings, RFIs.

B. Provide written certification that shop drawings are in accordance with the specifications and are dimensionally correct with reference to available space.

C. FIRE SPRINKLER CONTRACTOR SHALL NOT fabricate any portion of the system until the fire sprinkler design has been reviewed and approved in writing by the owner's contracted fire sprinkler system inspector.

D. All submittals will be reviewed a maximum of two (2) times. The cost of additional submittal reviews beyond those two specified will be charged to the Contractor.

E. Shop drawings for the Engineer's files are required on the following items:

1. Pipe hangers and supports, including any seismic bracing/restraints.

2. Piping materials, including flexible connections, and valves.

3. Complete equipment electrical data and wiring details. Include specifications for pressure switches, flow switches, alarm devices, and air compressors.

4. Sprinkler heads, escutcheons, and guards. Include manufacturer's data sheets for all sprinklers and finish trim, indicating which sprinkler wrenches apply.

5. Sprinkler plans including calculations and approval from the Authorities Having Jurisdiction.

6. Include all information pertaining to any standpipe and hose systems required, such as hose connections, stations, and cabinets.

7. Include information for all exterior installation, such as joints, restraints, valves, tapping, fire hydrants, bedding, thrust blocking, and preliminary Contractor's Material Test Certificate, to be signed at later date.

2.4 EQUIPMENT AND MATERIAL SUBSTITUTIONS

A. It is the responsibility of the Contractor to investigate any desired substitutions for specified equipment prior to submission of his bid. The Fire Suppression Contractor shall be responsible for any changes required in mechanical, electrical, or structural systems and shall bear all cost for those changes whether the substitute equipment is named by manufacturer in the specifications or is submitted to the Architect for "or equal" consideration. All changes shall be accomplished in a manner acceptable to the Architect per Section 01 60 00 at no additional cost to the Owner.

B. In order to obtain prior approval on equipment or material not specified in Fire Suppression Specifications or Equipment Schedules, Fire Suppression Contractor MUST submit to the Engineer any proposed equipment or material ten (10) working days prior to the bid date.

C. If ANY substitute equipment is submitted to Engineer for approval, without said equipment having been pre-approved, the entire submittal will be rejected for resubmittal.

D. Any equipment manufacturers which are a subsidiary to the listed acceptable manufacturers are not considered equal. Therefore, it is the responsibility of the Contractor and equipment supplier to obtain prior approval as described in paragraph 2.4, this Section.

2.5 ELECTRICAL MOTORS

A. Provide motors of a recognized manufacturer, wound for the voltage specified, and in conformance to latest standards of the manufacturer and performance of the National

Electrical Manufacturers Association and the Institute of Electrical and Electronic Engineers. Provide motors as manufactured by General Electric, Westinghouse, Century or Siemens-Allis, Baldor or approved equal.

B. Provide motors rated for continuous duty at 100% of rated capacity and temperature raise of 40 degrees Centigrade open type; 50 degrees Centigrade drip and splash proof; 55 degrees Centigrade explosion proof and totally enclosed above an ambient of 40 degrees Centigrade.

C. Unless otherwise required, provide integral horsepower, polyphase motors, Class B, general purpose, squirrel cage, open type induction motors, T-frame.

D. Provide single phase fractional horsepower motors of the open capacitor type. Generally, motors under 1/2 horsepower may be split phase type unless otherwise specified. Provide motors rated 1/2 horsepower or less with integral overcurrent protection.

E. Insure the insulation resistance between stator conductor and frames of motors is not less than 1/2 megohm. Provide shop test of motors including temperature rise, insulation resistance, motor terminal voltage, normal operating line current, RPMs, breaker or switch size with fusing and overload relay sizes.

PART 3 EXECUTION

3.1 COORDINATION OF WORK

A. Compare the Fire Suppression drawings and Specifications with the drawings and Specifications for other trades and report any discrepancies between them to the Engineer and obtain from him written instruction for changes necessary in the fire suppression work. Install the fire suppression work in cooperation with other trades installing inter-related work. Before installation, make proper provisions to avoid interferences in a manner approved by the Engineer. Make all changes required in the work caused either by neglect or existing field conditions at no cost to the Owner.

B. It is the responsibility of the Construction Manager, Mechanical Contractor, Electrical Contractor and Sprinkler Contractor to coordinate installation of all equipment. Equipment installed prior to proper coordination, which interferes with the harmony and intent of the specifications and drawings, will be removed and reinstalled at the cost of the responsible Contractor.

C. Furnish anchor bolts, sleeves, inserts and supports required for the fire suppression work. Locate anchor bolts, sleeves, inserts and supports as directed by the trade requiring them and insure that they are properly installed.

D. Adjust locations of pipes, equipment, etc., to accommodate the work and for interferences anticipated and encountered. Determine the exact route and location of each pipe prior to fabrication.

1. Provide right-of-way to lines that pitch over those that do not pitch. For example, Plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have the right-of-way over lines whose elevations can be changed.

2. Make offsets, transitions and changes in direction in pipes as required to maintain proper head room and pitch.

E. Install all Fire Suppression work to permit removal without damage to all parts requiring periodic replacement or maintenance. Insure proper clearance for the backflow prevention, fire sprinkler valves, alarm switches, and all such components. Arrange pipes and equipment to permit ready access to valves, cocks, traps, starters, motors, control components and to clear the openings of swinging and overhead doors and of access panels.

3.2 RECORD DRAWINGS

A. Maintain record drawings showing exact locations and sizes, as actually installed, of piping, drains, cleanouts, ductwork, controls and equipment as specified herein. Deliver to the Owner/Architect upon completion and acceptance of the work, one (1) complete set of contract drawings marked to indicate all deviations from intended installation.

3.3 CUTTING AND PATCHING

A. The Construction Manager shall be responsible for all required cutting, patching, etc., incidental to this work and shall make all required repairs thereafter to the satisfaction of the Engineer. Do not cut into any major structural element, beam or column without the written approval of the Engineer.

B. Cut, patch, repair and/or replace pavements, sidewalks, roads and curbs as required to permit the installation of the work and pay all expenses incurred for this work.

C. Pipes, conduits, cables, wires, pneumatic tubes and similar equipment that pass through fire or smoke barriers shall be protected by the Fire Suppression Contractor in accordance with NFPA 101.

D. All fire stopping assemblies must be UL approved assemblies.

3.4 EXCAVATION AND TRENCHING FOR PIPING

A. Excavate to the depths indicated on the Drawings or as required to provide adequate slope and burial depth. Excavated materials not required or suitable for backfill or fill shall be removed from the site. Do such grading as is necessary to prevent surface water from flowing into trenches or other excavations. Water accumulating therein shall be removed by pumping or by other method. Sheeting and shoring shall be installed as may be necessary for protection of the work and for safety of personnel. Excavation shall be by open cut except that short sections of a trench may be tunneled if the pipe can be safely and properly installed and backfill can be properly tamped in such tunnel sections.

B. Trench Excavation: Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil. Where rock is encountered excavate to a minimum overdepth of 4" below trench depths indicated on the Drawings or specified. Overdepth in rock excavation and unauthorized overdepths shall be backfilled. Whenever wet or otherwise unstable soil incapable of properly supporting the pipe is encountered such soil shall be removed and the trench backfilled to proper grade as hereinafter specified.

C. Depth of Cover: Trenches shall be of depth that will provide three feet (3') minimum cover or as required by the local utility authorities for fire lines from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

D. Utilities Locating: Locate existing utility lines prior to beginning any excavation

E. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor at his expense.

F. Trenches shall not be backfilled until required pressure and other tests have been performed and until the utilities systems as installed conform to requirements of Drawings and Specifications.

G. Backfill trenches with excavated materials consisting of earth, sandy clay, sand, gravel, soft shale or other approved materials, free from clods of earth or stones 2-1/2" maximum dimension, deposited in 6" layers and compacted to 95% Standard Proctor Compaction Test of the maximum laboratory density determined in accordance with ASTM D698, Moisture-Density Relation of Soils. If fills fail to meet the specified densities, the Contractor shall remove and re-compact the fill until specified densities are achieved. Compaction test shall be performed for each fifty linear feet of trench.

H. Provide a 4-inch thick (minimum) layer of 3/4-inch No. 4 gravel aggregate bedding beneath all buried piping. Bedding shall be compacted and leveled to provide sloping required.

3.5 EQUIPMENT START-UP AND TESTING

A. Instruct the Owner's operating personnel during start-up and separate operating tests of each major item of equipment. During the operating tests, prove the operation of each item of equipment to the satisfaction of the Engineer. Give at least seven (7) days notice to the Engineer of equipment start-up and operating tests.

3.6 CATALOG DATA FOR OWNER

A. Provide, in looseleaf binders, two (2) sets of a compilation of catalog data of each manufactured item of equipment used in the Fire Suppression work and present this compilation to the Owner/Architect for transmittal to the Owner before final payment is made. Include descriptive data and printed installation, operating and maintenance instructions for each item of equipment. Provide a complete double index as follows:

1. Listing of products alphabetically by name or by a clearly established, organized method approved by the engineer.

2. Listing the names of manufacturers whose products have been incorporated in the work alphabetically together with their addresses and the names and addresses of the local sales representatives.

3. Certificates of Final Inspections.

4. Complete spare parts data with current prices and supply sources.

5. Extended warranties.

6. As Built Drawings and calculations.

7. Final Release of Lien confirming, or contingent upon, final payment.

B. Deliver to the Owner all special tools, lubricants, extra materials and any other products necessary for the proper operation and maintenance of the fire suppression systems.

C. Provide project record documents indicating all changes from contract documents made during construction.

D. Submit all Certificates of Final Inspections from the Administrative Authorities.

3.7 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Instruct the representative of the Owner in the proper operation and maintenance of all elements of the fire suppression system.

3.8 PROTECTIVE COATINGS

A. Sprinkler Contractor shall clean and prep all exposed sprinkler piping. Painting by others with an acceptable color selected by the Architect.

3.9 CLEANING AND ADJUSTING

A. Do not allow waste material and rubbish to accumulate in or above the premises. After completion of this work, remove rubbish, tools, scaffolding and surplus materials from and about the building and leave all work clean and ready for use. Clean all equipment, pipes, valves and fittings of grease, metal cuttings and sludge. Repair any stoppage, discoloration or other damage to parts of the building, its finish or furnishings due to failure to properly clean the fire suppression systems, without additional cost to the Owner. Adjust all automatic control devices for proper operation.

3.10 ACCESS PANELS

A. Construction Manager shall provide access panels as required in all walls and ceilings to service and have access to all valves and operating parts. For all ceiling and wall access doors that are required in gypsum board and plaster, provide minimum 24" x 24", unless noted otherwise, Milcor type appropriate for the construction involved. Sprinkler Contractor shall coordinate with the Construction Manager required access locations. See paragraph 1.1C. this Specification Section for additional information.

3.11 FINALLY

A. It is the intention that this specification shall provide a complete installation except as herein before specifically excluded or noted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

B. The Fire Sprinkler Contractor is responsible for calling into question any deficiencies or inconsistencies relating to remote areas, hydraulic calculations/pipe sizing, sprinkler coverages, and system riser/fire pump/standpipe locations PRIOR to submitting a bid.

END OF SECTION

SECTION 21 05 01

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 21 05 53 - Identification for Fire Suppression Piping and Equipment: Piping identification.

B. Section 21 13 01 - 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/ANSI B16.1 - 1998 - Cast Iron Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; (R2006).C.ASME/ANSI B16.3 - 1998 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; (R2006).

C. UL 668 - Hose Valves for Fire Protection Service, 2004 rev 2008.

D. ASME B16.4 - Gray Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

E. ASME/ANSI B16.5 - 1996 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers.

F. ASME/ANSI B16.9 - 2001 - Factory-Made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers.

G. ASME/ANSI B16.11 - 2001 - Forged Steel Fittings, Socket-Welding and Threaded; ; The American Society of Mechanical Engineers.

H. ASME/ANSI B16.18 - 1984 (R1994) - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.

I. ASME/ANSI B16.21 - 2005 - Nonmetallic Flat Gaskets for Pipe.

J. ASME/ANSI B16.22 - 1995 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers.

K. ASME/ANSI B16.24 - 1991 (R1998) - Cast Copper Alloy Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers.

L. ASME/ANSI B16.25 - 1997 - Buttwelding Ends; The American Society of Mechanical Engineers.

M. ASME/ANSI B16.42 - 1998 - Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300; The American Society of Mechanical Engineers.

N. ASME/ANSI B 36.10 Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers; 1998.

O. ASTM A47/A47M-99(2009) - Standard Specification for Ferritic Malleable Iron Castings.

P. ASTM A53/A53M-07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

Q. ASTM A 135/A 135M - Standard Specification for Electric-Resistance Welded Steel Pipe; 2006.

R. ASTM A 183 - Standard Specification for Carbon Steel Track Bolts and Nuts.

S. ASTM A 193/A193M - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service.

T. ASTM A 234/A 234M-07 Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service R.ASTM A795/A795M-08 15-May-2008 Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

U. ASTM A 449 - Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.

V. ASTM A 536 - Standard Specification for Ductile Iron Castings.

W. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts.

X. ASTM A 795/A 795M - Standard Specification for Black and Hot Dipped Zinc-coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

Y. ASTM F 436 - Standard Specification for Hardoned Steel Washers, 2009.

Z. AWWA C110/A21.10 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids; American Water Works Association; 2003.

AA. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; American Water Works Association; 2007 (ANSI/AWWA C111/A21.11).

BB. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2002, and Errata 2002 (ANSI/AWWA C151/A21.51).

CC. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; edition adopted by the state.

DD. NFPA 14 - Standard for the Installation of Standpipes and Hose Systems.

EE. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.

FF. NFPA 1963 - Standard for Fire Hose Connections, edition adopted by the state.

GG. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

HH. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; 2004.

II. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; 2004.

1.4 SUBMITTALS

A. See Section 21 01 00 - General Fire Suppression Provisions.

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

C. 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.

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

E. Operation and Maintenance Data: Include installation instructions and spare parts lists.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Valve Stem Packings: Two for each type and size of valve.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience. approved by manufacturer.

C. Conform to UL, FM, and Warnock Hersey requirements.

D. Valves: Bear UL, FM, and Warnock Hersey label or marking. Provide manufacturer's name and pressure rating marked on valve body.

E. 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.

C. 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, with components being UL listed for 175 psig working pressure, made of materials compatible with piping. Where high pressure systems or regions are called out, such components shall be UL listed for 300 psig working pressure.

B. Welding Materials and Procedures: Conform to ASME Code, meeting requirements set forth by NFPA 13.

2.2 BURIED PIPING

A. Cast Iron Pipe: AWWA C151/A21.51.

1. Fittings: AWWA C110, standard thickness.

2. Joints: AWWA C111, rubber gasket.

3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

B. Ductile Iron Pipe: AWWA C151/A21.51.

1. Ductile Fittings: AWWA C110/A21.10 standard thickness.

2. Joints: AWWA C111, rubber gasket with steel nuts and bolts.

3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

4. Encasement shall apply and conform to ASTM A 674 or AWWA C105, PE Film, .008 inches (.20 mm) thick.

2.3 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A 135/A 135M Schedule 10, black for grooved piping.

1. Grooved End Fittings: UL listed, ASTM A 536, ductile iron casting with OD matching steel pipe OD.

2. Cast Iron Fittings: ASME B16.1, threaded fittings.

3. 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.

4. No XL pipe allowed.

5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

B. Steel Pipe: ASTM A 135/A 135M Schedule 30 or 40, black for threaded piping.

1. Steel Fittings: Steel Fittings: ASME B16.5, B16.9, B16.11, B16.25 & A234

2. Cast Iron Fittings: ASME B16.1 & B16.4

3. 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.

4. Pipe Nipples: ASTM A733 made of ASTM A 53 or A 106, Schedule 40, seamless steel pipe.

5. Steel Threaded Couplings: ASTM A 865

6. No XL pipe allowed.

7. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

C. Ductile Iron Pipe: AWWA C151/A21.51.

1. Fittings: AWWA C110/A21.10, standard thickness.

2. Joints: AWWA C111, rubber gasket with steel nuts and bolts

3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.4 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 6 inch: Carbon steel, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 8 inches and Over: Carbon steel, adjustable, clevis.

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

D. Trapeze Hangers: Should be attached to two (2) steel members.

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

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

G. Vertical Support: Steel riser clamp.

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

2.5 GATE VALVES

A. Up to and including 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Bronze body, bronze trim, rising stem, handwheel, solid wedge or disc, threaded ends.

B. Over 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid bronze or cast iron wedge, flanged ends.

C. Over 4 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.

2.6 GLOBE VALVES (COMPLY WITH UL 262)

A. Up to and including 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable rubber disc, threaded ends, with backseating capacity.

B. Over 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.7 BALL VALVES (COMPLY WITH UL 1091)

A. Up to and including 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Bronze two piece body, brass or stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends.

B. Over 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. 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.

2.8 BUTTERFLY VALVES (COMPLY WITH UL 1091)

A. Bronze Body:

1. Manufacturers: Nibco, Kennedy or equal.

2. 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 amp at 115 volt AC.

B. Cast or Ductile Iron Body

1. Manufacturers: Nibco, Kennedy or equal.

2. 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.

2.9 CHECK VALVES (COMPLY WITH UL 312)

A. Up to and including 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Bronze body and swing disc, rubber seat, threaded ends.

B. Over 2 inches:

1. Manufacturers: Nibco, Kennedy or equal.

2. Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends.

C. 4 inches and Over:

1. Manufacturers: Nibco, Kennedy or equal.

2. Iron body, bronze disc, stainless steel spring, resilient seal, threaded, wafer, or flanged ends.

2.10 DRAIN VALVES

A. Size and install per NFPA 13. Must be readily accessible with location, elevations, and accessibility subject to approval.

B. Compression Stop:

1. Manufacturers: Nibco, or equal.

2. Bronze with hose thread nipple and cap.

C. Ball Valve:

1. Manufacturers: Nibco, or equal.

2. Brass with cap and chain, 3/4 inch hose thread.

D. Auxiliary Drain Valve:

1. Manufacturers: Nibco, or equal.

2.11 POST INDICATOR VALVES (WALL TYPE OR UPRIGHT)

A. Comply with UL 789, upright post type, ductile iron body, with extension rod, locking device, and ductile iron barrel.

1. Manufacturers: Nibco Model NIP-1AJ, NIP-2AJ, or equal.

2. Bronze with hose thread nipple and cap.

2.12 INDICATING VALVES (COMPLY WITH UL 1091)

A. Integral indicating device, indoor/outdoor rated, ends matching connection piping.

1. Electrical 115 V ac, prewired, single circuit, supervisory switch.

2. All wiring to be performed by a licensed electrician.

2.13 DRY TYPE VALVES (COMPLY WITH UL 260)

A. Tyco DPV-1, or equal, with trim package. Install Quick Opening Device(s), if needed per NFPA 13.

B. Include Air Maintenance Device: UL 260, to correct air pressure in piping and keep such air at designed operating range.

C. Air Compressor: UL 753 shall be rated for 220 VAC, 60 HZ, Single Phase.

D. Include furnishing and installing PS-10, PS-40, flexible hose connectors, mounting kits, and all components required for a complete installation of the dry pipe system.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

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

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

3.2 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, sloping as required by NFPA 13. Maintain gradient.

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

D. Coordinate sprinkler piping installation with work of all other trades. Installation shall maintain harmony of entire mechanical, electrical and plumbing installation.

E. Group piping whenever practical at common elevations.

F. Sleeve pipes passing through partitions, walls, and floors. Fire walls should be fire caulked.

G. Where pipes pass through fire rated walls, use UL listed assembly to maintain the fire rating of wall.

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

I. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

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

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

J. 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 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.

K. Slope piping and arrange systems as needed to drain at low points. Use eccentric reducers to maintain top of pipe level.

L. Prepare pipe, fittings, supports, and accessories for finish painting where exposed to view (not concealed above ceilings, in walls, etc.). Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

M. Do not penetrate building structural members unless indicated.

N. Provide sleeves when penetrating footings and floors. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

O. 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.

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

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

R. Provide ball valves for shut-off or isolating service.

S. Provide drain valves at main shut-off valves, low points of piping and apparatus.

T. The Fire Sprinkler Contractor is responsible for calling into question any deficiencies or inconsistencies relating to remote areas, hydraulic calculations/pipe sizing, sprinkler coverages, and system riser/fire pump/standpipe locations PRIOR to submitting a bid.

END OF SECTION

SECTION 21 05 53

IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Ceiling tacks.

1.2 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.3 SUBMITTALS

A. See Section 21 01 00 - General Fire Suppression Provisions, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

D. Product Data: Provide manufacturers catalog literature for each product required.

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

F. Project Record Documents: Record actual locations of tagged valves.

1.4 IDENTIFICATION APPLICATIONS

A. Automatic Controls: Tags.

B. Control Panels: Nameplates.

C. Instrumentation: Tags.

D. Major Control Components: Nameplates.

E. Piping: Tags.

F. Pumps: Nameplates.

G. Relays: Tags.

H. Small-sized Equipment: Tags.

I. Thermostats: Nameplates.

J. Valves: Namplates and ceiling tacks where above lay-in ceilings.

1.5 NAMEPLATES

A. Manufacturers:

1. Kolbi Pipe Marker Co.

2. Seton Identification Products

3. Substitutions: See Section 21 01 00 General Fire Suppression Provisions for requirements.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.

2. Letter Height: 1/2 inch.

3. Background Color: Black.

1.6 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving.

2. Brady Corporation.

3. Kolbi Pipe Marker Co.

4. Seton Identification Products.

5. Substitutions: See Section 21 01 00 General Fire Suppression Provisions for requirements.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Chart: Typewritten letter size list in anodized aluminum frame.

1.7 STENCILS

A. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. Seton Identification Products.

4. Substitutions: See Section 21 01 00 General Fire Suppression Provisions for requirements.

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

1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.

2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.

3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.

4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.

5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.

6. Equipment: 2-1/2 inch high letters.

C. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

D. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. MIFAB, Inc.

4. Seton Identification Products.

5. Substitutions: See Section 21 01 00 General Fire Suppression Provisions for requirements.

E. Color: Conform to ASME A13.1.

F. 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.

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

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

1.8 CEILING TACKS

A. Manufacturers:

1. Marking Services Incorporated.

2. Seton.

3. Substitutions: See Section 21 01 00 General Fire Suppression Provisions for requirements.

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

C. Color code as follows:

1. Standard colors.

PART 3 EXECUTION

2.1 PREPARATION

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

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

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

SECTION 21 13 01

FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wet-pipe sprinkler system, submittals and quality control.

B. System design, installation, and certification.

C. Fire department connections, Life Safety System coordination and field quality control.

1.2 RELATED REQUIREMENTS

A. Section 21 05 01 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.

B. Section 21 05 53 - Identification for Fire Suppression Piping and Equipment.

C. Division 26 Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2007.

B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

C. IFC - International Fire Code, latest accepted edition.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

A. See Section 21 01 00 - General Fire Suppression Provisions, for submittal requirements.

B. 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.

C. Shop Drawings:

1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.

2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.

3. Submit shop drawings, product data, and hydraulic calculations to Fire Marshall for approval. Submit proof of approval to Engineer.

D. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

E. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds code requirements.

F. 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.

G. 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 all code requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience approved by manufacturer.

E. Equipment and Components: Provide products that bear UL label or marking.

F. 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. Keep all materials clean and free of debris and material damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tyco Fire Products.

B. Grinnell.

C. Star Manufacturing Company.

D. Reliable Automatic Sprinkler.

E. Substitutions: Approved equal.

2.2 SPRINKLER SYSTEM

A. Sprinkler System: Contractor shall rework existing fire protection system as required to provide coverage for remodeled areas within project scope. Contractor shall field verify existing conditions to determine extent of the work, including required piping connection points and coverage calculations per NFPA 13, prior to bid and construction.

B. Sprinkler System: Provide coverage for entire building.

C. Sprinkler System: Contractor shall extend existing fire protection system as required to provide coverage for new building additions. Contractor shall field verify existing conditions to determine extent of the work, including required piping connection points and coverage calculations per NFPA 13, prior to bid and constructi

D. Refer to civil and mechanical plans, Sprinkler Contractor shall provide connections for future building expansions where indicated.

E. Provide anti-freeze loop where required for coverage where wet system areas are exposed to freezing conditions. Include RPZ and expansion chamber as needed. Coordinate floor drain/sink locations and sizes needed for proper draining.

F. Remote Area may be decreased where quick response sprinklers are at level, flat ceilings of light or ordinary hazard wet systems - when such is the case, this SHALL BE THE FIRST modification made and shall be in accordance with this formula:

1. 675 + 22.5*H (where H is the peak ceiling height, up to 20 ft - minimum remote area is 900 sf).

G. Design Areas (Remote Areas) shall be increased 30% where dry systems are utilized.

H. Where sprinklers are under slopes exceeding 2:12, the remote area (obtained by figures, tables, or the above formula) must be increased 30%.

I. Occupancy per NFPA 13, Appendix A and elsewhere, and as clarified, amended and outlined below:

1. Automobile Parking Areas: Ordinary Hazard, Group 1.
2. Building Service Areas: Ordinary Hazard, Group 1.
3. Churches: Light Hazard.
4. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
5. Dry-Cleaners: Ordinary Hazard, Group 2.
6. General Storage Areas: Ordinary Hazard, Group 1.
7. Laundries: Ordinary Hazard, Group 1.
8. Libraries, Except Stack Areas: Light Hazard.
9. Library Stack Areas: Ordinary Hazard, Group 2.
10. Machine Shops: Ordinary Hazard, Group 2.
11. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
12. Office and Public Areas: Light Hazard.
13. Plastics Processing Areas: Extra Hazard, Group 2.
14. Printing Plants: Extra Hazard, Group 1.
15. Repair Garages: Ordinary Hazard, Group 2.
16. Residential Living Areas: Light Hazard.
17. Restaurant Service Areas: Ordinary Hazard, Group 1.
18. Solvent Cleaning Areas: Extra Hazard, Group 2.
19. Upholstering Plants: Extra Hazard, Group 1.

20. Laboratories, including Classroom Laboratories: Ordinary Hazard, Group 1 or 2 as determined by criteria set forth in NFPA 13.

J. Minimum Density for Automatic-Sprinkler Piping Design:

1. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft.
2. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft.
3. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft.
4. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft.
5. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft.

K. Maximum Protection Area per Sprinkler: Per UL listing.

1. Office Spaces: 225 sq. ft. (20.9 sq. m).
2. Storage Areas: 130 sq. ft. (12.1 sq. m).
3. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
4. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
5. Other Areas: NFPA 13, unless otherwise indicated.

L. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:

1. Light-Hazard Occupancies: 100 gpm (6.3 L/s) for 30 minutes.
2. Ordinary-Hazard Occupancies: 250 gpm (15.75 L/s) for 60 to 90 minutes.
3. Extra-Hazard Occupancies: 500 gpm (31.5 L/s) for 90 to 120 minutes.

M. Water Supply: Obtain static pressure and volumetric flow at residual pressure from a water flow test data conducted per NFPA 291.

N. Margin of Safety for Available Water Flow and Pressure:

1. Contact the Water Department to request a hydraulic model pressure based on maximum usage in peak season and maintain 20% safety margin unless flow test was conducted in peak season in the last 6 months, in which case 10% safety margin is acceptable. If a Fire Pump is required to meet the requirements of this section, fire sprinkler contractor shall submit a request for waiver of this requirement to the contractor.

O. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve. Include water flow switch tamper resistant hex key (allen wrench), paperwork related to all riser switches, sprinkler wrenches for each type of sprinkler provided on the job, and spare sprinklers of number and ratio provided by NFPA 13.

P. Hose Connections: Provide wet type, manual, interconnected hose connections per the pipe schedule method or calculated and sized, in accordance with NFPA 14.

Q. Provide hose connections at any point exceeding 100 feet of travel distance plus 30 feet of hose spray from egress or adjacent hose connections where locations of such hose connections are required by the fire department. Refer to fire protection drawings, details, and notations for hose connection requirements and locations. Provide with hose valve cabinet where noted on drawings.

1. Hose cabinet: Shall be equal to Potter Roemer model 1812 semi-recessed valve cabinet. Provide with flush solid metal door. Coordinate valve connection type with local fire department.

R. 175 PSIG Hose Connection: Comply with UL668, FM and UL approved bronze [no copper alloy (brass) allowed containing more than 15 percent zinc], 175 psig minimum pressure rating. Include angle pattern design; female NPS inlet and male hose outlet, and lugged cap, gasket and chain. Include NPS 1-1/2" or NPS 2-1/2" as required and hose valve threads according to NFPA 1963 and matching local fire department threads. Provide NPS 2-1/2" x 1-1/2" adapters where 1-1/2" male hose threads are furnished throughout the project, so the fire department connects to 2-1/2" NPS male thread.

S. Reference FP drawings for other information pertaining to the design of this project.

2.3 SPRINKLERS (PER UL 199) SPECIFIED FIRE SPRINKLERS ARE SUBJECT TO TYPES AND LOCATIONS SHOWN IN DRAWINGS.

A. Suspended Ceiling Type: Concealed pendant type with listed concealed plate (throughout most of the project).

1. Finish: Enamel, color as selected.

2. Escutcheon Plate Finish: Enamel, color as selected.

3. Glass Bulb Ordinary Temperature Rating with listed Concealed Plate.

4. Fusible Link: Temperature rated for application.

B. Suspended Ceiling Type: Recessed pendant type with matching screw on escutcheon plate (in closets and other such utility areas).

1. Finish: Enamel, color as selected.

2. Escutcheon Plate Finish: Enamel, color as selected.

3. Glass Bulb: 155 degrees.

4. Fusible Link: Temperature rated for application.

C. Exposed Area Type: Standard upright type with guard if needed.

1. Finish: Brass plated or color to match painted area.

2. Glass Bulb: 200 degrees.

3. Fusible Link: Temperature rated for application.

D. Sidewall Type: Semi-recessed horizontal sidewall type with matching escutcheon plate.

1. Finish: Enamel, color as selected.

2. Escutcheon Plate Finish: Enamel, color as selected.

3. Fusible Link: Temperature rated for application.

E. Dry Sprinklers: Concealed pendant type with listed concealed plate.

1. Finish: Enamel, color as selected.

2. Escutcheon Plate Finish: Enamel, color as selected.

3. Fusible Link: Temperature rated for application.

4. Dry assembly shall extend a minimum of 12" beyond penetration into heated area.

F. Sprinkler Guards: Finish to match sprinkler finish and to be listed with the fire sprinkler being protected. Wire cage type, including fastening device for attaching to sprinkler such guard is listed with. Provide Sprinkler Guards where sprinklers are less than 7'9 from finished floor and anywhere sprinklers are subject to being damaged (such as when located near shelving or racks, in or in proximity to gymnasiums, over conveyors, in trash chutes, etc…).

G. Special Coatings: Use special coatings where required; however, do not utilize quick response sprinklers where special coatings are needed. In such cases, manufacturer's corrosion resistant paint will be sufficient.

2.4 PIPING SPECIALTIES

A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim, with test and drain valve.

B. Electric Alarm per UL 464: Electrically operated red enameled 8” gong with pressure alarm switch, 24 VDC or as required by the Authority Having Jurisdiction.

C. Water Flow Switch per UL 346: Vane type switch for mounting horizontal or vertical, with two contacts; rated to match fire alarm panel by others.

D. Fire Department Connections per UL 405:

1. Outlets: of type and model subject to the "first responder" fire department, with hardware; threaded dust cap and chain of matching material and finish as subject to same wall mounted or free standing, as required by the fire department with signage designating what is supplied (Auto Sprinkler System, Standpipes, Dry Standpipes Only, etc.). Lockable caps and signage required by Fire Code shall be provided.

2. Drain: 3/4 inch automatic drip, outside.

3. Drain: 3/4 inch automatic drip, in gravel base at foot of 90 degree elbow below fire department connection.

4. Label: "Sprinkler - Fire Department Connection".

5. Refer to drawings for proposed location of fire department's connection. Gain approval of fire department officials for location of fire department connection prior to commencing installation. Department connection must be within 100 ft of a fire hydrant by state code and may be required to be located even closer in some jurisdictions.

E. Supervisory Switches per UL 753: As manufactured by Potter Model OSYSV-2 or approved equal.

F. Room Temperature Supervisory Switches: As manufactured by approved supplier.

G. Water Flow Switches per UL 346: As manufactured by Potter Model VSR-F2 or approved equal.

H. 24 VDC Electric 8" alarm bell mounted at 9 ft elevation on exterior wall near riser unless other such means of notification are required by the local fire authority, whether mechanical, horn/strobe, or otherwise..

PART 3 EXECUTION

3.1 INSTALLATION

A. FIRE SPRINKLER CONTRACTOR SHALL NOT fabricate any portion of the system until the fire sprinkler design has been reviewed and approved in writing by the owner's contracted fire sprinkler system inspector.

B. Install in accordance with referenced NFPA design and installation standard.

C. Install equipment in accordance with manufacturer's instructions.

D. Install buried shut-off valves in valve box. Provide post indicator for each Lead In.

E. Provide approved backflow preventer assembly at sprinkler system water source connection. Reduced pressure backflow preventer equipment and installation shall conform to the requirements of the city of Arkansas Backflow Prevention and Cross Connection Control Program and shall be approved by the city of Centerton Water Utilities.

F. Locate remote fire department connection, as indicated on plans, with sufficient clearance from walls, obstructions, and such to allow full swing of fire department wrench handle.

G. Locate outside alarm notification device (bell, horn,strobe, or gong) on building wall.

H. Place pipe runs to minimize obstruction to other work. Coordinate with electrical and other mechanical trades. Refer to site utility plans.

I. Place piping in concealed spaces above finished ceilings.

J. Center sprinklers in two directions in ceiling tile and provide piping offsets as required or locate concealed type sprinklers centered in tiles in one direction and not less than 6" off ceiling grids in any direction.

K. Apply masking tape, or paper cover, or plastic caps to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

L. Flush entire piping system of foreign matter per NFPA standard.

M. Install guards on sprinklers as required to prevent damage or injury.

N. Hydrostatically test entire system. Furnish completed test results signed by all required authorities and furnish a Contractor’s Material Test Certificate per State Rules and Regulations and NFPA 13.

O. Require test be witnessed by Fire Marshall and Authority Having Jurisdiction.

P. Test to be witnessed by the Authority Having Jurisdiction and/or fire official unless the Authority Having Jurisdiction waives the right to witness and thus defaults the responsibility solely to the Owner's representative. In such a case, the waiver shall be included in the closeout documents. In all cases, the signed test certificate shall be provided in the closeout documents.

3.2 INTERFACE WITH OTHER PRODUCTS

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

B. All fire sprinkler system components required to interface with the fire alarm system to be supplied and installed by the Fire Sprinkler Contractor. The Fire Alarm Contractor shall coordinate these components with the Fire Sprinkler Contractor and provide necessary equipment and wiring for connection of these components to the fire alarm system.

3.3 LABELING AND IDENTIFICATION

A. Install in accordance with Section 21 05 53.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Testing: All systems to be hydrostatically tested for the greater of 200 psi OR 50 psi above the maximum anticipated normal system pressure at 2 hours per NFPA 13.

2. Electronic/Alarm Equipment Testing: All alarm devices, fire pump controls, and all such electrical equipment and devices interfaced with the fire sprinkler system to be tested and attested to in Contractor’s Material Test Certificate, noting such tests were coordinated and verified.

3. Training and Educating: This Contractor shall train and educate the Owner, or his designated representative, by supplying NFPA 25, with highlighted sections corresponding to his responsibilities and information he should need to know, AND instructions shall be given for emergency procedures and general maintenance of the system, and test sheets shall be given for any periodic tests the Owner is responsible for, beyond the supplier’s annual testing.

4. Annual Inspection: Include a 1 year annual inspection to be conducted 1 year after this work is completed and the warranty has expired. Any Work revealed by such inspection that should have been included in the initial installation shall be

so referenced in the inspection documents and completed as warranty work within 30 days of the inspection.

END OF SECTION

SECTION 22 01 00

GENERAL PLUMBING PROVISIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work covered by Division 22 sections consist of furnishing all labor, equipment, appliances and material for the heating, air conditioning, piping and plumbing systems in strict accordance with Codes, Specifications and the applicable drawings and subject to the terms and conditions of the contract. Include all appurtenances necessary to the proper operation of the systems and equipment specified.

B. General Contractor shall install all concrete pads and bases required for installing mechanical equipment. Mechanical Contractor is responsible for the exact sizes required, location of anchor bolts, etc.

C. Some equipment may be furnished by other divisions. Mechanical Contractor is responsible to check the drawings and specifications for equipment that will be furnished by others. Furnish the supplies (hot and cold water cut-offs), traps, drains, controls, gas piping, pressure reducing valves, etc., on all equipment furnished by other divisions.

D. General Contractor shall furnish and install all ceiling access panels required to service mechanical equipment, valves and controls above gyp board or hidden spline ceilings.

E. General Contractor shall provide all site drive, sidewalk and other surfaced areas saw cutting and repairs back to preexisting conditions for the required mechanical piping. Mechanical Contractor shall provide the trenching, bedding and backfill required for the pipe installation.

1.2 RELATED SECTIONS

A. The General Conditions and Division 1, General Requirements, as bound in the specification preamble, apply to all work under Division 22. Carefully note its contents in performance of the work.

B. The Architectural, Fire Suppression, Mechanical, Electrical, and Structural plans and Specifications, including Information to Bidders and other pertinent documents issued by the Engineer are a part of this Specifications and the accompanying mechanical plans. Comply with them in every respect. Examine all the above carefully. Failure to comply does not relieve the Contractor of responsibility nor may it be used as a

basis for additional compensation due to omission of architectural, electrical and structural details from the mechanical drawings.

C. All electrical power wiring is specified under Division 26 of the Specifications. Mechanical Contractor shall furnish all motor starters required for the control and protection of all motors furnished for the Division 22.

D. All concrete pads and bases required for installing mechanical equipment are specified in another section of the Specifications. Advise the General Contractor as to the exact sizes required, location of anchor bolts, etc.

E. Paint all mechanical equipment piping, supports and other exposed material. Do not paint equipment supplied with painted finish, such as the main mechanical equipment unless damaged during handling and installation. In such cases, use touch-up paint of the same type and color as original paint. Conform to requirements in other sections of the Specifications and match wall finish to the room in which installed.

1.3 CODES, FEES AND LATERAL COSTS

A. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations, and the applicable requirements of the following latest nationally accepted codes and standards:

1. 2021 Centerton, Arkansas City Building Code.
2. 2021 Arkansas State Mechanical Code.
3. 2018 Arkansas State Plumbing Code.
4. 2014 Arkansas Energy Code.
5. IBC - International Building Code; latest accepted edition.
6. IFC - International Fire Code; latest accepted edition.
7. IGC - International Gas Code; latest accepted edition.
8. IPC - International Plumbing Code; latest accepted edition.
9. IMC - International Mechanical Code; latest accepted edition.
10. IECC - International Energy Conservation Code; latest accepted edition.
11. AMCA - Air Moving & Conditioning Association.
12. ASA - American Standards Association.

13. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
14. ASME - American Society of Mechanical Engineers.
15. ASTM - American Society of Testing Materials.
16. AWWA - American Water Works Association.
17. NBS - National Bureau of Standards.
18. NEMA - National Electrical Manufacturers Association.
19. NFPA - National Fire Protection Association.
20. SMACNA - Sheet Metal & Air Conditioning Contractors' National Association.
21. UL - Underwriters' Laboratories, Inc.
22. AGA - American Gas Association.
23. OSHA - Occupational Safety and Hazard Association.
24. AABC - Associated Air Balance Councils.
25. NEBB - National Environmental Balancing Bureau.

B. Comply with State of Arkansas adopted ADA Accessible Guidelines in regard to accessible or handicapped features.

C. In case of difference between building codes, Specifications, state Laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent governs. Promptly notify the Engineer in writing of any such difference.

D. Remove any work installed that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility company regulations, correct the deficiencies, and reinstall all work at no cost to the Owner.

E. The mechanical drawings show the general arrangement of all piping, equipment and appurtenances. Follow as closely as actual building construction and the work of other trades will permit. Final layout will be governed by actual field conditions with all measurements verified at the site. Conform to the requirements shown on all of the drawings. General and structural drawings take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to

indicate all offsets, fittings and accessories which may be required. Investigate the existing and finish conditions affecting the work and arrange the work accordingly, providing such fittings, valves and accessories as may be required to meet such conditions. Contractor shall verify that all equipment, ducts, pipes and all other components will fit in the space provided before fabrication or ordering.

F. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith. Arrange with the serving utility companies for the connections to all utilities and pay all charges for same including inspection fees and meters if required. Refundable deposits will be paid by the Owner.

G. Mechanical Contractor shall provide and install, where applicable, seismic restraints for all piping and duct systems per the latest accepted Building Code.

1.4 GUARANTEE

A. Furnish a written certificate guaranteeing all materials, equipment and labor furnished to be free of all defects for a period of one (1) year from and after the date of final acceptance of the work by the Owner and further guarantee to replace such work without charges if any defects appear within the stipulated guaranty period.

1.5 SOIL CONDITIONS

A. The Specifications and the drawings in no way imply the conditions of the soil to be encountered. When excavating may be required in execution of the work, this Contractor agrees that he has informed himself regarding conditions affecting the work.

1.6 INSPECTION OF PREMISES

A. Before submitting a bid, visit the site of the proposed job and determine the conditions relating to this work.

1.7 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered as a general guide only, without guarantee as to accuracy. Verify the location and elevation of all utilities and their relation to the work before entering into a contract.

B. Identify outdoor underground lines with continuous strip of plastic utility marker tape at regular intervals (maximum of 10 feet) "Caution (state utility) pipe below". Install one foot directly above pipe before backfilling to grade.

1.8 EXISTING BUILDING AND EXISTING MECHANICAL EQUIPMENT

A. Visit the existing building and become thoroughly acquainted with the existing mechanical systems and utilities in order to determine all of the work that will be necessary to carry out the intent of the plans and specifications.

B. If it is necessary, in any way, to interfere with normal operations of the existing utilities in order to carry out the work, give notice and obtain written approval from the Owner before the work is started.

C. The work involved in this project requires the Contractor to work inside of an existing building. Interruption of the regular routine of the building by the Contractor must be kept to a minimum.

1.9 EQUIPMENT NOT SPECIFIED UNDER DIVISION 22

A. Equipment which requires plumbing and other mechanical connections may be specified in another division of this Specification. Under these conditions, provide necessary utilities including waste, water and natural gas.

B. Rough-in work from approved shop drawings only.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide new materials bearing the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. Furnish the standard product of a manufacturer regularly engaged in the production of the required type of equipment. Provide the manufacturer's latest approved design.

B. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. Store all items subject to moisture damage (such as controls) in dry, heated spaces.

C. Provide equipment and materials of the same general type and of the same make throughout the work to provide uniform appearance, operation and maintenance.

D. Tightly cover equipment and protect against dirt, water and chemical or mechanical injury and theft. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly. Turn over to the Owner in a condition satisfactory to the Engineer. Repair damage or defects developing before acceptance of the work at no expense to the Owner.

E. Insure that items to be furnished fit the space available. Make necessary field measurements to ascertain space requirements, including those for connections. Furnish and install such sizes and shapes of equipment that the final installation suits the true intent and meaning of the drawings and Specifications.

F. Follow manufacturer's directions completely in the delivery, storage, protection and installation of all equipment and materials. Promptly notify the Engineer in writing of any conflicts between any requirements of the Contract Documents and the manufacturers' directions. Obtain the Engineer's written instruction before proceeding with the work. Replace any work that does not comply with the manufacturers' directions or such written instructions from the Engineer, at no cost to the Owner.

G. Support all products by service organizations with adequate spare parts inventory and personnel located reasonably close to the site.

H. Where multiple units of the same type or class of products are required, provide all units of the same manufacturer.

2.2 EQUIPMENT ACCESSORIES

A. Furnish and install all equipment, accessories, connections and incidental items necessary to fully complete all work, ready for use, occupancy and operation by the Owner.

B. Where equipment requiring different arrangement or connections from those shown is provided, install the equipment to operate properly and in harmony with the intent of the drawings and Specifications.

C. Support, plumb, rigid and true to line, all work and equipment furnished. Study thoroughly all general, structural, electrical and mechanical drawings, shop drawings and catalog data to determine how equipment, fixtures, piping, ductwork, etc., are to be supported, mounted or suspended and provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper supports whether or not shown on the drawings. When directed, submit drawings showing supports.

D. If accessories are required to complete the work and meet the intent of the specification, it is the responsibility of the Contractor to provide such accessories.

2.3 MATERIAL AND EQUIPMENT SCHEDULE

A. Submit to the Engineer as soon as practical, six (6) complete sets of the schedule of materials and equipment proposed for the installation, or electronic submittals as detailed below. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data and submit under one cover with an index sheet in front.

1. If Electronic files are submitted, a complete set of the schedule of materials and equipment proposed for the installation shall be included. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data. All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files according to the corresponding specification section (i.e. "22 10 06 - Plumbing Specialties.pdf"). Unless incomplete submittals are authorized by the project engineer, all Division 22 submittals shall be electronically sent at one time. Without authorization, incomplete submittals shall be rejected.

B. Provide written certification that shop drawings are in accordance with the specifications and are dimensionally correct with reference to available space.

C. All submittals will be reviewed a maximum of two (2) times. The cost of additional submittal reviews beyond those two specified will be charged to the Contractor.

D. Shop drawings for the Engineer's files are required on the following items:

1. Commercial water heaters.
2. Plumbing fixtures and floor drains.
3. Valves/Circulation pumps/flex connectors and other specialties.
4. Water balance certification.
5. Piping materials including valves.
6. Piping insulation materials.
7. Complete mechanical equipment electrical data and wiring details.

2.4 EQUIPMENT AND MATERIAL SUBSTITUTIONS

A. It is the responsibility of the Contractor to investigate any desired substitutions for specified equipment prior to submission of his bid. The Mechanical Contractor shall be responsible for any changes required in mechanical, electrical, structural or vibration isolation systems and shall bear all cost for those changes whether the substitute equipment is named by manufacturer in the specifications or is submitted to the Architect for "or equal" consideration. All changes shall be accomplished in a manner acceptable to the Architect per Section 01 60 00 at no additional cost to the Owner.

B. In order to obtain prior approval on equipment or material not specified in Division 22 Specifications or Equipment Schedules, Mechanical Contractor MUST submit to the

Engineer any proposed equipment or material ten (10) working days prior to the bid date.

C. If ANY substitute equipment is submitted to Engineer for approval, without said equipment having been pre-approved, the entire submittal will be rejected for resubmittal.

D. Any equipment manufacturers which are a subsidiary to the listed acceptable manufacturers are not considered equal. Therefore, it is the responsibility of the Contractor and equipment supplier to obtain prior approval as described in paragraph 2.4, this Section.

2.5 ELECTRICAL MOTORS

A. Provide motors of a recognized manufacturer, wound for the voltage specified, and in conformance to latest standards of the manufacturer and performance of the National Electrical Manufacturers Association and the Institute of Electrical and Electronic Engineers. Provide motors as manufactured by General Electric, Westinghouse, Century or Siemens-Allis, Baldor or approved equal.

B. Provide motors rated for continuous duty at 100% of rated capacity and temperature raise of 40 degrees Centigrade open type; 50 degrees Centigrade drip and splash proof; 55 degrees Centigrade explosion proof and totally enclosed above an ambient of 40 degrees Centigrade.

C. Unless otherwise required, provide integral horsepower, polyphase motors, Class B, general purpose, squirrel cage, open type induction motors, T-frame.

D. Provide single phase fractional horsepower motors of the open capacitor type. Generally, motors under 1/2 horsepower may be split phase type unless otherwise specified. Provide motors rated 1/2 horsepower or less with integral overcurrent protection.

E. Insure the insulation resistance between stator conductor and frames of motors is not less than 1/2 megohm. Provide shop test of motors including temperature rise, insulation resistance, motor terminal voltage, normal operating line current, RPMs, breaker or switch size with fusing and overload relay sizes.

PART 3 EXECUTION

3.1 COORDINATION OF WORK

A. Compare the mechanical drawings and Specifications with the drawings and Specifications for other trades and report any discrepancies between them to the

Engineer and obtain from him written instruction for changes necessary in the mechanical work. Install the mechanical work in cooperation with other trades installing inter-related work. Before installation, make proper provisions to avoid interferences in a manner approved by the Engineer. Make all changes required in the work caused either by neglect or existing field conditions at no cost to the Owner.

B. It is the responsibility of the General Contractor, Mechanical Contractor, Electrical Contractor and Sprinkler Contractor to coordinate installation of all equipment. Equipment installed prior to proper coordination, which interferes with the harmony and intent of the specifications and drawings, will be removed and reinstalled at the cost of the responsible Contractor.

C. Furnish anchor bolts, sleeves, inserts and supports required for the mechanical work. Locate anchor bolts, sleeves, inserts and supports as directed by the trade requiring them and insure that they are properly installed.

D. Adjust locations of pipes, ducts, equipment fixtures, etc., to accommodate the work and for interferences anticipated and encountered. Determine the exact route and location of each pipe and duct prior to fabrication.

1. New work and remodeled areas are to interface with existing facility services. Contractor to familiarize himself with the extent of the work prior to submitting his bid. Failure to gain familiarity will not be grounds for additional compensation.

2. Provide right-of-way to lines that pitch over those that do not pitch. For example, Plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have the right-of-way over lines whose elevations can be changed.

3. Make offsets, transitions and changes in direction in pipes and ducts as required to maintain proper head room and pitch.

E. Install all mechanical work to permit removal without damage to other parts, to coils, fan shafts and wheels, filters, belt guards, sheaves and drives and all other parts requiring periodic replacement or maintenance. Arrange pipes, ducts and equipment to permit ready access to valves, cocks, traps, starters, motors, control components and to clear the openings of swinging and overhead doors and of access panels.

3.2 CHLORINATION OF DOMESTIC WATER LINES

A. After the hot and cold water systems are complete, all fixtures connected, the system flushed out completely and the shut-off valve to the water main closed, fill the system with a solution containing 50 parts per million of available chlorine. Allow the solution to stand six (6) hours before flushing and returning to service.

B. Then fill the system with a solution containing 100 parts per million of available chlorine. Allow this solution to stand two (2) hours before flushing and returning to service.

C. Notify the Owner twenty-four hours prior to test so his representative can witness test. Obtain chemical analysis of the domestic water lines after chlorination from a Certified Chemist and submit the results of these tests to the Engineer and Owner.

3.3 RECORD DRAWINGS

A. Maintain record drawings showing exact locations and sizes, as actually installed, of piping, drains, cleanouts, ductwork, controls and equipment as specified herein. Deliver to the Owner/Architect upon completion and acceptance of the work, one (1) complete set of contract drawings marked to indicate all deviations from intended installation.

3.4 CUTTING AND PATCHING

A. The General Contractor shall be responsible for all required Building cutting, patching, etc., incidental to this work and shall make all required repairs thereafter to the satisfaction of the Engineer. Do not cut into any major structural element, beam or column without the written approval of the Engineer.

B. The General Contractor shall cut, patch, repair and/or replace pavements, sidewalks, roads and curbs as required to permit the installation of the plumbing work and pay all expenses incurred for this work.

C. Openings in fire or smoke barriers for air handling ductwork or air movement shall be protected in accordance with NFPA 90A and 90B and the Standard Mechanical Code.

D. Pipes, conduits, cables, wires, air ducts, pneumatic tubes and ducts and similar handling service equipment that pass through fire or smoke barriers shall be protected in accordance with NFPA 101 by the plumbing contractor.

E. All fire stopping assemblies must be UL approved assemblies.

3.5 EXCAVATION AND TRENCHING FOR PIPING

A. Excavate to the depths indicated on the Drawings or as required to provide adequate slope and burial depth. Excavated materials not required or suitable for backfill or fill shall be removed from the site. Do such grading as is necessary to prevent surface water from flowing into trenches or other excavations. Water accumulating therein shall be removed by pumping or by other method. Sheeting and shoring shall be installed as may be necessary for protection of the work and for safety of personnel.

Excavation shall be by open cut except that short sections of a trench may be tunneled if the pipe can be safely and properly installed and backfill can be properly tamped in such tunnel sections.

B. Trench Excavation: Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil. Where rock is encountered excavate to a minimum overdepth of 4" below trench depths indicated on the Drawings or specified. Overdepth in rock excavation and unauthorized overdepths shall be backfilled. Whenever wet or otherwise unstable soil incapable of properly supporting the pipe is encountered such soil shall be removed and the trench backfilled to proper grade as hereinafter specified.

C. Depth of Cover: Trenches shall be of depth that will provide three feet (3') minimum cover for domestic water, fire lines, sanitary and storm sewers from existing grade or from indicated finish grade, whichever is lower, unless otherwise specifically shown.

D. Utilities Locating: Locate existing utility lines prior to beginning any excavation

E. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the Drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor, at his expense.

F. Trenches shall not be backfilled until required pressure and other tests have been performed and until the utilities systems as installed conform to requirements of Drawings and Specifications.

G. Backfill trenches with excavated materials consisting of earth, sandy clay, sand, gravel, soft shale or other approved materials, free from clods of earth or stones 2-1/2" maximum dimension, deposited in 6" layers and compacted to 95% Standard Proctor Compaction Test of the maximum laboratory density determined in accordance with ASTM D698, Moisture-Density Relation of Soils. If fills fail to meet the specified densities, the Contractor shall remove and re-compact the fill until specified densities are achieved. Compaction test shall be performed for each fifty linear feet of trench.

H. Provide a 4-inch thick (minimum) layer of 3/4-inch No. 4 gravel aggregate bedding beneath all buried piping. Bedding shall be compacted and leveled to provide sloping required.

I. Tests for displacement of sewers: After the trench has been backfilled to 2 feet or more above the pipe, if the pipe shows poor alignment, displaced pipe, or any other defects, such defects shall be remedied by the Contractor at his expense.

3.6 EQUIPMENT START-UP AND TESTING

A. Instruct the Owner's operating personnel during start-up and separate operating tests of each major item of equipment. During the operating tests, prove the operation of each item of equipment to the satisfaction of the Engineer. Give at least seven (7) days notice to the Engineer of equipment start-up and operating tests.

3.7 CATALOG DATA FOR OWNER

A. Provide, in looseleaf binders, two (2) sets of a compilation of catalog data of each manufactured item of equipment used in the mechanical work and present this compilation to the Owner/Architect for transmittal to the Owner before final payment is made. Include descriptive data and printed installation, operating and maintenance instructions for each item of equipment. Provide a complete double index as follows:

1. Listing of products alphabetically by name.

2. Listing the names of manufacturers whose products have been incorporated in the work alphabetically together with their addresses and the names and addresses of the local sales representatives.

3. Certificates of Final Inspections.

4. Complete spare parts data with current prices and supply sources.

5. Extended warranties.

B. Deliver to the Owner all special tools, lubricants, extra materials and any other products necessary for the proper operation and maintenance of the mechanical and plumbing systems.

C. Provide project record documents indicating all changes from contract documents made during construction.

D. Submit all Certificates of Final Inspections from the Administrative Authorities.

E. Submit TAB reports on approved forms. Final TAB report submittals shall include all required rebalances if any are required.

F. Submit to the Engineer as soon as practical, electronic closeout documents as detailed below.

1. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data and submit under one cover with an index sheet in front.All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files.

3.8 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical system.

3.9 PROTECTIVE COATINGS

A. Paint exterior surfaces of steel piping run in or through concrete floor fill, under tile floors or underground, and aluminum surfaces in contact with masonry, with one coat of acid resisting bituminous base paint.

3.10 TEST AND ACCEPTANCE

A. Water Piping System: Test with water at 100 psi for one (1) hour or with available city water pressure for twenty-four (24) hours to prove tight and free from leaks.

B. Plumbing and Drainage System: Test the new system humidity and drain piping with water and prove tight. Test system with 10 feet of water for 24 hour period. Air test is not permitted.

C. Storm Drainage System: Test storm drainage system with 10 feet of water for a 24-hour period. If approved by the administrative authority and there is proof that no site water is available, an air test of 5 pounds for 24 hours without introduction of additional air may be used. The air test shall be conducted with a three-inch gage with a maximum scale of 100 psig. This test applies to new storm drains connecting to existing storm drain system. Any failures to the existing storm drain system shall be brought to the attention of the administrative authority prior to the completion of the installation.

3.11 NOISE CONTROL

A. It is intended that the mechanical systems as installed under this contract be free from objectionable noise when the system is operating. The system shall operate at noise levels below criteria recommended for the application by ASHRAE. Provide vibration isolation accessories and isolate equipment, pipeline, ductwork, etc., as required so as to insure an acceptable noise level in all of the mechanical systems.

3.12 CLEANING AND ADJUSTING

A. Do not allow waste material and rubbish to accumulate in or above the premises. After completion of this work, remove rubbish, tools, scaffolding and surplus materials from and about the building and leave all work clean and ready for use. Clean all equipment, pipes, valves and fittings of grease, metal cuttings and sludge. Repair any stoppage, discoloration or other damage to parts of the building, its finish

or furnishings due to failure to properly clean the mechanical systems, without additional cost to the Owner. Adjust all automatic control devices for proper operation.

3.13 SYSTEM OPERATING TESTS

A. After the successful completion of all equipment start-up and test requirements, perform the following tests on the complete mechanical systems:

1. First Operating Test by Contractor: Prove the operation of the mechanical systems and of each individual item in the systems. Give at least 10 days prior notice to the Engineer of such tests. Adjust and set proper quantities to all items and equipment. Should any item of the systems fail to perform in an approved manner, repeat this test until approved by the Engineer. During this test, balance circulation of heating and cooling water to balancing cocks, valves, thermostats and similar Items to insure that the mechanical systems perform as intended.

2. Checking by Owner and Engineer: Following the successful completion of first operating tests by the Contractor, the Owner and the Engineer have the privilege of making such tests as they may desire during a period of three weeks to ascertain in detail if any corrections are to be made to the system. At the end of the testing by the Owner and the Engineer, the Engineer may direct the Contractor in writing to make such corrections to the systems as are within the scope of the contract.

3. Contractor's Corrections to Systems: Make all required corrections to the systems and notify the Engineer in wiring that the corrections outlined have been completed. Give at least seven (7) days notice of a final three-day operating test.

4. Three-Day Operating Test: Perform an operating test to the satisfaction of the Engineer for a period of three (3) days. Should any element of the systems not perform properly, make all required corrections and repeat the test until successfully performed.

a. Submit the Form of Record proposed by the Contractor for the recording of all measurements to the Engineer for approval at least two weeks before the approved form will be required by the Contractor.

b. Measurements: Make the following measurements at two-hour intervals (5 measurements per 8-hour day) during the three-day operating test.

1) Electrical: Running amperes and voltage of each motor 3/4 horsepower or larger.

2) Air temperatures in each heated or air conditioned space and outdoor temperatures.

c. Instruments: Provide all instruments, materials and labor to perform the tests and to obtain and record the measurements specified herein, including the furnishing of all required record forms as approved by the Engineer. Submit for the Engineer's approval, complete shop drawings or catalog data for all instruments to be used for the three day operating test and obtain approval at least two weeks before the instruments will be required for test measurements.

d. Report: Submit four (4) copies of a written report of the three-day operating test on the approved Form of Record to the Engineer for approval and subsequent transmittal to the Owner.

3.14 MOTOR CONTROL

A. General: Provide each motor 1/8 horsepower or larger with a suitable controller and devices that will perform the functions as specified for the respective motors, together with manual reset thermal overload, protection in each undergrounded conductor. Provide the controller either integral with circuit protective device or mounted in separate enclosure. Starters shall be Allen-Bradley, G.E., Westinghouse, Square D or approved equal.

B. Control: Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motor directly, provided the device used is designated for that purpose and has an adequate horsepower rating. When automatic control device does not have such a rating, use a magnetic starter with the automatic control device actuating the pilot control circuit. When combination manual and automatic control is specified and the control device operates the motor directly, provide a manual motor starter and selector switch. When combination manual and automatic control is specified and the automatic control device actuates the pilot control circuit, a magnetic control device actuates the pilot control provided. Provide all magnetic starters with push buttons or selector switches in the covers. Provide connections to the selector switch such that only the normal automatic regulating control devices will be bypassed when the switch is in the manual position. Connect all safety control devices, such as low or high pressure cutouts, high temperature cutouts and motor overload protective devices in the motor control circuit in both the manual and automatic positions of the selector switch control circuit. Make connections to any selector switch or to more than one (1) automatic regulatory control device in accordance with wiring diagrams recommended by the manufacturer and approved by the Engineer. Where required for manual control, provide push-

button stations consisting of two (2) momentary contact operators, 600 volts, 10 amperes installed and wired for three wire control to provide under-voltage relays, auxiliary contacts or other devices required for a complete system.

C. Location: Where the controller is located within sight of the motor driven equipment (fifty feet or less), the controller and circuit protective device shall be capable of being locked in the open position. Where the controller is located out of sight of the motor driven equipment (more than fifty feet) provide a non-fused safety disconnect, suitable for the service, and which opens all ungrounded conductors simultaneously, at or on the motor driven equipment.

D. Enclosure: Enclosure to be general purpose, NEMA Type 1 unless noted otherwise (NEMA Type 1 gasketed). The circuit breaker shall be operable by hand from outside the enclosure and shall be so interlocked with the door or doors that it must be returned to the "OFF" position before the door can be opened.

E. Push-buttons: Provide maintained contact, standard duty type in a general purpose, NEMA Type 1 enclosure for surface mounting rated for 10 amperes continuous at 600 volts or less.

3.15 ACCESS PANELS

A. Provide access panels as required in all walls, ceilings and ductwork to service and have access to all valves, and other operating parts. For all ceiling and wall access doors that are required in gypsum board and plaster, provide minimum 24" x 24", unless due to structural restraints the access door can be reduced to a minimum of 18" x18", Milcor type appropriate for the construction involved.

3.16 DEMOLITION

A. There are areas in the existing building in which demolition will have to be performed due to the requirements for remodeling. The demolition work involved is not fully described herein; however, the information given on the electrical and mechanical drawings and the information set out in the specifications will substantially serve to inform the mechanical Contractor as to the full extent of the demolition required.

B. Contractor should visit job site to verify extent of demolition required to complete project.

C. It is the intent of this Specification that all required demolition work be fully and completely performed and all work be accomplished in a neat and workmanlike manner.

D. Remove all existing piping, fittings, heating, cooling, ventilation equipment that is required to accomplish the remodel work. All existing utilities that are disconnected shall be capped recessed in walls and floors. Contractor shall be responsible for visiting building and determining the extent of the demolition work. Contractor shall provide any necessary temporary piping required to keep existing building utilities (water, gas and sewer) in operation until new construction is completed to the extent that the new utilities can be reconnected.

E. All rubbish, debris and expendable items resulting from demolition work shall be removed from the premises as it accumulates and disposed of at an off-site location by the Contractor.

3.17 SALVAGE

A. Except as otherwise specified herein, or noted on drawings, the Contractor shall receive title to all building materials indicated to be demolished or removed which are not specifically designated as being retained by the Owner, said title to vest in the Contractor immediately upon receipt of Work Order. All salvage materials removed shall be taken from the premises promptly, as the storage of salvage materials on the site will not be permitted. Bidders shall take into account the salvage value to them of materials removed and such value shall be reflected in the bids.

B. All items of usable equipment shall remain the property of the Owner. All such items of equipment which are to be removed and which are not to be reused shall be stored on the premises by the Contractor as directed by the Owner.

C. Usable items shall be determined by the Owner and shall include existing heating and cooling pumps and other equipment so designated as "usable" by the Owner.

3.18 FINALLY

A. It is the intention that this specification shall provide a complete installation except as herein before specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe Markers.

E. Underground warning tape.

F. Ceiling tacks.

1.2 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

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

C. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

1.3 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

D. Product Data: Provide manufacturers catalog literature for each product required.

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

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Pipe Markers: 3/4 inch diameter and higher.

2.2 IDENTIFICATION APPLICATIONS

A. Instrumentation: Tags.

B. Piping: Pipe markers.

C. Pumps: Nameplates.

D. Small-sized Equipment: Tags.

E. Tanks: Nameplates.

F. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.3 NAMEPLATES

A. Manufacturers:

1. Kolbi Pipe Marker Co.

2. Seton Identification Products.

3. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.

2. Letter Height: 1/4 inch.

3. Background Color: Black.

4. Plastic: Conform to ASTM D709.

2.4 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving.

2. Brady Corporation.

3. Kolbi Pipe Marker Co.

4. Seton Identification Products.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame. Valve tag chart should should indicate valve size, valve model and valve location. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

2.5 STENCILS

A. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. Seton Identification Products.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

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

1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.

2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.

3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.

C. Stencil Paint: Semi-gloss enamel, colors conforming to ASME A13.1.

2.6 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. MIFAB, Inc.

4. Seton Identification Products.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Comply with ASME A13.1.

C. 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.

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

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

F. Color code as follows:

1. Potable, Cooling, Boiler, Feed, Other Water: Green with white letters.

2. Fire Quenching Fluids: Red with white letters.

3. Combustible Fluids: Brown with white letters.

2.7 CEILING TACKS

A. Manufacturers:

1. Marking Services Incorporated.

2. Seton.

3. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Color code as follows:

1. Plumbing Equipment: Yellow.

2. Plumbing Valves: Green.

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

F. Apply ASME A13.1 Pipe Marking Rules:

1. Place pipe marker adjacent to changes in direction.

2. Place pipe marker adjacent each valve port and flange end.

3. Place pipe marker at both sides of floor and wall penetrations.

4. Place pipe marker every 25 to 50 feet interval of straight run.

G. Install metallic detection tape located approximately 12 inches above pipe, where in ground utility lines are buried outside building footprint. Tape shall be continuous and be marked, indicating utility type (ie. water, sewer, gas, electric, etc).

H. 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.

I. Locate ceiling tacks to locate valves above lay-in panel ceilings. Locate in corner of panel closest to equipment.

J. Identify all piping on this project as described, except piping which is concealed and/or not accessible. Identify piping concealed by ceiling tiles, floor tiles and, crawl spaces. Piping outside, on roof, above grade, and within parking structures shall also be identified. Only piping located within walls or inaccessible areas need not be identified. Install pipe markers on long straight runs every 20 feet. Install pipe markers above and below every floor penetration and on either side of every wall penetration and, insure there is at least one marker per pipe in every room. Install pipe markers at every valve, branch and, any change in piping direction. Install pipe markers so they are visible for a normal standing position.

END OF SECTION

SECTION 22 07 19

PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible elastomeric cellular insulation.

B. Piping insulation.

C. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).

D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).

E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

F. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2017 (Reapproved 2023).

G. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.

H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2013).

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

K. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

1.4 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions, for submittal procedures.

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

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

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

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Deliver material to job site in original non-broken factory packaging, labeled with manufacturer's density and thickness.

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.

C. Perform work at ambient and equipment temperature as recommended by the adhesive manufacturer.

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 E84, NFPA 255, or UL 723.

2.2 GLASS FIBER

A. Manufacturers:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corp.

4. CertainTeed Corporation.

5. Armstrong World Industries, Inc.

6. Rubatex Corp.

7. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: ASTM C547 ; semi-rigid, noncombustible, end grain adhered to jacket.

1. 'K' value: ASTM C177, 0.24 at 75 degrees F.

2. Maximum service temperature: 650 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; moisture vapor transmission when tested in accordance with ASTM E96/E96M 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 C195; 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.

H. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd weight.

2. Vinyl emulsion type acrylic, compatible with insulation, white color.

I. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Outdoor Breather Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K. Insulating Cement:

1. ASTM C449/C449M.

2.3 CELLULAR GLASS

A. Manufacturers:

1. Pittsburgh Corning Corporation.

2. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: ASTM C 552.

1. 'K' value: 0.37 at 100 degrees F.

2. Service Temperature: Up to 900 degrees F.

3. Water Vapor Permeability: 0.005 perm inch.

4. Water Absorption: 0.2 percent by volume, maximum.

2.4 HYDROUS CALCIUM SILICATE

A. Manufacturers:

1. Johns Manville Corporation.

2. PABCO.

3. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: ASTM C533 ; rigid molded, asbestos free, gold color.

1. 'K' value: ASTM C177 and C518; 0.40 at 300 degrees F, when tested in accordance with ASTM C177 or C518.

C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

D. Insulating Cement:

1. ASTM C449/C449M.

2.5 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:

1. Armacell International.

2. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 2; use molded tubular material wherever possible.

1. 'K' value: ASTM C 177; 0.27 at 75 degrees F.

2. Maximum Moisture Absorption - Pipe Insulation: 3.5 percent, by weight, when tested in accordance with ASTM D 1056.

3. Maximum Moisture Absorption - Sheets: 6.0 percent, by weight, when tested in accordance with ASTM D 1056.

4. Water Vapor Permeability: 0.20 perm-inches, when tested in accordance with ASTM E 96.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

1. Air dried, contact adhesive, compatible with insulation.

2.6 JACKETS

A. PVC Plastic.

1. Manufacturers:

a. Johns Manville Corporation.

b. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. Jacket: One piece molded type fitting covers and sheet material, off-white color.

a. Minimum Service Temperature: 0 degrees F.

b. Maximum Service Temperature: 150 degrees F.

c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

d. Thickness: 15 mil.

e. Connections: Pressure sensitive color matching vinyl tape.

3. Covering Adhesive Mastic:

a. Compatible with insulation.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Lagging Adhesive:

a. Compatible with insulation.

C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.

1. Thickness: 0.016 inch sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

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.

C. Repair all insulation that is damaged during construction using the same materials.

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 glass cloth and vapor barrier adhesive or 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. Inserts and Shields:

1. Application: Piping 1 inch diameter or larger.

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.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

H. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.

I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.

J. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

L. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULES

A. Plumbing Systems:

1. Domestic Hot Water Supply:

a. Glass Fiber Insulation:

1) Pipe Size Range: 2 inch and under: 1 inch thickness.

2) Pipe Size Range: 2-1/2 inch and larger: 1-1/2 inch thickness.

3) Thickness: 1/2 inch (in interior walls).

2. Domestic Cold Water Supply:

a. Glass Fiber Insulation:

1) Pipe Size Range: 2 inch and under: 1 inch thickness.

2) Pipe Size Range: 2-1/2 inch and larger: 1 inch thickness.

3) Thickness: 1/2 inch (in interior walls).

3. Roof Drainage Above Grade:

a. Glass Fiber Insulation:

1) Pipe Size Range: all sizes.

2) Thickness: 1 inch.

4. Domestic Hot Water Recirculation:

a. Glass Fiber Insulation:

1) Pipe Size Range: All sizes.

2) Thickness: 1 inch.

5. Sanitary Piping Above Ceilings:

a. Glass Fiber Insulation:

1) Pipe Size Range: all sizes.

2) Thickness: 1 inch.

B. Cooling Systems:

1. Condensate Drains from Cooling Coils: 1/2 inch thickness; cellular insulation.

2. Refrigerant Suction: 3/4 inch thickness; cellular insulation.

3. Refrigerant Hot Gas: 3/4 inch thickness; cellular insulation.

END OF SECTION

SECTION 22 10 05

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 water.
4. Gas.
5. Flanges, unions, and couplings.
6. Valves.
7. Flow controls.
8. Strainers.

1.2 RELATED REQUIREMENTS

A. Section 22 01 00 - General Plumbing Provisions.

B. Section 22 05 53 - Identification for Plumbing Piping and Equipment.

C. Section 22 07 19 - Piping Insulation.

1.3 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2025).

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

C. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

F. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2024.

G. ASME B31.9 - Building Services Piping; 2025.

H. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.

I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

J. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2025.

K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2025.

L. ASTM B32 - Standard Specification for Solder Metal; 2020.

M. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2025.

N. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed; 2025.

O. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2011.

P. ASTM C4 - Standard Specification for Clay Drain Tile and Perforated Clay Drain Tile; 2004 (Reapproved 2014).

Q. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe; 2015.

R. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2026.

S. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; latest accepted edition.

T. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).

U. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2025.

V. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2026.

W. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2024.

X. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).

Y. ASTM D3517 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe; 2024.

Z. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2024.

AA. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992 (Reapproved 2008).

BB. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.

CC. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.

DD. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 3/4 In. (19 mm) Through 3 In. (76 mm), for Water Service; 2025.

EE. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.

FF. 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; 2020.

GG. MSS SP-67 - Butterfly Valves; 2022.

HH. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.

II. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.

JJ. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.

KK. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

LL. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2012.

1.4 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

D. Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.

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

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Perform Work in accordance with State of Arkansas, city of Centerton standards.

C. Valves: Manufacturer's name and pressure rating marked on valve body.

D. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

E. Welder Qualifications: Certified in accordance with ASME (BPV IX).

F. 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 Arkansas, and city of Centerton plumbing code.

B. Conform to city of Centerton, Arkansas 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. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. 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, BURIED BEYOND 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C 564 neoprene gaskets.

B. PVC Pipe: ASTM D2665 or ASTM D3034.

1. Fittings: PVC.

2. Joints: Pipe sizes 4 inches or less: Solvent welded, with ASTM D 2564 solvent cement.

3. Joints: Pipe sizes greater than 4 inch: Push-on, using ASTM F477 elastomeric gaskets.

2.2 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron.

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C 564 neoprene gaskets.

B. Cast Iron Pipe: CISPI 301, hubless.

1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.

C. PVC Pipe: ASTM D2665 or ASTM D3034.

1. Fittings: PVC.

2. Joints: Pipe sizes 4 inch and smaller: Solvent welded, with ASTM D 2564 solvent cement.

3. Joints: Pipe sizes greater than 4 inch: Push-on, using ASTM F477 elastomeric gaskets.

2.3 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74, service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C 564 neoprene gaskets.

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

1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D2665.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

D. In Fire-rated Walls:

1. Cast iron.

a. Fittings: Cast iron.

E. In Plenum-rated Areas:

1. Cast iron.

a. Fittings: Cast iron.

2.4 WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2. Joints: ASTM B 32, alloy Sn95 solder.

B. PVC SDR 21: pipe shall be manufactured from a Type I, Grade I Polyvinyl Chloride (PVC) compound with a Cell Classification of 12454 per ASTM D1784.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.5 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn Type "K".

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2. Joints: AWS A5.8M/A5.8, BCuP copper/silver braze.

2.6 WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints: ASTM B32, alloy Sn95 solder or mechanical press-fit couplings.

2.7 STORM WATER PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C 564 neoprene gaskets.

B. PVC Pipe: ASTM D 2729.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.8 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C 564 neoprene gaskets.

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

1. Fittings: Cast iron.

2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D 2729.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.9 STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe Where Noted: ASTM A 74 service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C 564 neoprene gaskets.

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

1. Fittings: Cast iron.

2. Joints: Neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D2665 or ASTM D3034.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D2564 solvent cement.

D. In Fire-rated Walls:

1. Cast iron.

a. Fittings: Cast iron.

2.10 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A234/A234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil 10 mil polyethylene tape.

2. Joints: ASME B31.1, welded.

2.11 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASTM A 234/A 234M, forged steel welding type.

2. Joints: ASME B31.1, welded.

3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.12 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.

2. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A 234M, forged steel welding type.

3. Joints: NFPA 54, threaded or welded to ASME B31.1.

2.13 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. Grooved and Shouldered Pipe End Couplings:

1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.

2. Sealing gasket: "C" shape composition sealing gasket.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

E. Victaulic Devices:

1. Couplings shall consist of a one or more piece ductile or malleable iron cast housing, a synthetic rubber gasket of a central cavity pressure-responsive design, with nuts, bolts, locking toggle or luggs to secure unit together.

a. Coupling housings shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12) or malleable iron conforming to ASTM A-47 (Grade 32510), hot dip galvanized to ASTM A-153, or zinc electroplated to ASTM B-633, as manufactured by Victaulic Company of America. Refer to Victaulic product specifications for other materials.

b. Coatings shall consist of an alkyd enamel paint, or hot-dip galvanizing to ASTM A-153, or zinc electroplating to ASTM B-633, as specified.

2. Couplings for grooved end steel pipe shall be Victaulic couplings for grooved end steel pipe.

a. Line, fittings and valve joints shall be Victaulic flexible (styles 75, 77, 78, or 791) or rigid (styles 005, 07 or HP-70).

b. Rigid joints shall be Victaulic style 07 "Zero-Flex", style HP-70 or style 005 "FireLock" couplings.

c. Pin assembled joints shall be Victaulic style 791 "Vic-Boltless" couplings.

d. Reducing joints shall be Victaulic style 750 Reducing Couplings for pipe to pipe joints or to create reducing fittings using straight fitting configurations.

e. Outlets: All joints designated Outlet Couplings, or where feasible to replace reducing outlet tees, shall be Victaulic style 72 Outlet Couplings (specify grooved, female or male threaded outlet).

f. Flanged Connections shall be Victaulic style 741 (2-24") "Vic-Flange" adapters, engaging directly into grooved pipe and bolting directly to ANSI Class 125 cast iron and Class 150 steel flanged components or style 743 (2-12") for ANSI Class 300 flanged components; installer to supply standard flange bolts.

g. Quick disconnects shall be Victaulic style 78 "Snap-Joint" Couplings or style 780/781 for double grooved pipe.

3. Gasket shall be molded of synthetic rubber in a central cavity, pressure-responsive configuration conforming to the pipe outside diameter and coupling housing, of elastomers having properties as designated in ASTM D-2000. Reference shall always be made to the latest published Selection Guide for Victaulic Gaskets for proper gasket selection for the intended service.

a. Water service: Gasket supplied for water services from -30 degrees F to +230 degrees F, shall be a Grade "E" EPDM compound, with green color

code, molded of materials conforming to ASTM D-2000, designation 2CA615A25B24F17Z, recommended for hot water service within the specified temperature range, plus a variety of dilute acids, oil-free air, and many chemical services. Not recommended for petroleum services.

4. Bolts and nuts shall be heat treated carbon steel, track head, conforming to physical properties of ASTM A-183 minimum tensile 110,000 psi, black, or zinc electroplated to ASTM B-633, as supplied or specified.

5. Fittings shall be Victaulic full flow cast fittings, steel fittings or segmentally welded fittings with grooves or shoulders designed to accept Victaulic grooved end couplings.

   a. Standard fittings shall be cast of ductile iron conforming to ASTM A-536 (Grade 65-45-12), or malleable iron conforming to ASTM A-47, Grade 32510, painted with alkyd enamel or hot-dip galvanized to ASTM A-153 or zinc electroplated to ASTM B-633 or cadmium plated to ASTM A-165 as required.

   b. Standard steel fittings including large size elbows (16-24") shall be forged steel conforming to ASTM A-234 Grade WPB (0.375" wall), painted with alkyd enamel or hot-dip galvanized to ASTM A-153.

6. Branch outlets for hole cut steel pipe shall be Victaulic hole cut products.

7. Branch outlets shall be made with Victaulic style 920, 921 or 929 "Mechanical-T" branch connections with locating collar or foot engaging into hole. (Specify outlet/branch connection type - grooved, female threaded or FIT, as available.)

8. Sprinkler head connections: Branch connections, direct sprinkler head connections, drop nipples and sprigs shall be made with Victaulic style 922 "Hooker" outlet connections with locating collar engaging into hole, assembled with standard plated breakaway head bolt (specify 1/2, 3/4 or 1" female threaded outlet).

9. Gauge, meter outlets for hole cut steel pipe shall be Victaulic strapless mechanical outlet products style 923 "Vic-Let" or 924 "Vic-O-Well" and shall provide a pipe outlet without a need for a strap or lower housing to wrap around the pipe.

10. Flow indicators for hole cut steel pipe shall be Victaulic style 736 Waterflow Indicators for wet sprinkler systems, to sense water flow to 10 GPM or greater.

11. Fittings for plain end steel pipe shall be Victaulic FIT fittings (sizes 1", 1 1/4", 1 1/2" and 2") with internal pipe stop for uniform takeout dimensions, 1/4-turn

positive locking lugs of heat treated carbon steel conforming to AISI C-1022, cadmium plated, with externally locked-position indicator for inspection or connection of plain end steel pipe. FIT fittings shall have self-contained, pressure responsive gaskets: for water service (-30 degrees to +230 degrees F) Grade "E"; FIT silicone Grade "L" (-30 degrees to +160 degrees F) are recommended for fire protection dry systems, all systems operating below 0 degrees F, plus dry heat, air without hydrocarbons, certain chemical services and water to +160 degrees F. FIT Nitrile gaskets Grade "T" (0 degrees to +180 degrees F) are recommended for petroleum products, hydrocarbons, air without hydrocarbons, except hot dry air over +140 degrees F, vegetable and mineral oils within the specified temperature range. Not recommended for hot water services.

12. Reducing outlet tees shall be Victaulic FIT style 96 with female threaded outlet (specify 1/2, 3/4 or 1" outlet) for direct sprinkler head, sprig or drop nipple connections.

13. 90 degree elbows shall be Victaulic FIT style 969.

14. FIT Outlet/Mechanical-T shall be Victaulic FIT style 929 with FIT locking lug branch outlet (specify 1 1/4, 1 1/2 or 2" outlet) for direct branch connections.

15. Straight tees shall be Victaulic FIT style 963.

16. Straight couplings shall be Victaulic FIT style 960.

17. Reducing elbows shall be Victaulic FIT style 966 with female threaded outlet (specify 1/2, 3/4, or 1" outlet) for direct sprinkler head, sprig or drop nipple connections.

2.14 MECHANICALLY FORMED TEE FITTINGS

A. Mechanically extracted outlets shall have a height not less than three times the thickness of the branch tube wall.

B. Branch tubes shall not restrict the flow in the main tube. Mechanical Contractor shall insure the branch tube penetration into the collar is of the correct depth.

C. Mechanically formed tee fittings shall be cleaned and brazed with filler material conforming to AWS A5.8.

2.15 PRESS FITTINGS

A. Fittings shall comply with NSF 61, CSA, UPC and be approved by the local jurisdiction. Wrot copper press fittings shall be made from commercially pure copper mill products per ASTM B 75 Alloy C12200. Cast copper alloy press fittings shall be

made from materials with a minimum of 78% copper and a maximum of 15% zinc. The press fittings connections shall be compatible with seamless K, L or M copper tube made to ASTM B 88. Fittings shall have a maximum non-shock working pressure of 200 PSI between the temperatures of -20°F and +250°F. Elastomeric seals shall be made of EPDM material, and the fittings shall be manufactured with an inboard bead design. All fittings shall be installed in accordance with the manufacturer's installation instructions and according to local plumbing and mechanical codes. The press-to-connect joint shall be made with pressing tools and jaw sets recommended and authorized by press fitting manufacturer.

2.16 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

B. Plumbing Piping - Drain, Waste, and Vent:

1. Conform to ASME B31.9.

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

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers 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.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:

1. Conform to ASME B31.9.

2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Carbon steel, 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. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.

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

7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.

8. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

9. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

10. Vertical Support: Steel riser clamp.

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

12. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

13. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.17 GATE VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Crane Co.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up To and Including 2 1/2 Inches:

1. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder or threaded ends.

C. 3 Inches and Larger:

1. MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.18 GLOBE VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Crane Co.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up To and Including 2 1/2 Inches:

1. MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder or threaded ends.

C. 3 Inches and Larger:

1. MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.19 BALL VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Crane Co.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

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, threaded ends with union.

2.20 PLUG VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Construction 2-1/2 Inches and Larger: MSS SP-78, 250 psi CWP, cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or grooved ends. Provide lever operator with set screw.

2.21 BUTTERFLY VALVES

A. Manufacturers:

1. Hammond Valve.

2. Crane Co.

3. Milwaukee Valve Company.

4. Stockham.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Construction 1-1/2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, elastomer coated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 6 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.22 FLOW CONTROLS

A. Manufacturers:

1. ITT Bell & Gossett.

2. Griswold Controls.

3. Taco, Inc.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet , blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi psi.

2.23 SWING CHECK VALVES

A. Manufacturers:

1. Hammond Valve.
2. Nibco, Inc.
3. Milwaukee Valve Company.
4. Crane Co.
5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up to 2 Inches:

1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded ends.

C. Over 2 Inches:

1. MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.24 SPRING LOADED CHECK VALVES

A. Manufacturers:

1. Hammond Valve.
2. Crane Co.
3. Milwaukee Valve Company.
4. Stockham.
5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.25 WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Amtrol Inc.
2. Cla-Val Co.
3. Watts Regulator Company.
4. Spence Engineering Co.
5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Up to 2 Inches:

1. MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

C. Over 2 Inches:

1. MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.26 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers:
   a. Cla-Val Co.
   b. Henry Technologies.
   c. Watts Regulator Company.
   d. Spence Engineering Co.
   e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.
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 labelled.

B. Temperature and Pressure Relief:

1. Manufacturers:

a. Cla-Val Co.

b. Henry Technologies.

c. Watts Regulator Company.

d. Spence Engineering Co.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

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 labelled.

2.27 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc.

2. Green Country Filtration.

3. WEAMCO.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Size 1-1/2 inch to 4 inch:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

C. Size 5 inch and Larger:

1. Class 125, flanged iron body, basket pattern with 1/8 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. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

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

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

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

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 19.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors.

I. Establish elevations of buried piping outside the building to ensure not less than 3 ft of cover.

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

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

L. Provide support for utility meters in accordance with requirements of utility companies.

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

N. Install bell and spigot pipe with bell end upstream.

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

P. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

Q. Install water piping to ASME B31.9.

R. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

S. Sleeve pipes passing through partitions, walls and floors.

T. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

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

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

U. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.

2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

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

5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

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

9. Provide hangers adjacent to motor driven equipment with vibration isolation.

10. Support cast iron drainage piping at every joint.

V. Where water pressure within the building exceeds 75 psi static, install an approved water-pressure reducing valve conforming to ASSE 1003 with strainer to reduce the building pressure to 75 psi static or less.

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

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

E. Install ball valves for throttling, bypass, or manual flow control services.

F. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

G. Provide spring loaded check valves on discharge of water pumps.

H. Provide ball valves in natural gas systems for shut-off service.

I. Provide flow controls in water recirculating systems where indicated.

J. All sanitary waste and vent pipe installed above grade in fire-rated walls, fire-rated plenum spaces or return air plenums shall be cast iron.

3.5 TOLERANCES

A. Drainage Piping: Maintain invert elevations within 1/4 inch vertically of location indicated on drawings. Slope to drain at minimum of 1/4 inch per foot slope for pipes 3 inch and smaller and 1/8 inch per foot slope for pipes larger than 3 inch.

B. Contractor must maintain inverts as indicated on the drawings. The contractor shall employ the latest precision technology available to insure the accuracy of the installation. If the contractor is unable to maintain, the contractor should notify the engineer IMMEDIATELY to obtain direction.

C. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Arkansas state and local codes.

B. Prior to starting work, verify system is complete, flushed and clean.

C. Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. 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.

3.7 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. 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.

B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer.

C. Connections to existing manholes shall be made at the locations shown on the plans. An opening shall be cut in the wall of the manhole and shall be of sufficient size to permit installation of the pipe at the designated elevation. The invert of the existing manhole shall be removed and a new invert constructed. The end of the pipe shall be flush with the inside wall of the manhole and shall be sealed in the wall with mortar to provide a water tight joint.

D. Connection of dissimilar pipe materials shall be made with the specified adapter couplings.

E. Sewers shall be encased or cradled in concrete where shown on the plans or as directed by the Engineer. Unless otherwise noted on the plans, concrete encasement shall encircle the pipe and shall be a minimum thickness of four inches.

F. Provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure of 5 psi. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

G. This Contractor shall extend the system of gas piping, to the various outlets as indicated on plans, complete with stop ball valves, drip pockets, valves and other accessories that may be required to give proper and adequate service.

H. Provide gas ball valves in final connection to all equipment. Unions will not be permitted, except in final connections to equipment. Proper reducing fittings shall be used. Bushings will not be accepted. Gas piping in building shall be standard weight schedule 40 black steel pipe with malleable fittings, unless contractor wishes to weld all joints. Welded rod shall be of same material as piping. No. 22 bronze welding will be permitted.

I. All underground gas service exterior to the building (5 psi or less) shall be a polyethylene plastic pipe manufactured in accordance with ASTM No. D-2517 or D-2513 and shall be indicated on the pipe. Gas piping shall be laid at least 36" below grade at all points. Provide a #12 THN copper wire in trench with pipe and leave both ends exposed for future accessibility.

J. All gas piping in ground, including service, shall be checked with a "Holiday" detector to assure that the coating is free of holes, voids, contamination, cracks, etc. This test shall be performed after the completion of joint and finish coating and touch-up. This test shall be conducted in the presence of the Owner's inspector and performed by experienced personnel.

K. For corrosion protection, all underground and exposed exterior steel pipe and fittings must be coated and wrapped.

L. Test all gas piping operating at 6 oz. with air pump and mercury gauge to pressure that will maintain 25 psig for 20 minutes and inspected by gas service official.

M. All gas piping operating at more than 1 psig shall be tested at 100 psig for steel and 50 psig for plastic, for a minimum of 15 minutes and inspected by gas service official.

N. The pressure regulator at the building shall be sized, and approved by gas service official.

O. All above ground piping shall be rigid steel pipe designated for natural gas use. Pipe shall be painted with a rust inhibiting primer and a final coat the color of which shall be determined by governing regulations or as directed by the Engineer if no governing regulations exist regarding finish color.

P. All gas piping systems within a building and other above ground gas piping shall be electrically continuous and bonded to a grounded electrode as defined in NFPA 70.

Q. Medium and high pressure gas regulators installed in the medium and high pressure gas lines (2 psi or greater) shall comply with the following provisions:

1. Shall be suitable for the inlet and outlet gas pressure.

2. Shall comply with Code and gas official requirements.

3. Shall be accessible for servicing.

4. Shall be vented to outdoors when located indoors.

5. Shall be installed in the gas piping system so that it cannot be concealed by building construction.

R. Provide a listed shut off valve immediately ahead of and immediately behind each medium pressure regulator.

S. Underground gas piping shall be installed in a separate ditch.

3.8 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

a. Pipe size: 1/2 inches to 1-1/4 inches:

1) Maximum hanger spacing: 8 ft.

2) Hanger rod diameter: 1/4 inch.

b. Pipe size: 1-1/2 inches to 2 inches:

1) Maximum hanger spacing: 8 ft.

2) Hanger rod diameter: 1/4 inch.

c. Pipe size: 2-1/2 inches to 3 inches:

1) Maximum hanger spacing: 8 ft.

2) Hanger rod diameter: 3/8 inch.

d. Pipe size: 4 inches to 6 inches:

1) Maximum hanger spacing: 8 ft.

2) Hanger rod diameter: 3/8 inch.

e. Pipe size: 8 inches to 12 inches:

1) Maximum hanger spacing: 10 ft.

2) Hanger rod diameter: 1/2 inch.

f. Pipe size: 14 inches and Over:

1) Maximum hanger spacing: 10 ft.

2) Hanger rod diameter: 7/8 inch..

2. Plastic Piping:

a. All sizes:

1) Maximum hanger spacing: 6 ft.

2) Hanger rod diameter: 3/8 inch.

3. Roof Supports:

a. Provide gas piping roof supports as indicated on the plans.

b. Provide condensate piping roof supports as indicated on the plans.

4. Roof Piping Supports:

a. All sizes:

1) Maximum linear pipe spacing: 10 ft.

2) At all changes in direction.

END OF SECTION

SECTION 22 10 06

PLUMBING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof and Floor drains.

B. Downspouts.

C. Floor Sinks.

D. Cleanouts.

E. Hose bibbs.

F. Hydrants.

G. Washing machine boxes and valves.

H. Refrigerator valve and recessed box.

I. Backwater valves.

J. Backflow preventers.

K. Water hammer arrestors.

L. Thermostatic mixing valves.

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 40 00 - Plumbing Fixtures.

C. Section 22 30 00 - Plumbing Equipment.

1.3 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor Drains; 2022.

B. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.

C. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2021.

D. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.

E. NSF 61 - Drinking Water System Components - Health Effects; 2024.

F. NSF 372 - Drinking Water System Components - Lead Content; 2024.

G. PDI-WH 201 - Water Hammer Arresters; 2017.

1.4 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions, for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.

D. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

E. Project Record Documents: Record actual locations of equipment and cleanouts.

F. Operation Data: Indicate frequency of treatment required for interceptors.

G. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

I. Product Data: Manufacturer’s standard data sheets describing components including materials, dimensions, relationship to adjacent construction, and attachments.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than five 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. Josam Company.
2. Jay R. Smith Manufacturing Company.
3. Zurn Industries, Inc.
4. Wade Tyler Pipe.
5. MIFAB, Inc.
6. Watts Water Technologies.
7. Substitutions: See Section 22 10 00 - General Plumbing Provisions.

B. Roof Drains:

1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Removable cast iron dome with vandal proof screws.
4. Accessories: Coordinate with roofing type, refer to roof section.
    a. Membrane flange and membrane clamp with integral gravel stop.
    b. Adjustable under deck clamp.
    c. Roof sump receiver.
    d. Waterproofing flange.
    e. Controlled flow weir.
    f. Leveling frame.
    g. Adjustable extension sleeve for roof insulation.
    h. Perforated or slotted ballast guard extension for inverted roof.
    i. Perforated stainless steel ballast guard extension.

C. Roof Overflow Drains:

1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Removable cast iron dome with vandal proof screws.

4. Accessories: Coordinate with roofing type, refer to roof section.

    a. Membrane flange and membrane clamp with integral gravel stop.

    b. Adjustable under deck clamp.

    c. Roof sump receiver.

    d. Waterproofing flange.

    e. Controlled flow weir.

    f. Leveling frame.

    g. Adjustable extension sleeve for roof insulation.

    h. Perforated or slotted ballast guard extension for inverted roof.

D. Downspout Nozzles and Boots:

1. Bronze round with straight bottom section.

2. Bell reducer with cap. Size bell reducer as required to fit downspout. Cut cap to match size of downspout and seal around downspout watertight.

3. Cast iron coated rectangular downspout boot with no-hub outlet and securing strap.

E. 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 round nickel bronze strainer with removable perforated sediment bucket.

F. Floor Sink:

1. Square lacquered cast iron body with integral seepage pan, epoxy coated interior, aluminum dome strainer, clamp collar, sediment bucket; and nickel bronze frame; half grate.

2.2 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.

2. Josam Company.

3. Ward Manufacturing, Inc.

4. Zurn Industries, Inc.

5. Wade Tyler Pipe.

6. Watts Water Technologies.

7. MIFAB.

8. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Cleanouts at Exterior Surfaced Areas:

1. Round cast nickel bronze access frame and heavy duty, non-skid cover.

C. Cleanouts at Exterior Unsurfaced Areas:

1. Line type with lacquered cast iron body and round heavy duty, epoxy coated gasketed tractor-type cover.

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 machine screw.

E. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.3 HOSE BIBBS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.

2. Watts Regulator Company.

3. Zurn Industries, Inc.

4. Wade Tyler Pipe.

5. Woodford Manufacturing.

6. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Interior Hose Bibbs:

1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome plated where exposed with lockshield and removable key, integral vacuum breaker in conformance with ASSE 1011.

2.4 HYDRANTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.
2. Zurn Industries, Inc.
3. Wade Tyler Pipe.
4. Woodford.
5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Wall Hydrants:

1. ASSE 1019; freeze resistant, self-draining type with chrome plated lockable recessed box hose thread spout, lockshield and removable key, and integral vacuum breaker.

2.5 WASHING MACHINE BOXES AND VALVES

A. Box Manufacturers:

1. Guy Gray Manufacturing.
2. IPS Corporation/Water-Tite.
3. Oatey.
4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Valve Manufacturers:

1. Guy Gray Manufacturing.
2. IPS Corporation/Water-Tite.
3. Zurn Industries, Inc.
4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

C. Description: Painted metal preformed rough-in box with brass long shank valves with wheel handles, socket for 2 inch waste, slip in finishing cover.

2.6 REFRIGERATOR VALVE AND RECESSED BOX

A. Box Manufacturers:

1. Guy Gray Manufacturing.
2. IPS Corporation/Water-Tite.
3. Oatey.
4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Valve Manufacturers:

1. Guy Gray Manufacturing.
2. IPS Corporation/Water-Tite.
3. Zurn Industries, Inc.
4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

C. Description: Painted metal preformed rough-in box with brass valves with wheel handle, slip in finishing cover.

2.7 BACK WATER VALVES

A. Manufacturers:

1. Jay R. Smith Manufacturing Company; Model _____: www.jayrsmith.com.
2. Savko Plastic Pipe & Fittings, Inc; Model _____: www.savko.com/#sle.
3. Zurn Industries, Inc; Model _____: www.zurn.com/#sle.
4. Substitutions: See Section 01 60 00 - Product Requirements.

B. Cast Iron Back Water Valves: ANSI A112.21.2M; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.

C. Plastic Back Water Valves: ABS body and valve, extension sleeve, and access cover.

2.8 BACKFLOW PREVENTERS

A. Manufacturers:

1. Conbraco Industries.
2. Valve Solutions, Inc.

3. Watts Regulator Company.

4. Zurn Industries, Inc.

5. FEBCO.

6. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Reduced Pressure Backflow Preventers:

1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.

2.9 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.

2. Watts Regulator Company.

3. Zurn Industries, Inc.

4. Wade Tyler Pipe.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

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.

2.10 MIXING VALVES

A. Thermostatic Mixing Valves:

1. Manufacturers:

a. ESBE.

b. Leonard Valve Company.

c. Honeywell Water Controls.

d. Powers Process Controls.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. Valve: Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.

3. Accessories:

a. Check valve on inlets.

b. Volume control shut-off valve on outlet.

c. Stem thermometer on outlet.

d. Strainer stop checks on inlets.

4. Cabinet: 16 gage stainless steel, for surface mounting with keyed lock.

B. Pressure Balanced Mixing Valves:

1. Manufacturers:

a. Delta Faucet Company.

b. H.G. Specialties.

c. Powers Process Controls.

d. Taconova.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. Valve: Chrome plated cast brass body, stainless steel cylinder, integral temperature adjustment.

3. Accessories:

a. Volume control shut-off valve on outlet.

b. Stem thermometer on outlet.

c. Strainer stop checks on inlets.

d. Cabinet: 16 gage stainless steel, for surface mounting with keyed lock.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade. Refer to plans for detail.

D. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; janitor rooms, flush valves, interior and exterior hose bibbs.

E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories,sinks, washing machine outlets and water closets.

F. Install city approved backwater valve on all building sewers at the exterior of the building and prior to connection to the public sewer system.

G. Install components in accordance with manufacture's instructions and approved product data submittals.

END OF SECTION

SECTION 22 10 08

PLUMBING SOLDER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Lead-free plumbing solder.

1.2 RELATED SECTIONS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 40 00 - Plumbing Fixtures.

C. Section 22 30 00 - Plumbing Equipment.

1.3 REFERENCES

A. ASTM B 32 - Standard Specification for Solder Metal; 1996.

B. NSF 61 - Drinking Water System Components - Health Effects; 2002 (ANSI/NSF 61).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: The Harris Products Group

B. Substitutions: See Section 22 01 00 - General Plumbing Provisions for equipment and material substitutions.

C. Provide all plumbing solder from a single manufacturer.

2.2 MATERIALS

A. Plumbing Solder: Sterling® solder or equal, ASTM B 32, Alloy Grade TC; 95 percent tin, 4.85 percent copper, 0.15 percent selenium.

1. Certified to comply with NSF 61.

2. Melting Temperature: 410 degrees F.

3. Tensile Strength: 7,130 psi.

4. Shear Strength: 5,979 psi.

5. Elongation Percent: 19.1.

6. Brinell Hardness: 15.1.

7. Burst Strength: 5,800 psi.

8. Pressure/Temperature Test Data on Copper Tube Assemblies comprised of 3 inch, 2 inch, 1 inch, 3/4 inch, and 1/2 inch Tubing with a Reducing Tee:

   a. No leaks at 70 degrees F., 200 psi, held for 2 minutes.

   b. No leaks at 180 degrees F., 200 psi, held for 2 minutes.

   c. No leaks at 70 degrees F., 2,000 psi, held for 5 minutes.

B. No lead in plumbing solder.

PART 3 EXECUTION

3.1 INSTALLATION

A. Apply plumbing solder in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water heaters.

B. Pumps.

1. Circulators.

1.2 RELATED REQUIREMENTS

A. Division 26 - Equipment wiring; electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. Comply with State of Arkansas adopted ADA Accessible Guidelines in regard to accessible or handicapped features.

B. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.

1.4 SUBMITTALS

A. See Section 22 01 00 - General Plumbing Provisions, for submittals procedures.

B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

2. Indicate pump type, capacity, power requirements.

3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

4. Provide electrical characteristics and connection requirements.

C. 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.

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 five years of documented experience.

B. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

C. Standards: Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:

1. National Sanitation Foundation (NSF).

2. American Society of Mechanical Engineers (ASME).

3. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).

4. National Electrical Manufacturers' Association (NEMA).

5. Underwriters Laboratories (UL).

D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.6 CERTIFICATIONS

A. Water Heaters: NSF approved.

B. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1 or ANSI Z21.10.3, as applicable.

C. Pressure Vessels for Heat Exchangers: ASME labeled, to ASME (BPV VIII, 1).

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

1.8 WARRANTY

A. Provide five year manufacturer warranty for domestic water heaters.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 WATER HEATER MANUFACTURERS

A. Commercial Condensing Tankless Gas Fired Water Heater Manufacturers

1. Rinnai.
2. A.O. Smith Water Products Co.
3. State Industries.
4. Takagi.
5. Navien.
6. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2.2 COMMERCIAL CONDENSING TANKLESS GAS FIRED WATER HEATERS

A. Type: Automatic, condensing natural gas-fired, tankless, temperature controlled, continuous flow, direct vent, forced combustion, 95% efficient, PVC vented, cold water by-pass, copper primary heat exchanger. 12 year heat exchanger warranty..

B. Performance:

1. As specified in drawing schedule.

C. Accessories: Provide:

1. Water Connections: Copper.
2. Water flow sensor with electronic water control.
3. Unit Mounted Digital Controller.
4. Manufacturer's PVC concentric vent kit.
5. Air to Fuel Sensor.

6. Condensate neutralization kit.

7. Provide approved manufacturer's drain pan or shop fabricated 24 gage galvanized steel drain pan.

D. Approval: By AGA.

2.3 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Manufacturers:

1. Amtrol Inc.

2. ITT Bell & Gossett.

3. Taco, Inc.

4. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psig.

D. Size: Refer to plans or as required to match system volume.

2.4 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.

2. ITT Bell & Gossett.

3. Sterling Fluid Systems.

4. Grundfos.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Casing: Bronze, rated for 150 psig working pressure, with stainless steel rotor assembly.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Performance:

1. As scheduled on drawings.

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.

B. Install water heaters in accordance with manufacturer's instructions and to AGA or UL requirements.

C. Coordinate with plumbing piping and related electrical work to achieve operating system.

D. Pumps:

1. Provide air cock and drain connection on horizontal pump casings.

2. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.

3. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

4. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

5. Align and verify alignment of base mounted pumps prior to start-up.

6. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.

3.2 SCHEDULES

A. Water Heaters:

1. Refer to plan schedule.

B. Recirculating Pumps:

1. Refer to plan schedule.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Water closets.

B. Urinals.

C. Lavatories.

D. Sinks.

E. Service sinks.

F. Showers.

G. Electric water coolers/ Bottle filler.

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.

B. Section 22 10 06 - Plumbing Specialties.

C. Section 22 30 00 - Plumbing Equipment.

D. Division 26 - Equipment wiring, electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. Comply with State of Arkansas adopted ADA Accessible Guidelines in regard to accessible or handicapped features.

B. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

C. ASME A112.18.1 - Plumbing Supply Fittings; 2024.

D. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.

E. NSF 61 - Drinking Water System Components - Health Effects; 2024.

F. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.4 SUBMITTALS

A. Section 22 01 00 - General Plumbing Provisions: Procedures for submittals.

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

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

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 five 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. Provide five year manufacturer warranty for drinking fountain.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 FLUSH VALVE WATER CLOSETS

A. Water Closets: Vitreous china, ASME A112.19.2, floor mounted, powerful direct-fed siphon jet flush action , china bolt caps.

1. Bowl: Height as indicated on plans, with elongated rim.
2. Flush Volume: 1.6 gallon, maximum.
3. Flush Valve: Exposed (top spud).
    a. Dual-Filtered Bypass.
4. Flush Operation: Manual, oscillating handle.
5. Manufacturers:
    a. American Standard Inc.
    b. Kohler Company.
    c. Zurn Industries, Inc.
    d. Sloan.
    e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Flush Valves: ASME A112.18.1, diaphragm type, dual-filtered bypass, complete with vacuum breaker stops and accessories.

1. Exposed Type: Chrome plated, escutcheon, integral screwdriver stop.
    a. Valve shall be equal to Sloan Valve Company; Model Sloan #111-DFB.
2. Manufacturers:
    a. Sloan Valve Company.
    b. Substitutions: Not permitted.
3. Manual Operated:
    a. Type: ASME A112.18.1 or ASME A112.19.5; diaphragm type complete with vacuum breaker stops, and accessories.
    b. Supplied Volume Capacity: 1.5 gal per flush.

C. Seats:

1. Manufacturers:
    a. Beneke Magnolia.
    b. Bemis Manufacturing Company.

c. Church Seat Company.

d. Olsonite.

e. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. Solid white plastic, open front, self-sustaining hinge, brass bolts, without cover.

2.3 WALL HUNG URINALS

A. Wall Hung Urinal Manufacturers:

1. American Standard Inc.

2. Kohler Company.

3. Zurn Industries, Inc.

4. Sloan.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Urinals: Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action with side shields and concealed carrier.

1. Flush Volume: 1 gallon, maximum.

2. Flush Style: Siphon jet.

3. Flush Valve: Exposed (top spud).

4. Flush Operation: Manual, oscillating handle.

5. Trap: Integral.

6. Removable stainless steel strainer.

7. Supply Size: 3/4 inch.

8. Outlet Size: 2 inches.

C. Flush Valves: ASME A112.18.1, diaphragm type, complete with dual filtered bypass, vacuum breaker stops and accessories.

1. Exposed Type: Chrome plated, escutcheon, dual-filtered bypass, integral screwdriver stop.

a. Valve shall be equal to Sloan Valve Company, model Sloan #186-DFB.

2. Where indicated, exposed Sloan Optima or approved equal flushometer electronic, automatic flush valve.

D. Flush Valve Manufacturers:

1. Sloan Valve Company.

2. Substitutions: Not permitted.

E. Manual Operated:

1. Type: ASME A112.18.1 or ASME A112.19.5; diaphragm type, complete with vacuum breaker stops, and accessories.

2. Supplied Volume Capacity: 1.5 gal per flush.

F. Carriers:

1. Manufacturers:

a. JOSAM Company.

b. Sloan Valve Company.

c. Zurn Industries, Inc.

d. Wade Tyler Pipe.

e. Watts Water Technologies.

f. MIFAB.

g. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.4 LAVATORIES

A. Lavatory Manufacturers:

1. American Standard Inc.

2. Zurn Industries, Inc.

3. Kohler Company.

4. Sloan.

5. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Vitreous China Wall Hung Basin:

1. ASME A112.19.2; vitreous china wall hung lavatory, with 4 inch high back, rectangular basin with front overflow.

a. Drilling Centers: 4 inch.

C. Supply Faucet Manufacturers:

1. Kohler Company.

2. Sloan Valve Company.

3. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

D. Supply Faucet: ASME A112.18.1; chrome plated combination supply fitting with open grid strainer, water economy aerator with maximum flow of 0.5 gallon per minute (low-flow), single lever handle.

E. Accessories:

1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.

2. Offset waste with plug and strainer where required.

3. Wheel handle stops.

4. Rigid supplies.

5. Carrier:

a. Manufacturers:

1) JOSAM Company.

2) Sloan Valve Company.

3) Zurn Industries, Inc.

4) Watts Water Technologies.

5) MIFAB.

6) Substitutions: See Section 22 01 00 - General Plumbing Provisions.

b. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs.

F. All lavatory faucets shall be listed to ASSE 1070 for temperature and pressure protection with a maximum control flow of 0.5 gpm (2.2 lpm). Faucet shall feature a single cartridge design for ease of repair and maintenance and shall provide an approach temperature of no greater than 5ºF (3°C). Faucet shall include integral check valves to prevent cross flow and shall be in compliance with the American with Disabilities Act (ADA). Faucet shall feature ceramic disc mixing and shall be constructed using Lead Free material.

2.5 WALL-HUNG, SOLID SURFACE, MULTISTATION LAVATORY UNITS

A. Description: Rectilinear, level-surface deck, seamless and integral elongated basin, with stainless steel enclosed pedestal cabinet.

B. Surface Burning Characteristics: Smoke developed index less than 450, and flame spread index less than 25, Class A, when tested in accordance with ASTM E84.

C. Number of Wash Stations: Four.

D. Unit Length: 42 inches.

E. Soap Dispenser:

1. Liquid Soap Dispenser.

F. Color: As selected by Architect from manufacturer's full line.

G. Faucet Drilling: 4 inch (100 mm) centerset drilling.

H. Access Panel: Stainless steel.

2.6 SHOWERS (WALL MOUNTED SYSTEM)

A. Manufacturers:

1. Symmons.

2. Leonard.

3. Acorn.

4. Chicago.

5. T & S.

6. Bradley.

7. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Wall-mounted, compact shower system, preassembled encased in 18 gauge stainless steel, vandal-proof cover with #4 brush finish.

C. Trim: Pressure Balance mixing valve, with inline diverter valve, vandal resistant all brass, ball joint, adjustable spray with volume control institutional shower head, vacuum breaker, inline screw driver service stops, single-handle shutoff, and color-coded dial.

D. ADA Trim: Pressure Balance and Metering mixing valve, single-handle shutoff, color-coded dial, adjustable temperature limit, screwdriver service inlet stops, hand shower with 60-inch hose, vacuum breaker.

E. Provide folding seat with phenolic slats equal to Bobrick B-5181. Verify left hand or right hand seat.

2.7 SERVICE SINKS

A. Service Sink Manufacturers:

1. Elkay Manufacturing Company.

2. American Standard. Inc..

3. Williams.

4. Crane-Fiat.

5. Florestone

6. Substitutions: See Section 22 01 00 - General Plumbing Provisions.

B. Bowl:

1. 24 x 24 x 12 inch high white terrazzo, floor mounted, with two inch wide shoulders, vinyl bumper guard, stainless steel strainer.

C. Trim:

1. ASME A112.18.1 exposed wall type supply with cross handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps, hot and cold water supply check valves, and adjustable threaded wall flanges.

D. Accessories:

1. 5 feet of 1/2 inch diameter plain end reinforced rubber hose.

2. Hose clamp hanger.

3. Mop hanger.

4. 20 ga. stainless steel splash catcher panels for all adjacent walls.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. 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 each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome plated rigid supplies to fixtures with hand wheel stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall carriers and bolts.

E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, color to match fixture

F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

G. Install handicap valve handles to the accessible side.

H. Provide HandiLav or approved equal molded trap and supply insulation kit for all exposed drain and supply handicap lavatories.

I. Install a check valve in the hot and cold water supply lines at every service sink.

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.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

3.8 SCHEDULES

A. Fixture Heights: Install fixtures to heights above finished floor as indicated.

1. Water Closet Flush Valves:

a. Standard: 11 inches min. above bowl rim.

2. Lavatory:

a. Standard: 31 inches to top of basin rim.

b. Accessible: 34 inches maximum to top of basin rim.

c. Youth: Refer to Architectural Plans.

B. Minimum fixture rough-in sizes or as required for particular fixtures.

1. Water Closet (Flush Valve Type):

a. Cold Water: 1 Inch.

b. Waste: 4 Inch.

c. Vent: 2 Inch.

2. Urinal (Flush Valve Type):

a. Cold Water: 3/4 Inch.

b. Waste: 2 Inch.

c. Vent: 1-1/2 Inch.

3. Lavatory:

a. Hot Water: 1/2 Inch.

b. Cold Water: 1/2 Inch.

c. Waste: 1-1/2 Inch.

d. Vent: 1-1/4 Inch.

4. Sink:

a. Hot Water: 1/2 Inch.

b. Cold Water: 1/2 Inch.

c. Waste: 1-1/2 Inch.

d. Vent: 1-1/4 Inch.

5. Service Sink:

a. Hot Water: 1/2 Inch.

b. Cold Water: 1/2 Inch.

c. Waste: 3 Inch.

d. Vent: 2 Inch.

END OF SECTION

SECTION 23 01 00

GENERAL HVAC PROVISIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. The work covered by Division 23 sections consist of furnishing all labor, equipment, appliances and material for the heating, air conditioning, piping and plumbing systems in strict accordance with Codes, Specifications and the applicable drawings and subject to the terms and conditions of the contract. Include all appurtenances necessary to the proper operation of the systems and equipment specified.

B. General Contractor shall install all concrete pads and bases required for installing mechanical equipment. Mechanical Contractor is responsible for the exact sizes required, location of anchor bolts, etc.

C. Some equipment may be furnished by other divisions. Mechanical Contractor is responsible to check the drawings and specifications for equipment that will be furnished by the Owner. Furnish the duct, insulation, controls, etc., on all equipment furnished by other divisions.

D. General Contractor shall furnish and install all ceiling access panels required to service mechanical equipment, valves and controls above gyp board or hidden spline ceilings.

E. NOTE: HVAC DDC Controls are included in the specification for reference only. The HVAC controls system described in the specifications and on the drawings is to be provided by the owner under separate contract. The controls system will be bid directly to the owner at a date as specified elsewhere in this specification.

F. NOTE: The equipment described in the following sections is to be provided by Owner through a purchasing agreement. Mechanical contractor SHALL be responsible for installation of such equipment and all necessary accessories in order to provide a complete and working system.

1. Section 23 36 06 - Air Terminal Units - Variable Volume.
2. Section 23 54 00 - Furnaces.
3. Section 23 62 13 - Air Cooled Condensing Units.
4. Section 23 74 33 - Packaged Rooftop Dedicated Outdoor Air Units.

5. Section 23 09 25 - DDC Control System.

6. Section 23 81 27 - Small Capacity Split-System Air Conditioning Units.

1.2 RELATED SECTIONS

A. The General Conditions and Division 1, General Requirements, as bound in the specification preamble, apply to all work under Division 23. Carefully note its contents in performance of the work.

B. The Architectural, Fire Suppression, Plumbing, Electrical, and Structural plans and Specifications, including Information to Bidders and other pertinent documents issued by the Engineer are a part of this Specifications and the accompanying mechanical plans. Comply with them in every respect. Examine all the above carefully. Failure to comply does not relieve the Contractor of responsibility nor may it be used as a basis for additional compensation due to omission of architectural, electrical and structural details from the mechanical drawings.

C. All electrical power wiring is specified under Division 26 of the Specifications. Mechanical Contractor shall furnish all motor starters required for the control and protection of all motors furnished for the Division 23. Provide and install all automatic temperature and interlock wiring required for controlling mechanical equipment furnished under Division 23, in compliance with Division 26 of the Project Manual.

D. All concrete pads and bases required for installing mechanical equipment are specified in another section of the Specifications. Advise the General Contractor as to the exact sizes required, location of anchor bolts, etc.

E. Paint all roof top mechanical equipment ducts, supports and other exposed material. Do not paint indoor equipment supplied with painted finish, such as the main mechanical equipment unless damaged during handling and installation. In such cases, use touch-up paint of the same type and color as original paint. Conform to requirements in other sections of the Specifications and match wall finish to the room in which installed.

1.3 CODES, FEES AND LATERAL COSTS

A. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations, and the applicable requirements of the following latest nationally accepted codes and standards:

1. 2021 Centerton, Arkansas City Building Code.

2. 2021Arkansas State Mechanical Code.
3. 2018 Arkansas State Plumbing Code.
4. 2014 Arkansas Energy Code.
5. IBC - International Building Code; latest accepted edition.
6. IFC - International Fire Code; latest accepted edition.
7. IGC - International Gas Code; latest accepted edition.
8. IMC - International Mechanical Code; latest accepted edition.
9. IPC - International Plumbing Code; latest accepted edition.
10. IECC - International Energy Conservation Code
11. AMCA - Air Moving & Conditioning Association.
12. ASA - American Standards Association.
13. ASHRAE - American Society of Heating, Refrigerating and Air Conditioning Engineers.
14. ASME - American Society of Mechanical Engineers.
15. ASTM - American Society of Testing Materials.
16. AWWA - American Water Works Association.
17. NBS - National Bureau of Standards.
18. NEMA - National Electrical Manufacturers Association.
19. NFPA - National Fire Protection Association.
20. SMACNA - Sheet Metal & Air Conditioning Contractors' National Association.
21. UL - Underwriters' Laboratories, Inc.
22. AGA - American Gas Association.
23. OSHA - Occupational Safety and Hazard Association.
24. AABC - Associated Air Balance Councils
25. NEBB - National Environmental Balancing Bureau

B. Comply with State of Arkansas adopted ADA Accessible Guidelines in regard to accessible or handicapped features.

C. In case of difference between building codes, Specifications, state Laws, local ordinances, industry standards and utility company regulations and the Contract Documents, the most stringent governs. Promptly notify the Engineer in writing of any such difference.

D. Remove any work installed that does not comply with the requirements of the applicable building codes, state laws, local ordinances, industry standards, or utility company regulations, correct the deficiencies, and reinstall all work at no cost to the Owner.

E. The mechanical drawings show the general arrangement of all piping, equipment and appurtenances. Follow as closely as actual building construction and the work of other trades will permit. Final layout will be governed by actual field conditions with all measurements verified at the site. Conform to the requirements shown on all of the drawings. General and structural drawings take precedence over mechanical drawings. Because of the small scale of the mechanical drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. Investigate the existing and finish conditions affecting the work and arrange the work accordingly, providing such fittings, valves and accessories as may be required to meet such conditions. Contractor shall verify that all equipment, ducts, pipes and all other components will fit in the space provided before fabrication or ordering.

F. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith. Arrange with the serving utility companies for the connections to all utilities and pay all charges for same including inspection fees and meters if required. Refundable deposits will be paid by the Owner.

1.4 GUARANTEE

A. Furnish a written certificate guaranteeing all materials, equipment and labor furnished to be free of all defects for a period of one (1) year from and after the date of final acceptance of the work by the Owner and further guarantee to replace such work without charges if any defects appear within the stipulated guaranty period.

1.5 SOIL CONDITIONS

A. The Specifications and the drawings in no way imply the conditions of the soil to be encountered. When excavating may be required in execution of the work, this

Contractor agrees that he has informed himself regarding conditions affecting the work.

1.6 INSPECTION OF PREMISES

A. Before submitting a bid, visit the site of the proposed job and determine the conditions relating to this work.

1.7 UTILITIES, LOCATIONS AND ELEVATIONS

A. Locations and elevations of the various utilities included within the scope of this work have been obtained from substantially reliable sources and are offered as a general guide only, without guarantee as to accuracy. Verify the location and elevation of all utilities and their relation to the work before entering into a contract.

B. Identify outdoor underground lines with continuous strip of plastic utility marker tape at regular intervals (maximum of 10 feet) "Caution (state utility) pipe below". Install one foot directly above pipe before backfilling to grade.

1.8 EXISTING BUILDING AND EXISTING MECHANICAL EQUIPMENT

A. Visit the existing building and become thoroughly acquainted with the existing physical plant, mechanical systems and utilities in order to determine all of the work that will be necessary to carry out the intent of the plans and specifications.

B. If it is necessary, in any way, to interfere with normal operations of the existing utilities in order to carry out the work, give notice and obtain written approval from the Owner before the work is started.

C. The work involved in this project requires the Contractor to work inside of an existing building. Interruption of the regular routine of the building by the Contractor must be kept to a minimum.

1.9 EQUIPMENT NOT SPECIFIED UNDER DIVISION 23

A. Equipment which requires plumbing and other mechanical connections may be specified in another division of this Specification. Under these conditions, provide necessary utilities including waste, water, natural gas, duct, insulation and controls.

B. Rough-in work from approved shop drawings only.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. Provide new materials bearing the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material. Furnish the standard product of a manufacturer regularly engaged in the production of the required type of equipment. Provide the manufacturer's latest approved design.

B. Deliver equipment and materials to the site and store in original containers, suitably sheltered from the elements, but readily accessible for inspection by the Engineer until installed. Store all items subject to moisture damage (such as controls) in dry, heated spaces.

C. Provide equipment and materials of the same general type and of the same make throughout the work to provide uniform appearance, operation and maintenance.

D. Tightly cover equipment and protect against dirt, water and chemical or mechanical injury and theft. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly. Turn over to the Owner in a condition satisfactory to the Engineer. Repair damage or defects developing before acceptance of the work at no expense to the Owner.

E. Insure that items to be furnished fit the space available. Make necessary field measurements to ascertain space requirements, including those for connections. Furnish and install such sizes and shapes of equipment that the final installation suits the true intent and meaning of the drawings and Specifications.

F. Follow manufacturer's directions completely in the delivery, storage, protection and installation of all equipment and materials. Promptly notify the Engineer in writing of any conflicts between any requirements of the Contract Documents and the manufacturers' directions. Obtain the Engineer's written instruction before proceeding with the work. Replace any work that does not comply with the manufacturers' directions or such written instructions from the Engineer, at no cost to the Owner.

G. Support all products by service organizations with adequate spare parts inventory and personnel located reasonably close to the site.

H. Where multiple units of the same type or class of products are required, provide all units of the same manufacturer.

2.2 EQUIPMENT ACCESSORIES

A. Furnish and install all equipment, accessories, connections and incidental items necessary to fully complete all work, ready for use, occupancy and operation by the Owner.

B. Where equipment requiring different arrangement or connections from those shown is provided, install the equipment to operate properly and in harmony with the intent of the drawings and Specifications.

C. Support, plumb, rigid and true to line, all work and equipment furnished. Study thoroughly all general, structural, electrical, fire suppression and mechanical drawings, shop drawings and catalog data to determine how equipment, fixtures, piping, ductwork, etc., are to be supported, mounted or suspended and provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper supports whether or not shown on the drawings. When directed, submit drawings showing supports.

D. If accessories are required to complete the work and meet the intent of the specification, it is the responsibility of the Contractor to provide such accessories.

2.3 MATERIAL AND EQUIPMENT SCHEDULE

A. Submit to the Engineer as soon as practical, six (6) complete sets of the schedule of materials and equipment proposed for the installation, or electronic submittals as detailed below. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data and submit under one cover with an index sheet in front.

1. If Electronic files are submitted, a complete set of the schedule of materials and equipment proposed for the installation shall be included. Include manufacturers' names, catalog data, diagrams, drawings and other descriptive data. All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files according to the corresponding specification section (i.e. "23 40 00 - Air Cleaning Devices.pdf"). Unless incomplete submittals are authorized by the project engineer, all Division 23 submittals shall be electronically sent at one time. Without authorization, incomplete submittals shall be rejected.

B. Provide written certification that shop drawings are in accordance with the specifications and are dimensionally correct with reference to available space.

C. All submittals will be reviewed a maximum of two (2) times. The cost of additional submittal reviews beyond those two specified will be charged to the Contractor.

D. Shop drawings for the Engineer's files are required on the following items:

1. Packaged Rooftop Dedicated Outdoor Air Units.

2. Small Capacity Air Conditioning Units.

3. Furnace Units.

4. Condensing Units.

5. Filters.

6. Wall Louvers.

7. Exhaust Fans.

8. Grilles and Registers.

9. Air Balance Certification.

10. Ductwork Materials Including Duct Accessories.

11. Duct Insulation Materials.

12. Complete Mechanical Equipment Electrical Data and Wiring Details.

13. Variable Frequency Drives.

14. Controls - Including Sequences of Operation specific to the job.

2.4 EQUIPMENT AND MATERIAL SUBSTITUTIONS

A. It is the responsibility of the Contractor to investigate any desired substitutions for specified equipment prior to submission of his bid. The Mechanical Contractor shall be responsible for any changes required in mechanical, electrical, structural or vibration isolation systems and shall bear all cost for those changes whether the substitute equipment is named by manufacturer in the specifications or is submitted to the Architect for "or equal" consideration. All changes shall be accomplished in a manner acceptable to the Architect per Section 01 60 00 at no additional cost to the Owner.

B. In order to obtain prior approval on equipment or material not specified in Division 23 Specifications or Equipment Schedules, Mechanical Contractor MUST submit to the Engineer any proposed equipment or material ten (10) working days prior to the bid date.

C. If ANY substitute equipment is submitted to Engineer for approval, without said equipment having been pre-approved, the entire submittal will be rejected for resubmittal.

D. Any equipment manufacturers which are a subsidiary to the listed acceptable manufacturers are not considered equal. Therefore, it is the responsibility of the

Contractor and equipment supplier to obtain prior approval as described in paragraph 2.4, this Section.

2.5 ELECTRICAL MOTORS

A. Provide motors of a recognized manufacturer, wound for the voltage specified, and in conformance to latest standards of the manufacturer and performance of the National Electrical Manufacturers Association and the Institute of Electrical and Electronic Engineers. Provide motors as manufactured by General Electric, Westinghouse, Century or Siemens-Allis, Baldor or approved equal.

B. Provide motors rated for continuous duty at 100% of rated capacity and temperature raise of 40 degrees Centigrade open type; 50 degrees Centigrade drip and splash proof; 55 degrees Centigrade explosion proof and totally enclosed above an ambient of 40 degrees Centigrade.

C. Unless otherwise required, provide integral horsepower, polyphase motors, Class B, general purpose, squirrel cage, open type induction motors, T-frame.

D. Provide single phase fractional horsepower motors of the open capacitor type. Generally, motors under 1/2 horsepower may be split phase type unless otherwise specified. Provide motors rated 1/2 horsepower or less with integral overcurrent protection.

E. Insure the insulation resistance between stator conductor and frames of motors is not less than 1/2 megohm. Provide shop test of motors including temperature rise, insulation resistance, motor terminal voltage, normal operating line current, RPMs, breaker or switch size with fusing and overload relay sizes.

PART 3 EXECUTION

3.1 COORDINATION OF WORK

A. Compare the mechanical drawings and Specifications with the drawings and Specifications for other trades and report any discrepancies between them to the Engineer and obtain from him written instruction for changes necessary in the mechanical work. Install the mechanical work in cooperation with other trades installing inter-related work. Before installation, make proper provisions to avoid interferences in a manner approved by the Engineer. Make all changes required in the work caused either by neglect or existing field conditions at no cost to the Owner.

B. It is the responsibility of the General Contractor, Plumbing Contractor, Mechanical Contractor and Electrical Contractor, and Sprinkler Contractor to coordinate installation of all equipment. Equipment installed prior to proper coordination, which

interferes with the harmony and intent of the specifications and drawings, will be removed and reinstalled at the cost of the responsible Contractor.

C. Furnish anchor bolts, sleeves, inserts and supports required for the mechanical work. Locate anchor bolts, sleeves, inserts and supports as directed by the trade requiring them and insure that they are properly installed.

D. Slots, chases, openings and recesses in existing structure shall be cut, patched and repaired by the Contractor.

E. Adjust locations of pipes, ducts, equipment fixtures, etc., to accommodate the work and for interferences anticipated and encountered. Determine the exact route and location of each pipe and duct prior to fabrication.

1. Provide right-of-way to lines that pitch over those that do not pitch. For example, Plumbing drains normally have right-of-way. Lines whose elevations cannot be changed have the right-of-way over lines whose elevations can be changed.

2. Make offsets, transitions and changes in direction in pipes and ducts as required to maintain proper head room and pitch.

F. Install all mechanical work to permit removal without damage to other parts, to coils, fan shafts and wheels, filters, belt guards, sheaves and drives and all other parts requiring periodic replacement or maintenance. Arrange pipes, ducts and equipment to permit ready access to valves, cocks, traps, starters, motors, control components and to clear the openings of swinging and overhead doors and of access panels.

G. Change the cross sectional dimensions of ductwork when required to meet job conditions, but maintain at least the same equivalent cross sectional area. Secure the approval of the Engineer prior to fabrication of ductwork requiring such changes. Sizes shown on the plans are clear dimensions; add for internal insulation if specified.

3.2 RECORD DRAWINGS

A. Maintain record drawings showing exact locations and sizes, as actually installed, of piping, drains, cleanouts, ductwork, controls and equipment as specified herein. Deliver to the Owner/Architect upon completion and acceptance of the work, one (1) complete set of contract drawings marked to indicate all deviations from intended installation.

B. Record drawings shall be provide in hard copy form, as well as, on a DVD in PDF form.

3.3 CUTTING AND PATCHING

A. The General Contractor shall be responsible for all required cutting, patching, etc., incidental to this work and shall make all required repairs thereafter to the satisfaction of the Engineer. Do not cut into any major structural element, beam or column without the written approval of the Engineer.

B. Openings in fire or smoke barriers for air handling ductwork or air movement shall be protected in accordance with NFPA 90A and 90B and the Mechanical Code.

C. Pipes, conduits, cables, wires, air ducts, pneumatic tubes and ducts and similar handling service equipment that pass through fire or smoke barriers shall be protected in accordance with NFPA 101.

D. All fire stopping assemblies must be UL approved assemblies.

3.4 EQUIPMENT START-UP AND TESTING

A. Instruct the Owner's operating personnel during start-up and separate operating tests of each major item of equipment. During the operating tests, prove the operation of each item of equipment to the satisfaction of the Engineer. Give at least seven (7) days notice to the Engineer of equipment start-up and operating tests.

B. Refer to Section 23 08 00 for additional information.

3.5 CATALOG DATA FOR OWNER

A. Provide, in looseleaf binders, two (2) sets of a compilation of catalog data of each manufactured item of equipment used in the mechanical work and present this compilation to the Owner/Architect for transmittal to the Owner before final payment is made. Include descriptive data and printed installation, operating and maintenance instructions for each item of equipment. Provide a complete double index as follows:

1. Listing of products alphabetically by name.

2. Listing the names of manufacturers whose products have been incorporated in the work alphabetically together with their addresses and the names and addresses of the local sales representatives.

3. Certificates of Final Inspections.

4. Complete spare parts data with current prices and supply sources.

5. Extended warranties.

B. Deliver to the Owner all special tools, lubricants, extra materials and any other products necessary for the proper operation and maintenance of the mechanical and plumbing systems.

C. Provide project record documents indicating all changes from contract documents made during construction.

D. Submit all Certificates of Final Inspections from the Administrative Authorities.

E. Submit TAB reports on approved forms. Final TAB report submittals shall include all required rebalances if any are required.

3.6 INSTRUCTION OF OWNER'S REPRESENTATIVE

A. Instruct the representative of the Owner in the proper operation and maintenance of all elements of the mechanical system. Spend not less than five (5) days in such formal instruction and additional time as directed by the Engineer to fully prepare the Owner to operate and maintain the mechanical equipment.

B. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated. Provide the following training as required to fully qualify the Owner's designated personnel. All training must be video taped to a CD and a copy included in each operation and maintenance closeout manual.

1. Furnace / Condenser Units.

2. Return Fan/Relief Fan.

3. Small Capacity Air Conditioning Units.

3.7 PROTECTIVE COATINGS

A. Paint exterior surfaces of steel piping run in or through concrete floor fill, under tile floors or underground, and aluminum surfaces in contact with masonry, with one coat of acid resisting bituminous base paint.

B. Paint all exposed galvanized ducts behind grilles flat black.

3.8 NOISE CONTROL

A. It is intended that the mechanical systems as installed under this contract be free from objectionable noise when the system is operating. The system shall operate at noise levels below criteria recommended for the application by ASHRAE. Provide vibration isolation accessories and isolate equipment, pipeline, ductwork, etc., as required so as to insure an acceptable noise level in all of the mechanical systems.

3.9 CLEANING AND ADJUSTING

A. Do not allow waste material and rubbish to accumulate in or above the premises. After completion of this work, remove rubbish, tools, scaffolding and surplus materials from and about the building and leave all work clean and ready for use. Clean all equipment, pipes, valves and fittings of grease, metal cuttings and sludge. Repair any stoppage, discoloration or other damage to parts of the building, its finish or furnishings due to failure to properly clean the mechanical systems, without additional cost to the Owner. Adjust all automatic control devices for proper operation.

3.10 SYSTEM OPERATING TESTS

A. After the successful completion of all equipment start-up and test requirements, perform the following tests on the complete mechanical systems:

1. First Operating Test by Contractor: Prove the operation of the mechanical systems and of each individual item in the systems. Give at least 10 day prior notice to the Engineer of such tests. Adjust and set proper quantities to all items and equipment. Should any item of the systems fail to perform in an approved manner, repeat this test until approved by the Engineer. During this test, balance circulation of heating and cooling water to balancing cocks, valves, thermostats and similar Items to insure that the mechanical systems perform as intended.

2. Checking by Owner and Engineer: Following the successful completion of first operating tests by the Contractor, the Owner and the Engineer have the privilege of making such tests as they may desire during a period of three weeks to ascertain in detail if any corrections are to be made to the system. At the end of the testing by the Owner and the Engineer, the Engineer may direct the Contractor in writing to make such corrections to the systems as are within the scope of the contract.

3. Contractor's Corrections to Systems: Make all required corrections to the systems and notify the Engineer in wiring that the corrections outlined have been completed. Give at least seven (7) days notice of a final three-day operating test.

4. Three-Day Operating Test: Perform an operating test to the satisfaction of the Engineer for a period of three (3) days. Should any element of the systems not perform properly, make all required corrections and repeat the test until successfully performed.

a. Submit the Form of Record proposed by the Contractor for the recording of all measurements to the Engineer for approval at least two weeks before the approved form will be required by the Contractor.

b. Measurements: Make the following measurements at two-hour intervals (5 measurements per 8-hour day) during the three-day operating test.

1) Electrical: Running amperes and voltage of each motor 3/4 horsepower or larger.

2) Air temperatures in each heated or air conditioned space and outdoor temperatures.

c. Instruments: Provide all instruments, materials and labor to perform the tests and to obtain and record the measurements specified herein, including the furnishing of all required record forms as approved by the Engineer. Submit for the Engineer's approval, complete shop drawings or catalog data for all instruments to be used for the three day operating test and obtain approval at least two weeks before the instruments will be required for test measurements.

d. Report: Submit four (4) copies of a written report of the three-day operating test on the approved Form of Record to the Engineer for approval and subsequent transmittal to the Owner.

3.11 MOTOR CONTROL

A. General: Provide each motor 1/8 horsepower or larger with a suitable controller and devices that will perform the functions as specified for the respective motors, together with manual reset thermal overload, protection in each undergrounded conductor. Provide the controller either integral with circuit protective device or mounted in separate enclosure. Starters shall be Allen-Bradley, G.E., Westinghouse, Square D or approved equal.

B. Control: Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motor directly, provided the device used is designated for that purpose and has an adequate horsepower rating. When automatic control device does not have such a rating, use a magnetic starter with the automatic control device actuating the pilot control circuit. When combination manual and automatic control is specified and the control device operates the motor directly, provide a manual motor starter and selector switch. When combination manual and automatic control is specified and the automatic control device actuates the pilot control circuit, a magnetic control device actuates the pilot control provided. Provide

all magnetic starters with push buttons or selector switches in the covers. Provide connections to the selector switch such that only the normal automatic regulating control devices will be bypassed when the switch is in the manual position. Connect all safety control devices, such as low or high pressure cutouts, high temperature cutouts and motor overload protective devices in the motor control circuit in both the manual and automatic positions of the selector switch control circuit. Make connections to any selector switch or to more than one (1) automatic regulatory control device in accordance with wiring diagrams recommended by the manufacturer and approved by the Engineer. Where required for manual control, provide push-button stations consisting of two (2) momentary contact operators, 600 volts, 10 amperes installed and wired for three wire control to provide under-voltage relays, auxiliary contacts or other devices required for a complete system.

C. Location: Where the controller is located within sight of the motor driven equipment (fifty feet or less), the controller and circuit protective device shall be capable of being locked in the open position. Where the controller is located out of sight of the motor driven equipment (more than fifty feet) provide a non-fused safety disconnect, suitable for the service, and which opens all ungrounded conductors simultaneously, at or on the motor driven equipment.

D. Enclosure: Enclosure to be general purpose, NEMA Type 1 unless noted otherwise (NEMA Type 1 gasketed). The circuit breaker shall be operable by hand from outside the enclosure and shall be so interlocked with the door or doors that it must be returned to the "OFF" position before the door can be opened.

E. Push-buttons: Provide maintained contact, standard duty type in a general purpose, NEMA Type 1 enclosure for surface mounting rated for 10 amperes continuous at 600 volts or less.

3.12 ACCESS PANELS

A. Provide access panels as required in all walls, ceilings and ductwork to service and have access to all valves, operating parts and duct mounted fire dampers. For all ceiling and wall access doors that are required in gypsum board and plaster, provide minimum 24" x 24", unless due to structural restraints the access door can be reduced to a minimum of 18" x18", Milcor type appropriate for the construction involved.

3.13 TEMPORARY HEATING AND COOLING

A. Permanent heating and cooling systems may be used to provide temporary heating and cooling to the building during construction, if the following requirements are met:

1. Provide filters in equipment filter racks.

2. Provide filter material at entrance to all return air ducts or over permanent return air grilles. All return air ductwork is to be protected from construction dust and debris. If return air duct work is not protected prior to equipment startup for temporary use, the Contractor will pay to have the entire ductwork system of the affected equipment thoroughly cleaned prior to Owner occupancy.

3. Contractor shall provide and pay for operation, maintenance, regular replacement of filters and worn or consumed parts.

4. Shall replace any equipment that is damaged during temporary usage with new equipment.

5. All warranty periods shall not begin until Certificate of Substantial Completion is issued.

6. Verify with engineer that the installation is ready and approved for operation.

B. Just prior to turning the building or portions of the building over to the Owner, Contractor will replace all filters on equipment used for temporary ventilation, heat or cooling during construction.

C. Do not turn water into the system until the systems have been thoroughly cleaned and approved by the Engineer.

3.14 FINALLY

A. It is the intention that this specification shall provide a complete installation except as herein before specifically excepted. All accessory construction and apparatus necessary or advantageous in the operation and testing of the work shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Stencils.

D. Pipe markers.

E. Ceiling tacks.

1.2 REFERENCE STANDARDS

1.3 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

D. Product Data: Provide manufacturers catalog literature for each product required.

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

F. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Air Handling Units: Nameplates.

B. Air Terminal Units: Tags.

C. Dampers: Ceiling tacks, where located above lay-in ceiling.

D. Ductwork: Stencilled painting.

E. Instrumentation: Tags.

F. Relays: Tags.

G. Small-sized Equipment: Tags.

H. Thermostats: Nameplates.

I. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving.
2. Kolbi Pipe Marker Co.
3. Seton Identification Products.
4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.
2. Letter Height: 1/2 inch.
3. Background Color: Black.
4. Plastic: Conform to ASTM D709.

2.3 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving.
2. Brady Corporation.
3. Kolbi Pipe Marker Co.
4. Seton Identification Products.
5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter.

C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

D. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame. Valve tag chart should should indicate valve size, valve model and valve location. Valve locations with tag numbers shall also be indicated on "as-built" drawings.

2.4 STENCILS

A. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. Seton Identification Products.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

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

1. 3/4 to 1-1/4 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 1/2 inch high letters.

2. 1-1/2 to 2 inch Outside Diameter of Insulation or Pipe: 8 inch long color field, 3/4 inch high letters.

3. 2-1/2 to 6 inch Outside Diameter of Insulation or Pipe: 12 inch long color field, 1-1/4 inch high letters.

4. 8 to 10 inch Outside Diameter of Insulation or Pipe: 24 inch long color field, 2-1/2 inch high letters.

5. Over 10 inch Outside Diameter of Insulation or Pipe: 32 inch long color field, 3-1/2 inch high letters.

6. Ductwork and Equipment: 2-1/2 inch high letters.

2.5 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation.

2. Kolbi Pipe Marker Co.

3. MIFAB.

4. Seton Identification Products.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Color: Conform to ASME A13.1.

C. 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.

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

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

F. Color code as follows:

1. Heating, Cooling, and Boiler Feedwater: Green with white letters.

2. Toxic and Corrosive Fluids: Orange with black letters.

2.6 CEILING TACKS

A. Manufacturers:

1. Marking Services Incorporated.

2. Seton.

3. Substitutions: See Section 23 01 00 - General HVAC Provisions.

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

C. Color code as follows:

1. Yellow - HVAC equipment.

2. Red - Fire dampers/smoke dampers.

3. Blue - Heating/cooling valves.

PART 3 EXECUTION

3.1 PREPARATION

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

B. Prepare surfaces in accordance with Section 09 91 00 for stencil painting.

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. 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.

F. Install ductwork with stencilled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

G. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1988, with 1997 Errata.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.3 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Submit to Architect.

2. Submit six weeks prior to starting the testing, adjusting, and balancing work.

3. Include certification that the plan developer has reviewed the contract documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.

4. Include at least the following in the plan:

    a. Preface: An explanation of the intended use of the control system.

    b. List of all air flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

    c. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

    d. Identification and types of measurement instruments to be used and their most recent calibration date.

    e. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

    f. Final test report forms to be used.

    g. Detailed step-by-step procedures for TAB work for each system and issue, including:

        1) Terminal flow calibration (for each terminal type).

        2) Diffuser proportioning.

        3) Branch/submain proportioning.

        4) Rechecking.

        5) Diversity issues.

    h. Expected problems and solutions, etc.

    i. Criteria for using air flow straighteners or relocating flow stations and sensors .

    j. Details of how TOTAL flow will be determined; for example:

        1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.

    k. Specific procedures that will ensure that air side is operating at the lowest possible pressures and methods to verify this.

l. Confirmation of understanding of the outside air ventilation criteria under all conditions.

m. Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).

n. Method of checking building static and exhaust fan and/or relief damper capacity.

o. Methods for making coil or other system plant capacity measurements, if specified.

p. Time schedule for TAB work to be done in phases (by floor, etc.).

q. Description of TAB work for areas to be built out later, if any.

r. Exhaust fan balancing and capacity verifications, including any required room pressure differentials.

s. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

t. Procedures for formal progress reports, including scope and frequency.

u. Procedures for formal deficiency reports, including scope, frequency and distribution.

D. Field Logs: Submit at least once a week to Construction Manager and Engineer. Field logs should be submitted with weekly progress reports and include a record of all discrepancies and issues encountered during the period covered.

E. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

F. Progress Reports.

G. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Submit to the Construction Manager, HVAC controls contractor, and Engineer within two weeks after completion of testing, adjusting, and balancing.

2. Revise TAB plan to reflect actual procedures and submit as part of final report.

3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

4. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

5. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

6. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

7. Units of Measure: Report data in I-P (inch-pound) units only.

8. Include the following on the title page of each report:

    a. Name of Testing, Adjusting, and Balancing Agency.

    b. Address of Testing, Adjusting, and Balancing Agency.

    c. Telephone number of Testing, Adjusting, and Balancing Agency.

    d. Project name.

    e. Project location.

    f. Project Architect.

    g. Project Engineer.

    h. Project Contractor.

    i. Project altitude.

    j. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC MN-1, AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.

4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.

5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.

D. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

2. Having minimum of two years documented experience.

3. Certified by one of the following agencies or methods:

a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.

b. NEBB, National Environmental Balancing Bureau: www.nebb.org.

c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.

d. Test and Balance under direct supervision of a Professional Engineer registered in the State of Arkansas.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

F. Acceptable TAB Agencies:

1. NEBB.

2. AABC.

3. SMACNA.

4. TABB.

5. Substitutions: Not permitted.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.

2. Temperature control systems are installed complete and operable.

3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place. If required, install temporary media in addition to final filters.

5. Duct systems are clean of debris.

6. Fans are rotating correctly.

7. Fire and volume dampers are in place and open.

8. Air coil fins are cleaned and combed.

9. Access doors are closed and duct end caps are in place.

10. Air outlets are installed and connected.

11. Duct system leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions. Since work will occur in phases, provide listing of system deficiencies for systems to be balanced during the specified phases.

3.3 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

C. Provide additional balancing devices as required.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply and outside air systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

3.5 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

H. Check and adjust systems approximately six months after final acceptance and submit report.

I. After all adjustments and corrections have been performed to balance system as designed, additional readjustment shall be performed to satisfy desired temperature.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities . Test and balance all air handlers for the three design positions i.e. minimum (5% adjustable) outside air, design outside air and economizer operation.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions.

L. Measure building static pressure and adjust supply, return, barometric relief dampers, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.

N. Measure and record supply, return, outside and exhaust air cfm, fan rpm, motor amps, coil entering and leaving air, temperatures (both wet and dry bulb temperatures), outside air (wet and dry bulb temperatures) for cooling and heating operations, system static pressures shall be measured at the required conditions at the minimum and maximum fan speeds.

O. Measure and record the following air handling and distribution systems.

1. Supply, return, outside air and exhaust when system is in the economizer operation. Measure and record supply air and outside air temperatures (both wet and dry bulb).

3.7 SCOPE

A. Test, adjust, and balance the following:

1. Forced Air Furnaces.
2. Dedicated Outside Air Units.
3. Air Cooled Refrigerant Condensers
4. Small Capacity Air Conditioning Units.
5. Fans.
6. Air Filters.
7. Air Terminal Units
8. Air Inlets and Outlets.

3.8 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer
2. Model/Frame
3. HP/BHP
4. Phase, voltage, amperage; nameplate, actual, no load
5. RPM
6. Service factor

7. Starter size, rating, heater elements

8. Sheave Make/Size/Bore

B. V-Belt Drives:

1. Identification/location

2. Required driven RPM

3. Driven sheave, diameter and RPM

4. Belt, size and quantity

5. Motor sheave diameter and RPM

6. Center to center distance, maximum, minimum, and actual

C. Combustion Equipment:

1. Model number

2. Serial number

3. Firing rate

4. Overfire draft

5. Gas meter timing dial size

6. Gas meter time per revolution

7. Gas pressure at meter outlet

8. Gas flow rate

9. Heat input

10. Burner manifold gas pressure

11. Percent carbon monoxide (CO)

12. Percent carbon dioxide (CO2)

13. Percent oxygen (O2)

14. Percent excess air

15. Flue gas temperature at outlet

16. Ambient temperature
17. Net stack temperature
18. Percent stack loss
19. Percent combustion efficiency
20. Heat output

D. Air Cooled Condensers:

1. Identification/number
2. Location
3. Manufacturer
4. Model number
5. Serial number
6. Entering DB air temperature, design and actual
7. Leaving DB air temperature, design and actual
8. Number of compressors

E. Air Moving Equipment:

1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Arrangement/Class/Discharge
6. Air flow, specified and actual
7. Return air flow, specified and actual
8. Outside air flow, specified and actual
9. Total static pressure (total external), specified and actual
10. Inlet pressure

11. Discharge pressure
12. Sheave Make/Size/Bore
13. Number of Belts/Make/Size
14. Fan RPM

F. Return Air/Outside Air:

1. Identification/location
2. Design air flow
3. Actual air flow
4. Design return air flow
5. Actual return air flow
6. Design outside air flow
7. Actual outside air flow
8. Return air temperature
9. Outside air temperature
10. Required mixed air temperature
11. Actual mixed air temperature
12. Design outside/return air ratio
13. Actual outside/return air ratio

G. Exhaust Fans:

1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Air flow, specified and actual
6. Total static pressure (total external), specified and actual

7. Inlet pressure
8. Discharge pressure
9. Sheave Make/Size/Bore
10. Number of Belts/Make/Size
11. Fan RPM

H. Duct Traverses:

1. System zone/branch
2. Duct size
3. Area
4. Design velocity
5. Design air flow
6. Test velocity
7. Test air flow
8. Duct static pressure
9. Air temperature
10. Air correction factor

I. Flow Measuring Stations:

1. Identification/number
2. Location
3. Size
4. Manufacturer
5. Model number
6. Serial number
7. Design Flow rate
8. Design pressure drop

9. Actual/final pressure drop
10. Actual/final flow rate
11. Station calibrated setting

J. Air Distribution Tests:

1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

B. Duct Liner.

C. Insulation jackets.

D. Adhesive, tie wires, tape

1.2 RELATED REQUIREMENTS

A. Section 23 01 00 - General HVAC Provisions.

B. Section 23 05 53 - Identification for HVAC Piping and Equipment.

C. Section 23 31 00 - Ducts: Glass fiber ducts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2025.

E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

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

C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than five years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with a minimum five years of documented experience and approved by manufacturer.

C. Perform work at ambient and equivalent temperatures as recommended by the adhesive manufacturer. Work shall be performed only by mechanics who regularly perform this type of work only.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period 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 E84, NFPA 255, or UL 723.

B. Adhesives to be waterproof.

C. Recovering jackets 6 ounce per square yard canvas attached with a lagging fire retardant adhesive. Install on exposed ductwork insulation. Cover thoroughly with several coats of sizing.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. Knauf Insulation.
2. Johns Manville Corporation.
3. Owens Corning Corp.
4. CertainTeed Corporation.
5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum Water Vapor Sorption: 5.0 percent by weight.
4. Maximum Moisture Absorption: 0.20 percent by volume.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E 96/E 96M.
3. Moisture Vapor Transmission: ASTM E 96; 0.02 perm.

4. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

F. Tie Wire: Annealed steel, 16 gage.

2.3 GLASS FIBER, RIGID

A. Manufacturer:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corp.

4. CertainTeed Corporation.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: ASTM C612; rigid, noncombustible blanket.

1. 'K' value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.

2. Maximum service temperature: 450 degrees F.

3. Maximum Water Vapor Sorption: 5.0 percent.

4. Maximum Moisture Absorption: 0.20 percent by volume.

5. Maximum Density: 8.0 lb/cu ft.

6. Density: 3.0 lb/cu ft.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.

2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E 96/E 96M.

3. Moisture vapor transmission: ASTM E 96; 0.04 perm.

4. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:

1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd weight, glass fabric.

2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.4 JACKETS

A. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Lagging Adhesive:

a. Compatible with insulation.

B. Mineral Fiber (Outdoor) Jacket: Asphalt impregnated and coated sheet, 50 lb/square.

C. Aluminum Jacket: ASTM B209 (ASTM B209M).

1. Thickness: 0.016 inch sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.5 DUCT LINER

A. Manufacturers:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corp.

4. CertainTeed Corporation.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions. .

B. Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; semi-rigid duct liner; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.

1. Fungi Resistance: ASTM G21.

2. Substitutions: See Section 23 01 00 - General HVAC Provisions.

3. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.

4. Service Temperature: Up to 250 degrees F.

5. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.

6. Minimum Noise Reduction Coefficients:

a. 1/2 inch Thickness: 0.30.

b. 1 inch Thickness: 0.45.

c. 1-1/2 inches Thickness: 0.60.

d. 2 inch Thickness: 0.70.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

D. Liner Fasteners: Galvanized steel, welded with press-on head.

2.6 MATERIALS

A. External Insulation

1. Exterior Duct:

2. Exterior Exposed Rectangular Ducts: Rigid glass fiber insulation, minimum installed R-value of R-8, with factory applied reinforced aluminum foil vapor barrier for systems conveying air at less than room temperature with alumaguard flexible weatherproof jacketing. Visible duct from ground locations shall be covered with an additional embossed aluminum exterior jacket.

3. Exposed Duct:

a. Exposed Rectangular Ducts: 1 1/2-inch expanded closed cell elastomeric insulation equal to Armstrong Armaflex, "K" valve at 75° F, 0.27 Btu/in/sq. ft./°F/hr.

4. Ductwork Located in Ventilated/Unvented Attic or Above Insulated Ceiling:

    a. Concealed Round and Rectangular Ducts: Flexible glass fiber insulation, minimum installed R-value of R-6, with factory applied reinforced aluminum foil vapor barrier for systems conveying air at less than room temperature. Round duct may be insulated with two wraps of flexible glass fiber insulation to obtain insulation value of R-6. Rectangular ducts may be internally lined with 1" duct liner and externally wrapped with one layer of flexible glass fiber insulation to obtain insulation value of R-6.

5. Ductwork Located below Unvented Roof Insulation or in Unconditioned Space:

    a. Concealed Round Ducts : Flexible glass fiber insulation, minimum installed R-value of R-3.5, with factory applied reinforced aluminum foil vapor barrier for systems conveying air at less than room temperature.

B. Internal Insulation

1. Ductwork Located in Ventilated/Unvented Attic or Above Insulated ceiling:

    a. Rectangular Ducts and Plenum Ducts Internal duct insulation shall be semi-rigid duct liner board manufactured from glass fibers bonded with a thermosetting resin. Insulation shall be coated on one side with a fire resistant black coating and shall have a minimum installed R-value of R-6. Duct liner shall be installed by cutting side pieces of insulation to lap both top and bottom sections for maximum support. Install side pieces first. Side pieces and bottom piece shall be attached with 4" strips of adhesive at one foot intervals. Top section of insulation shall be attached with Stick-Klip fasteners secured by Miracle adhesive spaced one fastener per two square feet of insulation. Edges of insulation shall be butted with adhesive to insure a tight joint and provide a smooth surface. Rectangular ducts may be internally lined with 1" duct liner and externally wrapped with one layer of flexible glass fiber insulation to obtain insulation value of R-6.

2. Ductwork Located below Unvented Roof Insulation or in Unconditioned Space:

    a. Rectangular Ducts and Plenum Ducts: Internal duct insulation shall be semi-rigid duct liner board manufactured from glass fibers bonded with a thermosetting resin. Insulation shall be coated on one side with a fire resistant black coating and shall have a minimum installed R-value of R-3.5. Duct liner shall be installed by cutting side pieces of insulation to lap both top and bottom sections for maximum support. Install side pieces first. Side pieces and bottom piece shall be attached with 4" strips of adhesive at one foot

intervals. Top section of insulation shall be attached with Stick-Klip fasteners secured by Miracle adhesive spaced one fastener per two square feet of insulation. Edges of insulation shall be butted with adhesive to insure a tight joint and provide a smooth surface.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

C. Finish with system at ambient conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.

2. Finish with tape and vapor barrier jacket.

3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.

2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Ducts Exposed in Mechanical Equipment Rooms or Finished Spaces : Finish with canvas jacket sized for finish painting.

F. Slope exterior ductwork to shed water.

G. Outdoor Exterior Applications: Provide insulation with vapor barrier jacket. Cover with embossed alumium jacket.

H. External Duct Insulation Application:

1. Secure insulation with vapor barrier with staples and seal jacket joints with vapor barrier adhesive or tape to match jacket.

2. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.

3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive or tape to match jacket.

4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

I. Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 100 percent coverage.

2. Secure insulation with welded mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible and NAIMA Fibrous Glass Duct Liner Standards (latest edition) for spacing.

3. Seal and smooth joints. Seal and coat transverse joints.

4. Seal liner surface penetrations with adhesive.

5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

A. Exhaust Ducts: Externally wrap with 2-inch thick flexible glass fiber insulation.

B. Outside Air Intake Ducts:

1. Round: Externally insulate with 2-inch thick flexible glass fiber insulation.

2. Rectangular: Internally insulate with 1-inch thick semi-rigid duct liner with adhesive and welded mechanical fasteners.

C. Plenums: Internally insulate with 1-inch thick semi-rigid duct liner with adhesive and welded mechanical fasteners.

D. Concealed Supply Ducts:

1. Round Ducts Duct: Externally insulate with 2-inch thick flexible glass fiber insulation.

2. Rectangular: Internally insulate with 1-inch thick semi-rigid duct liner, with adhesive and welded mechanical fasteners.

E. Concealed Return Air Ducts and Plenums:

1. Round: Externally insulate with 2-inch thick flexible glass fiber insulation.

2. Rectangular: Internally insulate with 1-inch thick semi-rigid duct liner, with adhesive and welded mechanical fasteners.

3. Plenums: Internally insulate with 1-inch thick semi-rigid duct liner with adhesive and welded mechanical fasteners.

F. Ducts Exposed to Outdoors:

1. Internally line all rectangular duct, seal and weatherproof all joints and seams. Minimum installed R-value of R-8.

END OF SECTION

SECTION 23 07 16

HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Equipment insulation.

B. Covering.

C. Breeching insulation.

1.2 RELATED REQUIREMENTS

A. Section 23 05 53 - Identification for HVAC Piping and Equipment.

B. Section 23 23 00 - Refrigerant Piping and Specialties: Placement of inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).

D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.

F. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.

G. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for equipment scheduled.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than five years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period 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 E84, NFPA 255, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturers:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corp.

4. CertainTeed Corporation.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: ASTM C553; flexible, noncombustible.

1. 'K' Value: 0.36 at 75 degrees F, when tested in accordance with ASTM C177 or ASTM C518.

2. Maximum Service Temperature: 450 degrees F.

3. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.

1. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E 96/E 96M.

2. Secure with self-sealing longitudinal laps and butt strips.

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 C195; hydraulic setting on mineral wool.

2.3 CELLULAR GLASS

A. Manufacturer:

1. Pittsburgh Corning Corporation.

2. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: ASTM C552, Grade 2.

1. 'K' Value: 0.41 at 100 degrees F.

2. Service Temperature: Up to 900 degrees F.

3. Water Vapor Permeability: 0.005 perm inch.

4. Water Absorption: 0.2 percent by volume, maximum.

5. Density: Minimum 6.80 lb/cu ft.

2.4 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:

1. Armacell International.

2. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 Grade 1, in sheet form.

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.

2.5 JACKETS

A. PVC Plastic:

1. Manufacturers:

a. Johns Manville Corporation.

b. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2. Jacket: Sheet material, off-white color.

a. Minimum Service Temperature: -40 degrees F.

b. Maximum Service Temperature: 150 degrees F.

c. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E 96/E 96M.

d. Thickness: 15 mil.

e. Connections: Pressure sensitive color matching vinyl tape.

3. Covering Adhesive Mastic:

a. Compatible with insulation.

B. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.

1. Thickness: 0.016 inch sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that equipment 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. Factory Insulated Equipment: Do not insulate.

C. Exposed Equipment: Locate insulation and cover seams in least visible locations.

D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.

F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.

G. Fiber glass insulated equipment containing fluids below ambient temperature: Provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.

H. Fiber glass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

I. Inserts and Shields:

1. Application: Equipment 1-1/2 inches diameter or larger.

2. Shields: Galvanized steel between hangers and inserts.

3. Insert location: Between support shield and equipment and under the finish jacket.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Finish insulation at supports, protrusions, and interruptions.

K. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.

L. Exterior Applications: Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal equipment.

M. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.

N. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

O. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

B. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2024).

D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2024).

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2025.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2025.

G. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.

H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

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

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

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

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of documented experience and approved by the manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

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 NFPA 255.

2.2 GLASS FIBER

A. Manufacturers:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corp.

4. CertainTeed Corporation.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: ASTM C547 ; rigid molded, noncombustible.

1. 'K' value: ASTM C177, 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; moisture vapor transmission when tested in accordance with ASTM E96/E96M 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 C195; 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.

H. Indoor Vapor Barrier Finish:

1. Cloth: Untreated; 9 oz/sq yd weight.

2. Vinyl emulsion type acrylic, compatible with insulation, white color.

I. Outdoor Vapor Barrier Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

J. Outdoor Breather Mastic:

1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

K. Insulating Cement:

1. ASTM C449/C449M.

2.3 POLYETHYLENE

A. Manufacturers:

1. Armacell International.

2. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.

1. 'K' value: ASTM C177; 0.25 at 75 degrees F.

2. Maximum Service Temperature: 200 degrees F.

3. Density: 2 lb/cu ft.

4. Maximum Moisture Absorption: 1.0 percent by volume.

5. Moisture Vapor Permeability: 0.05 perm inch, when tested in accordance with ASTM E96/E96M.

6. Connection: Contact adhesive.

2.4 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. Manufacturer:

1. Armacell International.

2. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534 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.

2.5 JACKETS

A. PVC Plastic.

1. Manufacturers:

a. Johns Manville Corporation.

b. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2. Jacket: One piece molded type fitting covers and sheet material, off-white color.

    a. Minimum Service Temperature: 0 degrees F.

    b. Maximum Service Temperature: 150 degrees F.

    c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.

    d. Thickness: 15 mil.

    e. Connections: Pressure sensitive color matching vinyl tape.

3. Covering Adhesive Mastic:

    a. Compatible with insulation.

B. Canvas Jacket: UL listed 6 oz/sq yd plain weave cotton fabric treated with dilute fire retardant lagging adhesive.

1. Lagging Adhesive:

    a. Compatible with insulation.

C. Aluminum Jacket: ASTM B209 (ASTM B209M) formed aluminum sheet.

1. Thickness: 0.016 inch sheet.

2. Finish: Embossed.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.

5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

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 glass cloth and vapor barrier adhesive or 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. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. 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 glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:

1. Application: Piping 1 inches diameter or larger.

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.

4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.

5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Section 07 84 13.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

L. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

M. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

N. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 SCHEDULE

A. Heating Systems:

1. Heating Water Supply and Return:

   a. Pipe Size Range: 2 inch and under: 1 inch thickness; glass fiber insulation.

   b. Pipe Size Range: 2-1/2 inch and larger: 1-1/2 inch thickness; glass fiber insulation.

2. Heating Water Supply and Return (Exposed in Mechanical Room): Fiber glass insulation with Red PVC Cover.

3. Heating Water Supply and Return (Concealed): Fiber glass insulation.

B. Cooling Systems:

1. Cooling Supply and Return (Exposed in Mechanical Room): Fiber glass insulation with Blue PVC Cover.

2. Cooling Supply and Return (Concealed): Fiber glass insulation.

3. Condensate Drains from Cooling Coils: 1/2 inch thickness; Flexible cellular insulation (interior drains only).

4. Refrigerant Suction: 3/4 inch thickness; Flexible cellular insulation.

5. Refrigerant Hot Gas: 3/4 inch thickness; Flexible cellular insulation.

6. Chemical Treatment Piping Exposed to Ambient Temperatures: Fiber glass insulation with PVC Jacket.

C. Other Systems:

1. Piping Exposed to Freezing with Heat Tracing: Fiber glass insulation with aluminum jacket.

END OF SECTION

SECTION 23 09 23

DDC CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. NOTE: HVAC DDC Controls are included in the specification for reference only. The HVAC controls system described in the specifications and on the drawings is to be provided by the owner under separate contract. The controls system will be bid directly to the owner at a date as specified elsewhere in this specification.

B. All labor, material, equipment and software not specifically referred to herein or on the plans, that are required to meet the functional intent of this specification, shall be provided without additional cost to the Owner. All programming, graphics, and devices shall become the sole property of the building owner.

C. Building Automation System (BAS), utilizing direct digital controls.

1.2 SYSTEM DESCRIPTION

A. Approved control system contractors:

1. Prime Buiding Solutions.

B. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Automation System (BAS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over the BACnet protocol.

1. The Facility Management and Control System (FMCS) shall be based on the Niagara 4 FrameworkTM , a framework technology developed by Tridium. Systems not utilizing the Niagara 4 FrameworkTM technology are not acceptable.

2. System architecture shall fully support third party systems via integration utilizing protocols including BACnet, LonTalk, and MODBUS.

3. System architecture shall provide secure Web-based access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.

4. The BAS server or system network controller shall host all graphic files for the control system.

5. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BAS.

1.3 SUBMITTALS

A. Submit under provisions of Division 01.

B. Submit in electronic format. Submittals shall be representative of the entire control system and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets. Provide BACnet Protocol Implementation Conformance (PICS) documentation for all DDC controllers upon Engineer request.

C. Product Data: Submit manufacturer's data sheets on each product to be used.

D. Control Drawings: Drawings shall contain complete wiring and schematic diagrams, sequences of operation, control system bus layout, material lists, and any other details required to demonstrate that the system has been coordinated and will properly function as a system.

E. Upon completion of the work, provide electronic 'as-built' drawings and other project-specific documentation.

F. Any deviations from these specifications or the work indicated on the drawings must be approved by the engineer and shall be clearly identified in the submittals and as-built documents.

1.4 QUALITY ASSURANCE

A. The Control System Contractor shall have a full service DDC office within 100 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.

B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary

business of design, installation and service of computerized building automation systems similar in size and complexity to the system specified.

C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

D. Factory Authorization: The Control System Contractor shall be a direct distributor and authorized agent of the primary controls line being installed (system network controllers, programmable equipment controllers, digital sensors, etc.)

1.5 DELIVERY, STORAGE AND HANDLING

A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. KMC Controls by Harrison Energy Partners

B. Substitutions: None

2.2 GENERAL

A. The Building Automation System (BAS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.

B. The installed system shall provide secure password access to all features, functions and data contained in the overall BAS.

2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing open protocols in one open, interoperable system.

B. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins.

2.4 BAS SUPERVISOR SERVER HARDWARE

A. The BAS shall include a Supervisory Server device as required to meet the design intention for BAS performance including proper alarm management, trending performance and long term storage, backup data base storage, reasonable system performance speeds, etc. If a BAS Supervisor is not provided, the Control System Contractor shall provide sufficient performance documentation to the Engineer of Record for review and approval before acceptance. This performance documentation must prove that the provided System Network Controller (SNC) utilized in lieu of the Supervisor Server meets the Minimum Computer Hardware Configuration requirements specified herein.

B. Minimum Computer Hardware Configuration

1. Processor: Intel Pentium N4200 1.1 GHz CPU
2. Memory: 4 GB LPDDR4 RAM
3. Operating System: Windows 10 IoT version (must be able to disable automatic updates)
4. Hard Drive: 64 GB Solid State Storage minimum, more recommended depending on archiving requirements. Minimum of 1 year of data storage.
5. Network Support: Dual Gb LAN ports
6. Connectivity: Full-time high-speed ISP connection shall be provided by the owner. Controls System Contractor shall offer remote connectivity via cellular service at an additional cost to the owner if needed.

C. Standard Client: The thin-client Web Browser BAS graphical user interface shall be Google Chrome or browser equivalent. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.5 SYSTEM NETWORK CONTROLLER (SNC)

A. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC), and integrated BACnet devices which are connected to its communications trunks. For sites utilizing a supervisory server, the SNC shall directly communicate with the BAS supervisor server. The SNC is also responsible to perform control and operating strategies for the system based on information from any controller connected to the BAS. The System Network Controller (SNC) shall be the Niagara JACE 8000 controller WITH AN OPEN NICS STATEMENT.

B. The controllers shall be capable of peer-to-peer communications with other SNC's and with any Operator Workstation (OWS) connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.

C. The SNC shall be capable of routing all BACnet ms/tp communications traffic. However, BACnet routers shall be installed to manage the ms/tp communications traffic. This requirement is enforced in order to minimize the workload of the SNC to ensure proper performance of the BAS.

D. The SNC shall be capable of executing application control programs to provide:

1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization.
6. Integration BACnet controller data.
7. Integration of LonWorks and MODBUS controller data via the use of additional drivers when required.
8. Network management functions for all SNC, PEC and ASC based devices.

E. The SNC shall provide the following hardware features as a minimum:

1. Two 10/100 Mbps Ethernet ports.
2. Two Isolated RS-485 ports with biasing switches.
3. 1 GB RAM
4. 4 GB Flash Total Storage / 2 GB User Storage
5. Wi-Fi (Client or WAP)
6. USB Flash Drive
7. High Speed Field Bus Expansion
8. Integrated 24 VAC/DC Global Power Supply
9. MicroSD Memory Card Employing Encrypted Safe Boot Technology

F. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.

G. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.

H. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.

1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:

a. Alarm.

b. Return to normal.

c. To default.

2. Alarms shall be annunciated in any of the following manners as defined by the user:

a. Screen message text.

b. Email of complete alarm message to multiple recipients.

c. Graphics with flashing alarm object(s).

I. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.

J. The SNC shall support the following security functions.

1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.

2. Role-Based Access Control (RBAC) for managing user roles and permissions.

3. Require users to use strong credentials.

4. Data in Motion and Sensitive Data at Rest be encrypted.

5. LDAP and Kerberos integration of access management.

K. The SNC shall be provided with a minimum 1 Year Software Maintenance license for system upgrades during the warranty period. Additional Software Maintenance

licenses shall be provided as needed to include system upgrades throughout the entire first year of system use. Labor to implement not included.

2.6 PROGRAMMABLE EQUIPMENT CONTROLLERS (PEC)

A. General: Controllers shall be responsible for monitoring and controlling directly connected HVAC equipment such as AHU's,, VAV Terminals, and Packaged Rooftop Dedicated Outdoor Air Units , and/or other building mechanical systems as required. Each controller shall be classified as a "native" BACnet device, supporting the BACnet Advanced Application Controllers (B-AAC) profile. Controllers that support a lesser profile such as B-ASC are not acceptable without written permission from the Engineer of Record. Controllers shall conform to the BACnet Advanced Application Controller (B-AAC) profile.

B. Software Specifications

1. General: The controller shall contain non-volatile memory to store both the resident operating system and application programming. Any program may affect the operation of any other program. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, extraction of the program for storage, routing communications, etc.

2. Automatic Restart after Power Failure: Upon restoration of power after an outage, the controller shall automatically and without human intervention update all monitored functions; resume operation based on current synchronized time and status, and implement special start-up strategies as required.

3. User Programming Language: The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and set points. Controllers shall be capable of utilizing both line code based programming and Graphical Function Block programming interfaces.

a. Programs shall be generated by an English-language based (line) editor or a Graphical Function Block interface.

b. The language shall be structured to allow for the easy configuration of control programs and mathematical calculations.

c. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.

d. Controllers that use non-editable factory programming only methods will not be accepted without written permission from the Engineer of Record.

4. Control Algorithms: The controller shall have the ability to perform the following control algorithms:

    a. Proportional, Integral plus Derivative Control (PID)

    b. Two Position Control

    c. Digital Filter

    d. Ratio Calculator

    e. Equipment Cycling Protection

5. Mathematical Functions: Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, trigonometric functions, Boolean logic statements, or combinations of all. The controllers shall be capable of performing complex logical statements including operators such as ???, ???, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators.

C. History Logging: Each controller shall be capable of locally logging any input, output, calculated value, etc. over user defined time intervals (1 second minimum time). Up to 128 values shall be stored in each log. Logged data shall be downloadable to the Supervisory Server or SNC for long term archiving based upon user-defined time intervals, COV notification or manual command.

D. Alarm Management: For each system point, alarms can be created based on high/low limits or conditional expressions. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided. If communication with the Operator Workstation is temporarily interrupted, the alarm will be time-stamped and buffered in the controller. When communications return, the alarm will be transmitted to the Supervisory Server or SNC.

E. Communications: The controllers shall be a native BACnet communications, available as EIA-485 (MS/TP) or Ethernet/IP physical connections as required. The controllers shall meet or exceed the specifications in the ANSI/ASHRAE BACnet Standard 135-2010 for BACnet Advanced Application.

1. MS/TP Devices: For devices with MS/TP connectivity, baud rates between 9600 and 115.2k baud shall be selectable. Segmentation shall be supported. Auto-baud functionality shall be supported.

2. Ethernet/IP Devices: For devices enabled with Ethernet/IP connectivity, the user shall be able to select BACnet 8802-3, BACnet IP, or BACnet Foreign Device. Segmentation shall be supported.

F. Firmware Upgrades: The controller firmware shall be upgradeable for updates as future enhancements and expanded functionality. Firmware updates shall be supported via BACnet communications (over-the-network). All programming and servicing software shall be commercially available to third parties.

G. Hardware Platform Features:

1. Processor: The controller shall employ at minimum a 32-bit microprocessor.

2. Memory: The operating system and the application programs for the controller shall be stored in non-volatile FLASH memory. The controller shall support up to 8 MB Flash memory and up to 2 MB of RAM. The controller shall include an on-board capacitor to back up the controller's RAM memory for a period of at least six hours. In the case of a power failure, the controller shall first try to restart from the RAM memory. If that memory is corrupted or unusable, then the controller shall restart itself from its application program stored in its FLASH memory.

3. Network Communication Ports: The controller shall have on-board, dual 10/100bT Ethernet port or an EIA-485 port. The dual Ethernet connections shall function as an Ethernet hub, allowing daisy-chained Ethernet topologies. The EIA-485 port shall have network protection bulbs and integrated end-of-line (EOL) terminations.

4. Inputs: The controller shall have on-board universal inputs with a minimum of 16-bit analog to digital conversion. Each universal input shall have over-voltage protection. Universal inputs shall have the following integrated, software selectable terminations: 1K pullup, 10K pullup, 0-12VDC, 0-20mA. Each universal input shall be software selectable as analog or binary. Manually set, hardware configuration jumpers shall not be necessary.

5. Outputs: The controller shall have on-board universal outputs with a 12-bit digital to analog conversion. Analog outputs shall be capable of sourcing 100 mA per channel and be short circuit protected. Each universal outputs shall be software selectable as analog or binary.

6. Terminal Block Connectors: The controller shall have removable screw terminal blocks that can accommodate wire sizes 14-22 AWG. Terminals shall be color coded for power, input and outputs, and communication.

7. Power Supply: The power supply for the controller shall be 24 volts AC (-15%, +20%) power. Voltage below the operating range of the system shall be considered an outage.

H. VAV Controller Specific Features:

1. Integrated Actuator: The controller shall have an integrated actuator with the following features:

   a. The actuator shall be rated at 40 inch-lbs.

   b. Connection to the damper shall be with a v-bolt clamp, accepting 3/8" to 5/8" damper shaft sizes.

   c. The actuator shall travel at a rate of 90 degrees per 90 seconds if supplied by 60 Hz power.

   d. The actuator shall have an integrated gear disengagement mechanism.

2. Integrated Pressure Sensor: The controller shall have an integrated pressure sensor for airflow measurement. The sensor shall have a range of 0-2"wc, accurate to 4.5% of reading.

3. Inputs: The controller shall have the following inputs:

   a. Inputs for room temperature and room setpoint from wall sensor.

   b. Additional universal inputs, software configurable as analog or binary.

   c. Actuator position feedback, via a potentiometer mechanically tied to the output coupler. Position information should be accurate even when the damper is moved manually (gear disengagement lever is depressed).

4. Outputs: The controller shall have the following outputs:

   a. Damper Actuator, Clockwise and Counter-clockwise

   b. Additional universal outputs, software configurable as analog or binary. Each output channel shall be capable of being manipulated individually, exclusive to any other output.

5. VAV Balancing: The VAV controller shall be capable of being balanced from the Digital Room Sensor without any specific pc-based software.

I. General Purpose Controller Specific Features:

1. Mounting: The controller shall be able to be mounted on standard DIN rail or to a panel using integrated mounting holes on 1" centers.

2. Inputs:

    a. Two dedicated inputs for room temperature and room setpoint from discrete wall sensor.

    b. Eight universal inputs, software configurable as analog or binary.

3. Outputs:

    a. Eight universal outputs, 0-12VDC software configurable as analog or binary. Each output shall be capable of supplying 100 mA with a limit of 300 mA for all universal outputs combined.

4. Modular Expandability: The controller shall allow expansion of the device Input and Output capacity via Expansion Modules, making it possible to add I/O as desired to meet the requirements for individual control applications.

2.7 DIGITAL ROOM SENSOR

A. General: The Digital Room Sensor shall provide the following types of functions and be field programmable:

1. Space condition measurements and indications, including temperature, humidity, local motion/occupancy, and CO2 as required by specific application.

2. User setpoint adjustments

3. Equipment status and mode indication

4. Outside air temperature indication

5. Capability to view the value of any input or output in the system

B. Temporary Network Interface: The Digital Room Sensor shall provide a Temporary Network Interface jack, field accessible without uninstalling the sensor, for connection to the BACnet MS/TP communication trunk to which the BACnet AAC is connected. The Digital Room Sensor, the connected controller, and all other devices on the BACnet network shall be accessible through the temporary communication jack.

C. Integrated Sensors: The Digital Room Sensor shall have integrated sensors for temperature, humidity, motion/occupancy, and CO2. The intent of this requirement is to minimize the number of physical devices installed in the zone. The Controls Contractor shall inform the Engineer or Record if multiple zone sensor devices will be

required for zone sensing of temperature, humidity, motion/occupancy, and CO2. The Engineer of Record will coordinate with the Architect for review/approval of the multiple zone sensors.

D. User Indicators: The Digital Room Sensor shall be capable of indicating the following at a minimum:

1. Fahrenheit, Celsius

2. CFM, LPS

3. Fan Status, Fan Speed (Low, Medium, High), Auto Fan, Heat Mode, Cool Mode, Auto Mode, Occupancy Mode, Override Mode

4. Outside Air Temperature, Part Per Million, % Relative Humidity, Time (AM/PM)

5. Rotational Values – Multiple values may be configured for display in the numeric display fields. If multiple values are configured, the display shall rotate through each point as a configurable rate.

E. User Set points: User/Occupant set points may be manipulated via the Digital Room Sensor. Single and/or multiple set points shall be supported and field configurable. Unique set point sequences shall be configurable and presented to the user based on a mode condition. Setpoint adjustment shall be capable of being locked out at the Digital Room Sensor. Setpoints shall be adjustable at the BAS when locked out locally.

F. Password Protection: The Digital Room Sensor shall have two levels of password protection: one level to protect user set point adjustment, and one level to protect configuration menu parameters. Passwords shall be at least 4 digits in length.

2.8 BACNET ROUTER

A. General: The BACnet router shall route BACnet traffic between BACnet networks, virtual and/or physical. The router shall be designed for both permanent installations as well as temporary use for BACnet device configuration and BACnet network troubleshooting.

B. Connections:

1. Power: The router shall be powered wither from 24VAC AC (-15%, +20%) or from USB. The 24VAC connections shall be a removable terminal block accepting 12 to 22 AWG wire.

2. USB: A micro USB connections shall be provided, supporting both temporary device power and device communications.

3. Network Communication Ports: The controller shall have an on-board, 10/100bT Ethernet port and an EIA-485 port. The EIA-485 port shall be optically isolated and have integrated end-of-line (EOL) terminations. The EIA-485 port shall be a removable terminal block accepting 12 to 22 AWG wire.

C. Configuration: The router shall be fully configured via integrated HTML5 based webpages, without the need for any specialized or PC based software. The router configuration may be exported to/imported from a local file via the configuration webpages.

D. Communications: The router shall be a native BACnet device, available as EIA-485 (MS/TP) or Ethernet/IP physical connections as required.

1. MSTP: MSTP network baud rates between shall be selectable between 9600 and 115.2k baud. Segmentation shall be supported.

2. Ethernet/IP: The following BACnet For devices enabled with Ethernet/IP connectivity, the user shall be able to select BACnet 8802-3, BACnet IP, BACnet BBMD, or BACnet Foreign Device. Segmentation shall be supported.

E. Firmware Upgrades: The router firmware shall be upgradeable for updates as future enhancements and expanded functionality. Firmware updates shall be supported via BACnet communications (over-the-network) and through the integrated configuration webpages.

2.9 DIRECT DIGITAL CONTROL SYSTEM HARDWARE

A. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 inch-lb torque per square foot of damper area. Damper actuators shall be capacitor-driven fail-safe or spring return failsafe where required on plans. Damper actuators shall have gear disengagement button, and adjustable mechanical end stop. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators. Belimo is basis of design.

B. Control Valves: Control valves shall be 2-way or 3-way pattern as shown and constructed for tight shutoff at the pump shut-off head or steam relief valve pressure. Control valves shall operate satisfactorily against system pressures and differentials.

Two-position valves shall be ' line' size. Proportional control valves shall be sized for a maximum pressure drop of 4.0 psi at rated flow (unless otherwise noted or scheduled on the drawings). Valves with sizes up to and including 2.5 inches shall be "screwed" configuration and 3 inches and larger valves shall be "flanged" configuration. Electrically-actuated control valves shall include capacitor-driven fail-safe or spring return failsafe actuators where required on plans and, when specified, shall be furnished with integral switches or positive feedback for indication of valve position. Belimo is basis of design.

C. Control Valve Actuators: Actuators for VAV terminal unit heating coils shall be "proportional" type. All actuators shall have inherent current limiting motor protection. Valve actuators shall be 24-volt, electronic type, modulating or two-position as required for the correct operating sequence. Modulating valves shall be positive positioning in response to the signal. All valve actuators shall be UL listed. Belimo is basis of design.

D. Only VAV terminal unit control valves and fan coil unit control valves shall allow for fail-in-place control valve actuators. All other hot water control valves shall be Normally-Open arrangement. Chilled water control valves shall be Normally-Closed arrangement.

E. Sensor Only Wall Mount Room Temperature sensors: Where shown on plans as sensor only, provide stainless steel flat plate temperature sensors. Flat Plate Sensors shall be Type III 10,000-ohm @ 77 degree thermistor type. These devices shall have an accuracy of -/+ 0.36 Degrees F.

F. Duct-mounted and Outside Air Temperature Sensors: Type III 10,000-ohm @ 77 degree thermistor temperature sensors with an accuracy of -/+ 0.5 degrees Fahrenheit over the entire range. Outside air sensors shall include an integral sun shield. Duct-mounted sensors shall have an insertion measuring probe of a length appropriate for the duct size, with a temperature range of -4 to 221 degrees Fahrenheit. The sensor shall include a utility box and a gasket to prevent air leakage and vibration noise. For all mixed air, preheat air, and other locations where air stratification might affect temperature readings, install bendable averaging duct sensors. Sensor element length shall be selected for sufficient coverage equal to one foot of sensor length for every two square feet or coverage area. These devices shall have accuracy of -/+ 0.5 degrees F over the entire range.

G. Humidity sensors shall be a CMOS chip sensor providing excellent linearity, sensitivity, and reliability, accuracy to plus or minus two percent (2%) over the 10 to 90% RH, 10 - 15 VDC input voltage, analog output (0 – 5 VDC output). Operating

range shall be 0 to 100% RH and 40 to 120 degrees Fahrenheit. Sensors shall be selected for wall, duct or outdoor type installation as appropriate.

H. Carbon Dioxide Sensors (CO2): NDIR (Non-Dispersive Infrared) sensor, single beam with a patented self-calibration algorithm. Five year calibration guarantee (in auto-calibration mode), in compliance with CA Title 24, Section 121(c). Sensor default range shall be 0 - 2000 PPM but configurable up to 7,500 PPM. Accuracy shall be plus or minus 75 PPM @ 1000PPM @ 72 Degrees Fahrenheit. Response shall be less than two minutes. Input voltage shall be 20 to 28 VAC or DC. Choice of field-adjustable analog current or voltage output signals (4–20 mA, 0–5 VDC, or 0–10 VDC), linearized over full range. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure.

I. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point.

J. Differential Analog (duct) Static Pressure Transmitters: Provide a pressure transmitter with switch-selectable pressure ranges (inches water column). Accuracy shall be plus or minus 1% of full scale range. Provide push button auto zero capability. Device shall have integral static pickup tube. Senva is basis of design.

K. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips or compression fittings.

L. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.

M. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. Indoor panels not subject to water damage shall be NEMA-1. Provide NEMA 3R panels for outdoor use or where subject to falling dirt, rain, sleet, snow, or external ice. In all cases where controls may be subject to windblown dust, splashing water, and hose-directed water, use NEMA-4 panels.

N. Pipe and Duct Temperature sensing elements: Type III 10,000 ohm thermistor encapsulated temperature sensors with an accuracy of -/+ 0.36 Degrees F. Their range shall be -4 to 221 degrees Fahrenheit. Thermal wells with heat conductive gel shall be included.

O. Low Air Temperature Sensors: Provide SPDT type switch, with 34 to 70 degrees Fahrenheit range, vapor-charged temperature sensor. KMC model CTE-3017, or approved equivalent.

P. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BAS via built-in interface card (BACnet) for information purposes. All control signals from VFD shall be controlled through direct, hardwired control signals (AO, BO, AI, BI).

Q. Relays: Start/stop relay model shall provide either momentary or maintained switching action as appropriate for the motor being started. All relays shall have indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.

R. Emergency Stop Switches: Provide toggle-type switch with normally-closed contact. Switch shall be labeled "EMERGENCY SHUTOFF".

S. Natural Gas Shutoff Valves: Provide 2-way normally closed operation Gas Shutoff Valve. Valve shall be 120V model with watertight enclosure. Size valve for line size installation. Basis of design is ASCO Series 8214.

T. Transducers: Differential pressure transducers shall be electronic with three output ranges: 4 to 20 mA, 0 to 5 VDC, and 0 to 10 VDC. Device shall have the following: push-button and remote zeroing terminal, uni-directional or bi-directional pressure-range selection switch, high/low port swap switch to solve incorrect plumbing for differential, normal or slow-surge damping switch to prevent false alarms and reduce noise and output polarity reverse switch so in reverse mode the analog output is maximum when the pressure differential is zero and decreases as pressure increases. Unit shall be designed to operate in the pressure ranges involved.

U. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 VA minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.

V. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.10 BAS SYSTEM WEB BROWSER GUI - SYSTEM OVERVIEW

A. The BAS Contractor shall provide system software based on thin-client architecture, designed around the open standards of web technology. The BAS Supervisory Server or SNC shall communicate using Ethernet and TCP. BAS shall be accessed using a web browser over Owner intranet and remotely over the Internet.

B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.

C. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:

1. Real time 'live' Graphic Programs.
2. Trending.
3. Scheduling.
4. Parameter change of properties.
5. Set point adjustments.
6. Consolidated system reports
7. Alarm / event information.
8. Configuration of operators.
9. Execution of global commands.

D. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:

1. Server/SNC Software, Database and Web Browser Graphical User Interface.

2. 1 Year Software Maintenance license. Labor to implement not included.

3. Embedded System Configuration Utilities for future modifications to the system and controllers.

4. Embedded Graphical Programming Tools.

5. Embedded Direct Digital Control software.

6. Embedded Application Software.

2.11 GRAPHICAL USER INTERFACE

A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application, and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.

B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.

C. Navigation: Navigation through the GUI shall be accomplished by selecting dynamic links to system graphics.

D. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic view to communicate information related to set points and comfort. Animated .gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:

1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24 bit True Color.

2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.

3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a

visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.

4. Mechanical Systems: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.

5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:

    a. Each building.

    b. Each floor and zone controlled.

    c. Each piece of equipment monitored or controlled including each terminal unit.

E. Hierarchical Schedules: An operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.

1. Schedules: Schedules shall comply with BACnet standards and shall allow events to be scheduled based on:

    a. Types of schedule shall be Normal, Holiday or Override.

    b. A specific date.

    c. A range of dates.

2. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.

F. Alarms: Alarms associated with a specific system or area shall be displayed in the 'Alarms' view. Alarms, and reporting actions shall have the following capabilities:

1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a URL link to the associated graphic for the selected system or area.

2. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.

3. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance.

4. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.

G. Trends: As system is engineered, all critical points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously.

1. Viewing Trends: The operator shall have the ability to view trends by using the BAS GUI. The system shall be able to simultaneously graphically display multiple trends per graph.

2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server or SNC. Trend data, including run time hours and start time date shall be retained in non-volatile module memory.

3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval.

4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.

H. Security Access: Systems that Security access from the web browser GUI to BAS server or SNC shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:

1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of ' easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.

    a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.

    b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.

    c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.

2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

PART 3 EXECUTION

3.1 GENERAL

A. Install system and materials in accordance with manufacturer's instructions and as detailed on the project drawing set.

B. Low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.

C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.

D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.2 WIRING

A. All low voltage electrical control wiring to the control panels shall be the responsibility of the Control System Contractor unless noted otherwise on plans.

B. All wiring shall be in accordance with the Project Electrical Specifications (Division 26), the National Electrical Code and any applicable local codes.

C. Wiring in concealed and accessible areas can be installed without raceway using plenum rated cable.

D. Non-concealed cable and cable where subject to physical damage shall be installed in EMT conduit.

E. Where these wiring requirements deviate from the Division 26 specifications, the more stringent of the two requirements is to be followed.

3.3 ACCEPTANCE TESTING

A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

B. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative or Engineer of Record. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.4 OPERATOR TRAINING

A. The Control System Contractor shall provide one day of comprehensive training for the Owner’s representative to enable proficient operation of the system. Training shall be provided after final commissioning of the project.

3.5 TEST AND BALANCE ASSISTANCE

A. The Control System Contractor shall provide up to 4 hours of training to the test and balance contractor on the use of test and balancing tool – provided by the Control System Contractor for adjusting of system setpoints needed to balance the system. If no tool is available, the Control System Contractor shall provide up to 24 hours of assistance to the test and balance contractor.

3.6 COMMISSIONING AGENT ASSISTANCE

A. The Control System Contractor shall provide up to 40 hours of assistance to the Commissioning Agent during final commissioning inspection. If additional hours are necessary, the Control System Contractor shall provide an hourly labor rate to the Commissioning Agent for the purchase of additional assistance labor hours as necessary for the completion of the commissioning process.

B. The Control System Contractor shall not make changes to the final control system design or sequence of operations without written approval from the Engineer of Record. Any proposed changes to the control system design shall be prepared and submitted in writing by the Commissioning Agent.

3.7 WARRANTY PERIOD SERVICES

A. Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance. Within this period, upon notice by the Owner, any defects in the BAS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.

3.8 WARRANTY ACCESS

A. The Owner shall grant to the Control System Contractor reasonable access to the BAS during the warranty period. Remote access to the BAS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.9 OPERATION & MAINTENANCE MANUALS

A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:

1. As-built control drawings.

2. General description and specifications for all components.

END OF SECTION

SECTION 23 21 13

HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heating water piping, above grade.

B. Pipe and pipe fittings for:

1. Equipment drains and overflows.

C. Pipe hangers and supports.

D. Unions, flanges, mechanical couplings, and dielectric connections.

E. Valves:

1. Gate valves.

2. Globe or angle valves.

3. Ball valves.

4. Plug valves.

5. Butterfly valves.

6. Check valves.

F. Flow controls.

1.2 RELATED REQUIREMENTS

A. Section 23 05 53 - Identification for HVAC Piping and Equipment.

B. Section 23 07 19 - HVAC Piping Insulation.

C. Section 23 21 14 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.

C. ASME B31.9 - Building Services Piping; 2025.

D. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2014.

F. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

G. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2025a.

H. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2024.

I. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020 (Reapproved 2024).

J. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2024).

K. AWWA C606 - Grooved and Shouldered Joints; 2022.

L. AWWA C606 - Standard Specification for Grooved and Shouldered Joints; American Water Works Association; 2006.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

C. Welders Certificate: Include welders certification of compliance with ASME (BPV IX).

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

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

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum five years of experience, documented.

C. Welder Qualifications: Certify in accordance with ASME (BPV IX).

1.6 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. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

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

1.7 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.

2. Use non-conducting dielectric connections whenever jointing dissimilar metals.

3. Grooved mechanical joints may be used in accessible locations only.

a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.

b. Use rigid joints unless otherwise indicated.

4. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:

1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch ball valves with cap; pipe to nearest floor drain.

2. For throttling, bypass, or manual flow control services, use globe valves.

3. For shut-off and to isolate parts of systems or vertical risers, use ball valves.

E. Welding Materials and Procedures: Conform to ASME (BPV IX).

2.2 HEATING WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:

1. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.

2.3 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Conform to ASME B31.9.

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

D. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

E. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

F. Hangers for Hot Pipe Sizes 6 Inches and Over: Adjustable steel yoke, cast iron roll, double hanger.

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

H. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 Inches and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

I. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

J. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

K. Wall Support for Hot Pipe Sizes 6 Inches and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

L. Vertical Support: Steel riser clamp.

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

N. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

O. Floor Support for Hot Pipe Sizes 6 Inches and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

P. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

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

R. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

S. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.4 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Under:

1. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.

2. Copper Piping: Bronze.

3. Gaskets: 1/16 inch thick preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.

2. Mechanical Couplings: Comply with ASTM F1476.

3. Housing Material: Malleable iron or ductile iron, galvanized.

4. Gasket Material: EPDM suitable for operating temperature range from -30 degrees F to 230 degrees F.

5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.

6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

D. Dielectric Connections: Union or waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, end types to match pipe joint types used.

2.5 GATE VALVES

A. Manufacturers:

1. Tyco Flow Control.

2. Conbraco Industries.

3. Nibco, Inc.

4. Milwaukee Valve Company.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Up To and Including 2 Inches:

1. Bronze body, bronze trim, screwed or union bonnet, rising stem, handwheel, inside screw with backseating stem, solid wedge disc, alloy seat rings, solder or threaded ends.

C. Over 2 Inches:

1. Iron body, bronze trim, bolted bonnet, non-rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends.

2.6 GLOBE OR ANGLE VALVES

A. Manufacturers:

1. Tyco Flow Control.

2. Conbraco Industries.

3. Nibco, Inc.

4. Milwaukee Valve Company.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Up To and Including 2 Inches:

1. Bronze body, bronze trim, screwed or union bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, solder or threaded ends.

C. Over 2 Inches:

1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.7 FULL PORT BALL VALVES

A. Manufacturers:

1. Tyco Flow Control.

2. Conbraco Industries.

3. Nibco, Inc.

4. Milwaukee Valve Company

5. Victaulic Company.

6. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Up To and Including 2 Inches:

1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

C. Over 2 Inches:

1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.8 PLUG VALVES

A. Manufacturers:

1. Conbraco Industries.

2. Nibco, Inc.

3. Milwaukee Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Up To and Including 2 Inches:

1. Bronze body, bronze tapered plug, full port opening, non-lubricated, teflon packing, threaded ends.

2. Operator: One plug valve wrench for every ten plug valves minimum of one.

C. Over 2 Inches:

1. Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.

2. Operator: Each plug valve with a wrench with set screw.

2.9 BUTTERFLY VALVES

A. Manufacturers:

1. Tyco Flow Control.

2. Hammond Valve.

3. Crane Co.

4. Milwaukee Valve Company.

5. Victaulic Company.

B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM enscapsulation, Buna-N enscapsulation, or _____.

1. Substitutions: See Section 23 01 00 - General HVAC Provisions.

C. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

D. Disc: Stainless steel.

E. Operator: 10 position lever handle.

2.10 SWING CHECK VALVES

A. Manufacturers:

1. Tyco Flow Control.

2. Hammond Valve.

3. Nibco, Inc.

4. Milwaukee Valve Company

5. Victaulic Company.

6. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Up To and Including 2 Inches:

1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

C. Over 2 Inches:

1. Iron body, bronze or _____ trim, stainless steel, bronze, bronze faced rotating, or _____ swing disc, renewable disc and seat, flanged, grooved, or _____ ends.

2. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.11 SPRING LOADED CHECK VALVES

A. Manufacturers:

1. Tyco Flow Control.

2. Hammond Valve.

3. Crane Co.

4. Milwaukee Valve Company.

5. Victaulic Company.

6. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.12 AUTOMATIC FLOW CONTROLS

A. Manufacturers:

1. Tyco Flow Control.

2. ITT Bell & Gossett.

3. Griswold Controls.

4. Taco, Inc.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Construction: Class 125, Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet , blowdown/backflush drain.

C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi psi.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

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

D. Prepare piping connections to equipment using jointing system specified.

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

F. After completion, fill, clean, and treat systems. Refer to Section 23 25 00 for additional requirements.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install chilled water piping to ASME B31.5 requirements.

C. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

D. Route piping in orderly manner, parallel to building structure, and maintain gradient.

E. Install piping to conserve building space and to avoid interfere with use of space.

F. Group piping whenever practical at common elevations.

G. Sleeve pipe passing through partitions, walls and floors.

H. Slope piping and arrange to drain at low points.

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

J. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

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

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

K. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.

2. Support horizontal piping as scheduled.

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

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

L. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

M. Provide access where valves and fittings are not exposed.

N. Use eccentric reducers to maintain top of pipe level.

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

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

3.3 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. 1 inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.

3. 1-1/2 inch and 2 inch: Maximum span, 8 feet; minimum rod size, 1/4 inch.

4. 2-1/2 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.

5. 3 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.

6. 4 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.

7. 6 inch: Maximum span, 8 feet; minimum rod size, 3/8 inch.

8. 8 inch: Maximum span, 10 feet; minimum rod size, 1/2 inch.

9. 10 inch: Maximum span, 10 feet; minimum rod size, 1/2 inch.

10. 12 inch: Maximum span, 10 feet; minimum rod size, 1/2 inch.

B. Hanger Spacing for Steel Piping.

1. 1/2 inch, 3/4 inch, and 1 inch: Maximum span, 8 feet; minimum rod size, 1/4 inch.
2. 1-1/4 inches: Maximum span, 8 feet; minimum rod size, 1/4 inch.
3. 1-1/2 inches: Maximum span, 8 feet; minimum rod size, 1/4 inch.
4. 2 inches: Maximum span, 8 feet; minimum rod size, 1/4 inch.
5. 2-1/2 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 3 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
7. 4 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
8. 6 inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.
9. 8 inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.
10. 10 inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.
11. 12 inches: Maximum span, 10 feet; minimum rod size, 1/2 inch.

C. Hanger Spacing for Plastic Piping.

1. 1/2 inch: Maximum span, 42 inches; minimum rod size, 1/4 inch.
2. 3/4 inch: Maximum span, 45 inches; minimum rod size, 1/4 inch.
3. 1 inch: Maximum span, 51 inches; minimum rod size, 1/4 inch.
4. 1-1/4 inches: Maximum span, 57 inches; minimum rod size, 3/8 inch.
5. 1-1/2 inches: Maximum span, 63 inches; minimum rod size, 3/8 inch.
6. 2 inches: Maximum span, 69 inches; minimum rod size, 3/8 inch.
7. 3 inches: Maximum span, 7 feet; minimum rod size, 3/8 inch.
8. 4 inches: Maximum span, 8 feet; minimum rod size, 1/2 inch.

END OF SECTION

SECTION 23 21 14

HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air vents.

B. Strainers.

C. Suction diffusers.

D. Pump connectors.

E. Combination pump discharge valves.

1.2 RELATED REQUIREMENTS

A. Section 23 21 13 - Hydronic Piping.

1.3 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Certificates: Inspection certificates for pressure vessels from authority having jurisdiction.

D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

E. Project Record Documents: Record actual locations of flow controls and flow meters.

F. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

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

1.6 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. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

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

PART 2 PRODUCTS

2.1 AIR VENTS

A. Manufacturers:

1. Armstrong International, Inc.

2. ITT Bell & Gossett.

3. Taco, Inc.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

C. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

D. Washer Type:

1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

E. Maximum Fluid Pressure: 150 psi.

F. Maximum Fluid Temperature: 250 degrees F.

2.2 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc.

2. Green Country Filtration.

3. WEAMCO.

4. Keckley.

5. Bell & Gossett.

6. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

2.3 SUCTION DIFFUSERS

A. Manufacturers:

1. ITT Bell & Gossett.

2. Taco.

3. Armstrong.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

2.4 PUMP CONNECTORS

A. Manufacturers:

1. The Metraflex Company.

2. Flex-Hose Saver.

3. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.

1. Maximum Operating Service: 150 psi at 120 degrees F.

2. Accommodate the Following:

a. Axial Deflection in Compression and Expansion: _____ inch.

b. Lateral Movement: _____ inch.

c. Angular Rotation: 15 degrees.

d. Force developed by 1.5 times specified maximum allowable operating pressure.

3. End Connections: Same as specified for pipe jointing.

4. Provide pump connector with integral vanes to reduce turbulent flow.

5. Provide necessary accessories including, but not limited to, limit stops, internal guides, control rods, and control cables.

2.5 COMBINATION PUMP DISCHARGE VALVES

A. Manufacturers:

1. Crane Co.

2. ITT Bell & Gossett.

3. Armstrong.

4. Taco, Inc.

5. Victaulic Company of America.

6. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

PART 3 EXECUTION

3.1 INSTALLATION

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

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide automatic air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain. Install vents in locations where vent tubing can be routed to a drain.

E. Provide valved drain and hose connection on strainer blow down connection.

F. Provide pump suction fitting on suction side of base mounted centrifugal pumps . Remove temporary strainers after cleaning systems.

G. Provide combination pump discharge valve on discharge side of base mounted centrifugal pumps .

H. Support pump fittings with floor mounted pipe and flange supports.

I. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING AND SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Strainers.

F. Check valves.

G. Filter-driers.

H. Solenoid valves.

I. Expansion valves.

1.2 RELATED REQUIREMENTS

A. Section 23 54 00 - Furnaces.

B. Section 23 63 13 - Air Cooled Refrigerant Condensers.

C. Section 23 81 27 - Small Split-System Heating and Cooling.

D. Division 26 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 710 - Performance Rating of Liquid-Line Driers; 2009.

B. AHRI 750 - Thermostatic Refrigerant Expansion Valves; 2007.

C. AHRI 760 - Performance Rating of Solenoid Valves for Use With Volatile Refrigerants; 2007.

D. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

E. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024, with Addendum (2025).

F. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2025, with Errata .

G. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2025, with Errata.

H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2024.

I. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.

J. ASME B31.9 - Building Services Piping; 2025.

K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.

L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2013.

M. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

C. Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.

D. Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

E. Test Reports: Indicate results of leak test, acid test.

F. Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.

G. Submit welders certification of compliance with ASME BPVC-IX.

H. Project Record Documents: Record exact locations of equipment and refrigeration accessories on record drawings.

I. Maintenance Data: Include instructions for changing cartridges, assembly views, spare parts lists.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

B. Design piping system under direct supervision of a licensed hvac company experienced in design of this type of work and licensed in the state where the Project is located.

1.6 REGULATORY REQUIREMENTS

A. Conform to ASME B31.9 for installation of piping system.

B. Welding Materials and Procedures: Conform to ASME (BPV IX) .

C. Welders Certification: In accordance with ASME (BPV IX).

D. Products Requiring Electrical Connection: Listed and classified by UL, as suitable for the purpose indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.

C. Liquid Indicators:

1. Use line size liquid indicators in main liquid line leaving condenser.
2. If receiver is provided, install in liquid line leaving receiver.
3. Use line size on leaving side of liquid solenoid valves.

D. Valves:

1. Use service valves on suction and discharge of compressors.
2. Use gage taps at compressor inlet and outlet.
3. Use gage taps at hot gas bypass regulators, inlet and outlet.
4. Use check valves on compressor discharge.
5. Use check valves on condenser liquid lines on multiple condenser systems.

E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.

F. Strainers:

1. Use line size strainer upstream of each automatic valve.
2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
3. On steel piping systems, use strainer in suction line.
4. Use shut-off valve on each side of strainer.

G. Filter-Driers:

1. Use a filter-drier on suction line just ahead of compressor.
2. Use sealed filter-driers in lines smaller than 1/2 inch outside diameter.
3. Use sealed filter-driers in low temperature systems.
4. Use sealed filter-driers in systems utilizing hermetic compressors.
5. Use replaceable core filter-driers in lines of 3/4 inch outside diameter or greater.
6. Use filter-driers for each solenoid valve.

H. Solenoid Valves:

1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.

2. Use in liquid line of single or multiple evaporator systems.

3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.

I. Receivers:

1. Use on systems with long piping runs.

2.2 PIPING

A. Copper Tube to 7/8 inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.

1. Fittings: ASME B16.26 cast copper.

2. Joints: Flared.

B. Pipe Supports and Anchors:

1. Conform to ASME B31.5.

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

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers 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.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

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

11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.3 REFRIGERANT

A. Refrigerant: As defined in ASHRAE Std 34.

1. R-32.

2. R-454B.

2.4 MOISTURE AND LIQUID INDICATORS

A. Manufacturers:

1. Henry Technologies.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 460 psi.

2.5 VALVES

A. Manufacturers:

1. Hansen Technologies Corporation.

2. Henry Technologies.

3. Danfoss Automatic Controls.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, solder or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Packed Angle Valves:

1. Forged brass , forged brass seal caps with copper gasket, rising stem and seat , molded stem packing, solder or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

D. Ball Valves:

1. Two piece forged brass body with teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 325 degrees F.

E. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi.

2.6 STRAINERS

A. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

B. Straight Line, Non-Cleanable Type:

1. Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure of 500 psi.

2.7 CHECK VALVES

A. Manufacturers:

1. Hansen Technologies Corporation.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Globe Type:

1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

C. Straight Through Type:

1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 250 degrees F.

2.8 FILTER-DRIERS

A. Manufacturers:

1. Flow Controls Division Emerson Electric Co.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Performance:

1. Flow Capacity - Liquid Line: As indicated in schedule, minimum, rated in accordance with AHRI 710.

2. Flow Capacity - Suction Line: As indicated in schedule, minimum, rated in accordance with AHRI 730 (I-P).

3. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.

4. Design Working Pressure: 500 psi, minimum.

C. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, and filtration to 40 microns; of construction that will not pass into refrigerant lines.

D. Construction: UL listed.

1. Replaceable Core Type: Steel shell with removable cap.

2. Sealed Type: Copper shell.

3. Connections: As specified for applicable pipe type.

2.9 SOLENOID VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Valve: AHRI 760, pilot operated, copper or brass body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi.

C. Coil Assembly: UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box.

2.10 EXPANSION VALVES

A. Manufacturers:

1. Flow Controls Division of Emerson Electric.

2. Parker Hannifin/Refrigeration and Air Conditioning.

3. Sporlan Valve Company.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, mechanical pressure limit (maximum operating pressure MOP feature), adjustable superheat setting, replaceable inlet strainer, with replaceable capillary tube and remote sensing bulb.

C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

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

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

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.

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

F. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

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

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

G. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.

2. Support horizontal piping as scheduled.

3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

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

5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

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

H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

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

J. Provide access to concealed valves and fittings.

K. Flood piping system with nitrogen when brazing.

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

M. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting.

N. Insulate piping and equipment; refer to Section and Section 23 07 16.

O. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

P. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

T. Fully charge completed system with refrigerant after testing.

U. Provide electrical connection to solenoid valves. Refer to Division 26.

3.3 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using electronic leak detector. Test to no leakage.

3.4 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.
7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.
8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.
9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

END OF SECTION

SECTION 23 31 00

DUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Duct cleaning.

1.2 RELATED REQUIREMENTS

A. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

B. Section 23 33 00 - Duct Accessories.

C. Section 23 33 30 - Air Duct Sealants.

D. Section 23 37 00 - Air Outlets and Inlets.

E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.3 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2015b.

D. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2015.

E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2025.

G. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

H. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2026.

J. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).

K. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

L. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).

M. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

N. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

O. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012, 2nd Edition.

P. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

Q. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.4 DEFINITIONS

A. Duct Sizes: Duct sizes indicated on drawings are inside clear dimensions.

B. Low Pressure: Static pressure in duct less than 1" WG and velocities less than 2000 fpm (10 meters/second).

C. Medium Pressure: Static pressure between 1 and 6 inches WG and velocities between 1500 and 3000 fpm.

1.5 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data for duct materials, duct liner, and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.

E. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

F. Confirm ductwork has been fabricated and installed in accordance with recommendations and SMACNA standards.

1.6 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.7 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96, standards.

1.8 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

C. Stainless Steel for Ducts: ASTM A 240/A 240M, Type 316.

D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.

2. VOC Content: Not more than 250 g/L, excluding water.

3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.

4. For Use With Flexible Ducts: UL labeled.

5. Products:

a. Seal all joints and seams on sheet metal supply, return, makeup air and exhaust ductwork with "Hardcast" type DT sealing tape and type FTA adhesive or "Hardcast" iron grip 601 duct sealant installed in strict accordance with manufacturer's instructions. Clean all dirt, oil, moisture, etc., before applying adhesive. Duct tape, UL listed or not, is not acceptable.

b. Substitutions: See Section 23 01 00 - General HVAC Provisions.

E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

F. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.

2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.

3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.

4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

5. Other Types: As required.

2.2 DUCT ASSEMBLIES

A. All Ducts: Galvanized steel, unless otherwise indicated.

B. Low Pressure Supply (Heating Systems): 1 inch w.g. pressure class, galvanized steel.

C. Medium and High Pressure Supply: 3 inch w.g. pressure class, galvanized steel.

D. Return and Relief: 1 inch w.g. pressure class, galvanized steel.

E. General Exhaust: 1 inch w.g. pressure class, galvanized steel.

F. Outside Air Intake: 1 inch w.g. pressure class, galvanized steel.

G. Combustion Air: 1 inch w.g. pressure class, galvanized steel.

2.3 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Provide air foil turning vanes when rectangular elbows must be used.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Fabricate continuously welded round duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

G. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. Lap metal duct in direction of air flow. Hammer down edges and slips to leave smooth duct interior.

I. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide duct transition to louver area. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

J. Size round ducts installed in place of rectangular ducts from ASHRAE Table of Equivalent Rectangular and Round Ducts. No variation of duct configuration or sizes permitted except by written permission.

K. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so as not to breathe, rattle, vibrate or sag. Caulk duct joints and connections with sealant as ducts are being assembled.

2.4 MANUFACTURED DUCTWORK AND FITTINGS

A. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.

1. Insulation: Fiberglass insulation with aluminized fiberglass scrim vapor barrier film.

2. Pressure Rating: 6 inches WG positive and 1.0 inches WG negative.

3. Maximum Velocity: 5000 fpm.

4. Temperature Range: -10 degrees F to 160 degrees F.

5. R-6.0 Formaldehyde free insulation.

6. UL -181 (UL listed).

7. Manufacturers:

a. Hart & Cooley.

b. Flex Master.

c. Substitutions: See Section 23 01 00 - General HVAC Provisions.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install in accordance with manufacturer's instructions.

C. Comply with safety standards NFPA 90A and NFPA 90B.

D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

F. Flexible Ducts: Connect to metal ducts with draw bands.

G. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

H. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

J. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

K. Use double nuts and lock washers on threaded rod supports.

L. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.

M. Connect flexible ducts to metal ducts per manufacturer's recommendations.

N. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

O. Louver Fit-out:

1. Provide blank-out panels sealing available area of wall-mounted exterior-faced louver when connected ductwork is smaller than actual louver free area, and duct outlet is smaller than the louver frame.

2. Use the same duct material painted black on the exterior side, then seal louver frame and duct.

P. Duct Insulation: Provide duct insulation in compliance with Section 23 07 13.

Q. All round and rectangular duct installed in exposed areas shall be paint lock duct.

3.2 CLEANING

A. If determined by the Architect and/or Engineer, that during construction the duct systems were not adequately protected and dirt/debris was allowed to enter the installed ductwork, then it will be required by the HVAC contractor for the duct system to be cleaned. If required, clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

SECTION 23 33 00

DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Backdraft dampers - metal.

C. Duct access doors.

D. Duct test holes.

E. Fire dampers.

F. Flexible duct connections.

G. Volume control dampers.

1.2 RELATED REQUIREMENTS

A. Section 23 31 00 - Ducts.

B. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

C. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Project Record Drawings: Record actual locations of access doors, volume dampers, test holes, and fire dampers.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fusible Links: Two of each type and size.

1.5 QUALITY ASSURANCE

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

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:

1. Krueger.

2. PCI Industries, Inc; Pottorff Brand.

3. Ruskin Company.

4. Titus.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

C. Multi-blade device with radius blades attached to pivoting frame and bracket, steel or aluminum construction, with worm drive mechanism with removable key operator.

2.2 BACKDRAFT DAMPERS - METAL

A. Manufacturers:

1. Louvers & Dampers, Inc.

2. Nailor Industries Inc.

3. PCI Industries, Inc; Pottorff Brand.

4. Ruskin Company.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Gravity Backdraft Dampers, Size 18 x 18 inches or Smaller, Furnished with Air Moving Equipment: Air moving equipment manufacturer's standard construction.

C. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.

2.3 DUCT ACCESS DOORS

A. Manufacturers:

1. Nailor Industries Inc.

2. Ruskin Company.

3. Greenheck Fan Corporation.

4. SEMCO Incorporated.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.

1. Less Than 12 inches Square: Secure with sash locks.

2. Up to 18 inches Square: Provide two hinges and two sash locks.

3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.

4. Larger Sizes: Provide an additional hinge.

D. Access doors with sheet metal screw fasteners are not acceptable.

2.4 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.5 FIRE DAMPERS

A. Manufacturers:

1. Louvers & Dampers, Inc.
2. Nailor Industries Inc.
3. Ruskin Company.
4. Greenheck Fan Corporation.
5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.

C. Ceiling Dampers: Galvanized steel, 22 gage frame and 16 gage flap, two layers 0.125 inch ceramic fiber on top side and one layer on bottom side for round flaps, with locking clip.

D. Horizontal Dampers: Galvanized steel, 22 gage frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

E. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1.0 inch pressure class ducts up to 12 inches in height.

F. Multiple Blade Dampers: 16 gage galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

G. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide dynamic style dampers with stainless steel closure springs and latches for closure under air flow conditions. Configure with blades out of air stream.

H. Fusible Links: UL 33, separate at 160 degrees F with adjustable link straps for combination fire/balancing dampers.

2.6 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. Connector: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.

    a. Net Fabric Width: Approximately 3 inches wide.

2. Metal: 3 inches wide, 24 gage thick galvanized steel.

2.7 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Louvers & Dampers, Inc.

2. Nailor Industries Inc.

3. Ruskin Company.

4. Greenheck Fan Company.

5. Jer-Air Manufacturing.

6. United Enertech.

7. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

1. Fabricate for duct sizes up to 6 x 30 inch.

2. Blade: 24 gage, minimum.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

1. Blade: 18 gage, minimum.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

F. Quadrants:

1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.

2. On insulated ducts mount quadrant regulators on minimum 2-inch stand-off mounting brackets, bases, or adapters.

3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.8 MISCELLANEOUS PRODUCTS

A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.

1. Thickness: 2 mils.

2. High tack water based adhesive.

3. UV stable light blue color.

4. Elongation Before Break: 325 percent, minimum.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.

D. Provide duct test holes where indicated and required for testing and balancing purposes.

E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

F. Demonstrate re-setting of fire dampers to Owner's representative.

G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

H. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

J. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 33 30

AIR DUCT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air duct sealants for permanently sealing fabricated joints and seams of HVAC air ducts and thermal insulation.

B. Reinforcing membrane for sealants.

1.2 RELATED SECTIONS

A. Section 23 07 13 - Duct Insulation.

B. Section 23 31 00 - HVAC Ducts and Casings.

C. Section 23 33 00 - Duct Accessories.

1.3 REFERENCES

A. ASTM D 1668 - Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing; 1995.

B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.

C. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

D. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors; Underwriters Laboratories Inc.; 2005.

E. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Underwriters Laboratories Inc.; 2005.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Manufacturer's product data, including physical properties and application instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

B. Store materials in accordance with manufacturer's instructions. Protect from freezing.

1. Storage Temperature: 40 to 100 degrees F.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not apply below 35 degrees F. or above 120 degrees F.

B. Avoid high humidity.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

1. Hardcast, Inc.

2. RCD Corporation.

B. Substitutions: See Section 23 01 00 - General HVAC Provisions.

C. Supply all products specified in this section from a single manufacturer.

2.2 AIR DUCT SEALANTS

A. Low to High Velocity Air Duct Sealant: Non-toxic, water-based, fiber-reinforced adhesive-sealant; for permanently sealing fabricated joints and seams of sheet metal air ducts, UL 181 listed rigid fiberglass air ducts, UL 181 listed flexible air ducts, and thermal insulation; for repairing damaged and leaking air ducts; for sealing conditioned spaces from air infiltration.

1. Type: Elastomeric terpolymer emulsion.

2. Underwriters Laboratories Listed: UL 181A-M and UL 181B-M.

3. Solids by Weight: 67 percent, plus or minus 2 percent.

4. Weight per Gallon: 10.5 pounds, plus or minus 0.20 pounds.

5. Wet Film Coverage: 100 linear feet per gallon at 1/16 inch thick by 3 inches wide.

6. Consistency: Thixotropic, non-sagging.

7. Adhesive Cure: 72 hours at 50 percent humidity and 70 degrees F.

8. Service Temperature Limits: Minus 10 degrees to 180 degrees F.

9. Water Vapor Transmission Rate: 0.6157 perms in accordance with ASTM E 96.

10. Flame Spread Index: Not greater than 5, when tested in accordance with ASTM E 84.

11. Smoke Developed Index: Zero, when tested in accordance with ASTM E 84.

B. Low to High Velocity Air Duct Sealant: Hardcast Iron Grip 601 non-toxic, water-based, adhesive-sealant; for permanently sealing fabricated joints and seams of sheet metal air ducts, UL 181 listed rigid fiberglass air ducts, UL 181 listed flexible air ducts, and thermal insulation; for repairing damaged and leaking air ducts; for sealing conditioned spaces from air infiltration.

1. Type: Elastomeric terpolymer emulsion.

2. Underwriters Laboratories Listed: UL 181A-M and UL 181B-M.

3. Solids by Weight: 70 percent, plus or minus 2 percent.

4. Wet Film Coverage: 320 linear feet per gallon at 20 mil thick by 3 inches wide.

5. Consistency: Thixotropic, non-sagging.

6. Adhesive Cure: 48 hours at 50 percent humidity and 70 degrees F.

7. Flame Spread Index: Not greater than 5, when tested in accordance with UL-723.

8. Smoke Developed Index: Zero, when tested in accordance with UL-723.

C. Reinforcing Membrane: RCD "Glasscoat" inorganic woven fiberglass reinforcing membrane; conforming to irregular surfaces for sealing and coating thermal insulation, air ducts, return air plenums, equipment, vessels, pipes, and fittings.

1. ASTM D 1668, Type III.

2. Nominal Dry Weight: 1.2 to 2.0 ounces per square yard.

3. Saturated Weight: 1.6 to 2.6 ounces per square yard.

4. Nominal Thread Count: 10 by 20.

5. Breaking Strength, Saturated: 75 warp, 75 fill minimum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive air duct sealants.

B. Notify Architect of conditions that would adversely affect application of sealants. Do not proceed with application until unsatisfactory conditions are corrected.

3.2 SURFACE PREPARATION

A. Prepare surfaces in accordance with manufacturer's instructions.

B. Remove water, dirt, oil, grease, and corrosion from surfaces to receive air duct sealants.

3.3 APPLICATION

A. Apply air duct sealants in accordance with manufacturer's instructions.

B. Apply to sheet metal air ducts, UL 181 listed rigid fiberglass air ducts, UL 181 listed flexible air ducts, thermal insulation, and other surfaces where indicated.

C. Do not thin or mix.

D. Apply tack coat at rate of 2 gallons per 100 square feet.

E. Embed reinforcing membrane into tack coat.

F. Apply finish coat at rate of 2 gallons per 100 square feet.

G. Allow drying time as follows:

1. Minimum 6 hours when used outdoors if wet weather is imminent.

2. Minimum 24 hours before using air duct system.

3. Additional time as required by air temperature and humidity conditions.

END OF SECTION

SECTION 23 34 23

POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wall exhausters.

B. Cabinet and Ceiling exhaust fans.

1.2 RELATED REQUIREMENTS

A. Section 23 31 00 - HVAC Ducts and Casings.

B. Section 23 33 00 - Duct Accessories: Backdraft dampers.

C. Division 26 - Electrical: Equipment Wiring.

1.3 REFERENCE STANDARDS

A. AMCA 261 - Directory of Products Licensed to Use the AMCA Certified Ratings Seal; Air Movement and Control Association International, Inc.; http://www.amca.org/licenses/search.aspx.

B. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.

C. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.

D. NEMA MG 00001 - Motors and Generators; 2024.

E. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

C. Manufacturer's Instructions: Indicate installation instructions.

D. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.5 QUALITY ASSURANCE

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

B. Equivalent fan selections shall not increase or decrease motor horsepower, increase top speed by more than 10%, or increase inlet air velocity by more than 20% from that specified.

C. Provide fans capable of accommodating static pressure variations of plus or minus 10%.

D. Provide balanced variable for motors 15 horsepower and under.

E. Statically and dynamically balance fans to eliminate vibration or noise transmission to occupied areas of the building.

F. Provide belt guards on belt driven fans.

G. Provide safety screen where inlet or outlet is exposed.

H. Prime coat fan wheels and housing factory inside and outside. Prime coating on aluminum parts is not required.

1.6 FIELD CONDITIONS

A. Permanent ventilators may be used for ventilation during construction only after ductwork is clean, filters are in place, bearings have been lubricated, and fan has been test run under observation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acme.

B. Captive Aire.

C. Greenheck.

D. Loren Cook Company.

E. Twin Cities Blower.

F. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 POWER VENTILATORS - GENERAL

A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99.

D. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.3 WALL EXHAUSTERS

A. Performance Ratings:

1. Refer to fan schedule on plan sheet for fan performance.

B. Fan Unit: V-belt or direct driven with spun aluminum housing; resiliently mounted motor; 1/2 inch mesh, 0.062 inch thick aluminum wire bird screen.

C. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor and solid state speed controller.

D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.

E. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

2.4 CABINET AND CEILING EXHAUST FANS

A. Performance Ratings:

1. Refer to fan schedule on plan sheet for fan performance.

B. Centrifugal Fan Unit: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.

C. Disconnect Switch: Cord and plug in housing for thermal overload protected motor and factory mounted solid state speed controller.

D. Grille: Molded white plastic.

E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Hung Cabinet Fans:

1. Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

C. Provide sheaves required for final air balance.

D. Install backdraft dampers on outlet to wall exhausters.

E. Provide backdraft dampers on outlet from ceiling exhauster fans and as indicated.

3.2 SCHEDULES

A. Drawing Code: See plan Schedule.

B. Air Flow Capacity: See plan Schedule.

C. Static Pressure: See plan Schedule.

D. Motor hp:

1. Electrical Characteristics: See plan Schedule.

E. Accessories:

1. See plan Schedule.

END OF SECTION

SECTION 23 36 06

AIR TERMINAL UNITS - VARIABLE VOLUME

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Single duct terminal units.

1. Variable volume.

B. Integral heating coils.

1. Hot water.

1.2 PRODUCTS NOT FURNISHED AND NOT INSTALLED UNDER THIS SECTION

A. Section 23 09 23 - DDC Controls Systems: Thermostats, hot water valves, and DDC control components.

B. Division 26 - Electrical Specification.

1.3 RELATED SECTIONS

A. Section 23 21 13 - Hydronic Piping: Connections to heating coils.

B. Section 23 21 14 - Hydronic Specialties: Connections to heating coils.

C. Section 23 31 00 - Ductwork.

D. Section 23 33 00 - Ductwork Accessories.

E. Section 23 37 00 - Air Outlets and Inlets.

F. Section 23 09 24 - Direct Digital Controls System for HVAC.

G. Division 26 - Electrical Systems: Equipment Wiring Systems: Electrical supply to units.

1.4 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. UL 181 - Factory-Made Air Ducts and Connectors.

C. NFPA 70 - Electric Duct Heaters.

D. UL 1995, Heating and Cooling Equipment.

E. CUL C22.2 No. 236, Heating and Cooling Equipment.

F. ARI 880 - Air-Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals.

G. ASTM A 527 (Steel Sheet, Zinc Coated Galvanized).

H. A-A-1419 or F-F-310 Federal specification (filter element, Air conditioning, Viscous-impingement or Dry type, replaceable), Tested per UL 900.

1.5 SUBMITTALS

A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.

B. Submit product performance data indicating design air flow, minimum static pressure drop, fan operating condition.

C. Submit installation, operation and maintenance documentation.

D. Submit sound power and noise criteria (NC) values for radiated and discharge paths.

1.6 QUALIFICATIONS

A. Manufacturer: The company manufacturing the products specified in this section shall have a minimum of ten years experience producing products of this type.

1.7 SYSTEM RESPONSIBILITY

A. The contractor shall be responsible for any and all costs associated with any and all changes resulting from the use of a supplier other than the listed acceptable manufacturers.

B. The duct system is computer designed for air balance and noise control using the performance data of the listed manufacturer. Substituting another VAV terminal unit manufacturer may require changes in the system design. These changes may include, but are not limited to, changes in ductwork size or layout, fittings, controls, building structure and piping.

1.8 WARRANTY

A. Provide manufacturer's parts warranty for one year from Date of Substantial Completion.

B. All warranties to begin at Date of Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers

1. Nailor.

2. Titus.

3. Trane Inc.

4. Metalaire.

5. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Manufacturer shall participate in the ARI Certification program. Unit performance data shall be rated in accordance with ARI Standard 880. The manufacturer shall display the ARI Symbol on all units.

C. Single and dual duct terminal units shall be UL listed as an entire assembly.

2.2 MANUFACTURED UNITS

A. Single duct terminal units.

1. Ceiling mounted primary air control terminal units for connection to a single medium - 1.5-3.0 in. wg pressure duct of a central air distribution system. Terminals units may be provided with integral heating coils - see plans.

B. Identify each terminal unit with clearly marked identification label and airflow indicator. Label shall include unit nominal air flow, maximum factory-set air flow, minimum factory-set air flow, and coil type.

2.3 FABRICATION

A. Casings: Units shall be completely factory-assembled, manufactured of corrosion protected steel, and fabricated with a minimum of 18-gauge metal on the high pressure (inlet) side of the terminal unit damper and 22-gauge metal on the low pressure (outlet) side and unit casing.

B. Plenum air filters shall be provided on all fan powered units.

C. Insulation - Dual Wall: The interior surface of the unit casing shall be thermally lined with a minimum 1 inch, 1.75 lb./cu. ft. density glass fiber with a high density facing. The insulation R-Value shall be a minimum of 1.9. Insulation shall meet NFPA-90A and UL 181 requirements. The insulation is covered by an interior metal liner made of

26 gauge galvanized steel. The interior metal liner shall isolate the fiberglass insulation from the airstream and allow for cleaning of the terminal unit interior surfaces. All wire penetrations through the interior metal liner shall be covered by grommets.

D. Insulation Edge Treatment: All cut edges of insulation shall completely enclosed by metal to arrest cut fibers and prevent erosion into the airstream.

E. Assembly: Primary air control damper, airflow sensor, fans, and optional heating coil in single cabinet.

F. Rectangular Supply Air Outlet Connections: Rectangular outlet connections for single duct units shall be slip and drive type. Rectangular outlet connections for dual duct and fan powered units shall be flanged type.

2.4 PRIMARY AIR CONTROL DAMPER ASSEMBLY

A. Locate primary air control damper assembly inside unit casing. Construct the damper assembly from extruded aluminum and/or a minimum 20 gauge galvanized steel components. Maximum damper leak rate shall not exceed 1% of damper nominal CFM at 4 inch wg differential.

B. Provide damper assembly with integral flow sensor. Flow sensor shall be provided regardless of control type. Flow sensor shall be a multi-point, averaging, ring or cross type. Bar or single point sensing type is not acceptable.

2.5 HEATING COILS

A. Hot Water Heating Coil: Coils shall be factory-installed and shall consist of aluminum plated fins and seamless copper tubes. Fins shall have full fin collars to provide accurate fin spacing and maximum fin-to-tube contact. Tubes shall be mechanically expanded into the fin collars. Coils shall be leak tested under water to 450 psig pressure. Supply and return water connections shall be on the same side of the coil.

B. Capacity: Provide coils in capacities as scheduled on the drawings.

2.6 FAN ASSEMBLY

A. Fan assembly shall be forward curved centrifugal fan with direct drive permanently lubricated, permanent split-capacitor type, thermally protected motor. Motor must be capable of continuous operation under maximum fan load with no external static pressure. Provide unit with a SCR motor speed adjustment that is factory-installed and wired to the fan motor.

B. Fan motor horsepower shall not exceed the horsepower scheduled for each unit. Fan motors shall be high efficiency and shall not exceed those shown in the table below for each motor size.

1. Fan HP: 1/15 - 115 Volt/AMPS: 1.5; 277Volt/AMPS: 1.3.

2. Fan HP: 1/8 - 115 Volt/AMPS: 2.7; 277Volt/AMPS: 1.3.

3. Fan HP: 1/3 - 115 Volt/AMPS: 7.4; 277Volt/AMPS: 2.9

4. Fan HP: 1/2 - 115 Volt/AMPS: 11.4; 277Volt/AMPS: 4.4.

C. Internally suspend and isolate fan motor assembly from unit casing by using rubber isolators or torsion flex mounting legs.

D. Unit shall be equipped with a fan motor disconnect switch which breaks both legs of power entering the control box.

2.7 WIRING

A. Factory install and wire power line fusing, a disconnect switch and a 24 VAC transformer for control voltage (and power). Provide terminal strip in control box for field wiring of power source.

B. Factory install and wire all terminal unit fan controls. Install electrical components in control box with removable cover. Incorporate single point electrical connection to power source.

C. Disconnect Switch: Provide single and dual duct terminals with a factory installed and wired switch to disconnect power to the unit controls.

D. Power Line Fuse: Provide terminal units with integral power line fusing installed in the control box to prevent overcurrent damage to the unit controls.

E. Control Transformer: Provide terminal units with a factory installed and wired 24 VAC transformer to provide control voltage power to the unit.

2.8 DIRECT DIGITAL VAV CONTROLS

A. Direct Digital Controls

1. General. Direct digital controls (DDC) and factory costs to mount, calibrate and test the system shall be the responsibility of Section 23 09 24 DDC Controls Systems/Building Automation System (BAS) Contractor.

2. Multi-point, multi-axis flow ring or cross sensor to be furnished and mounted by terminal unit manufacturer. Single point or flow bar sensors are not acceptable. Flow sensing device shall be capable of maintaining airflow to within +/- 5 percent of rated unit airflow setpoint when installed with 1.5 duct diameters straight duct, of the same size as the primary airflow inlet, upstream from the unit.

B. Variable Air Volume (VAV) Terminal Unit Control

1. The VAV terminal units shall be individually controlled by a DDC VAV controller per VAV terminal unit. The DDC VAV controller, damper motor, and transducer shall be supplied and installed by the BAS contractor.

2.9 TESTING/VERIFICATION

A. Factory set and test all analog electronic controllers to within 5% of the scheduled maximum and minimum settings. Base performance on test in accordance with ARI880.

B. Maximum Casing Leakage: 1 percent of nominal air flow at 0.5 in wg inlet static pressure.

C. Maximum Damper Leakage: 1 percent of design air flow at 4 in wg inlet static pressure.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.2 ADJUSTING

A. Reset volume with damper operator attached to assembly allowing flow range modulation form 100 percent of design air flow to 25 percent nominal air flow for cooling units and 30 to 50 percent for units with heating coils.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

1. Ceiling-mounted, linear exhaust and return register/grilles.

2. Ceiling-mounted, supply register/grilles.

3. Wall-mounted, supply register/grilles.

4. Wall-mounted, grid core exhaust and return register/grilles.

C. Louvers:

1. Air measuring station louvers.

1.2 REFERENCE STANDARDS

A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).

B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.

C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

1.3 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.4 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

1.5 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Air Devices, Inc.

B. Carnes Company HVAC.

C. Krueger.

D. Nailor.

E. Price Industries.

F. Ruskin.

G. Titus.

H. Tuttle-Bailey.

I. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 SQAURE CEILING DIFFUSERS

A. Type: Provide high performance 3-cone diffuser diffuser to discharge air in 360 degree pattern .

B. Frame: Surface mount, inverted T-Bar type. In plaster ceilings, provide plaster frame and ceiling frame.

C. Fabrication: Steel or aluminum as indicated on drawings with baked enamel finish.

D. Color: As shown on drawings.

E. See Air Distribution Schedule on drawings for details and accessories.

2.3 CEILING RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 1/2 inch minimum depth, 1/2 inch maximum spacing, with blades set at 45 degrees, horizontal face.

B. Type: Streamlined blades, 1/2 inch minimum depth, 3/4 inch maximum spacing, with blades set at 45 degrees, horizontal face.

C. Frame: 1-1/4 inch margin with concealed mounting.

D. Fabrication: Steel or aluminum as indicated on drawings with baked enamel finish.

E. Color: As shown on the drawings.

F. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face where not individually connected to exhaust fans, where indicated on plans.

G. See Air Distribution Schedule on drawings for details and accessories.

2.4 WALL SUPPLY REGISTERS/GRILLES

A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other device to set blades, vertical face, double deflection.

B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 20 gage minimum frame, or aluminum extrusions, with factory baked enamel finish.

D. Color: As shown on the drawings.

E. Damper: Integral, gang-operated opposed blade type with removable key operator, operable from face, where indicated on plans.

F. See Air Distribution Schedule on drawings for details and accessories.

2.5 WALL RETURN REGISTERS/GRILLES

A. Type: Streamlined blades, 1/2 inch minimum depth, 1/2 inch maximum spacing, with spring or other device to set blades, horizontal face.

B. Frame: 1-1/4 inch margin with gasket.

C. Fabrication: Steel or aluminum as indicated on drawings with factory baked enamel finish.

D. Color: As shown on the drawings.

E. See Air Distribution Schedule for details and accessories.

F. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face, where indicated on plans.

2.6 WALL GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

A. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch louvers.

B. Fabrication: Aluminum with factory baked enamel finish.

C. Color: As shown on the drawings.

D. Frame: 1-1/4 inch margin with countersunk screw mounting.

E. Damper: Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.7 LOUVERS

A. Manufacturers:

1. Ruskin Company

2. Pottroff.

3. Greenheck.

4. Substitutions. See Section 23 01 00 - General HVAC Provisions.

B. Type: 6 inch deep with blades on 45 degree slope , heavy channel frame, 1/4 inch square mesh screen over exhaust and 1/4 inch square mesh screen over intake.

C. Type: Combination louver/dampers, drainable type with drain gutters in each blade and downspouts in jambs and mullions. 6 inch deep with blades on 37 degree slope. 1/4 inch square mesh screen over exhaust and 1/4 inch square mesh screen over intake.

D. Color: As shown on the drawings.

E. Fabrication: 12 gage thick extruded aluminum, welded assembly, with finish as indicated on Air Distribution Schedule.

F. Mounting: Furnish with exterior flat flange for installation.

2.8 COUNTER BALANCED BACKDRAFT DAMPERS

A. Frame shall be 0.90 inch minimum wall thickness extruded aluminum with 12 gage galvanized steel structural brace at each corner.

B. Blades shall be 0.025 inch minimum roll-formed aluminum with extruded vinyl blade edge seals mechanically locked into the blades.

C. Blades shall include field adjustable, zinc plated steel counter balance weights to allow pressure relief at less than .05 inches water gage.

D. Bearings shall be corrosive resistant, long life synthetic type for quiet operation.

E. Linkage shall be 1/2 inch wide tiebar concealed in the frame.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black.

F. Provide minimum 6" deep plenum box on back of all return and exhaust grilles.

G. Install counter balanced backdraft dampers where indicated on the plans.

3.2 SCHEDULES

A. Air Outlet and Inlet Schedule

1. Drawing Code: Refer to plan schedule.

2. Manufacturer: As scheduled on drawings.

3. Model: As scheduled on drawings.

4. Description: As scheduled on drawings.
5. Finish: As scheduled on drawings.
6. Service: As scheduled on drawings.
7. Mounting: As scheduled on drawings.
8. Accessories: As scheduled on drawings.

END OF SECTION

SECTION 23 40 00

AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disposable, extended area panel filters.

1.2 RELATED REQUIREMENTS

A. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 850 (I-P) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013 (Reaffirmed 2023).

B. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.[CHOICE TEXT]

C. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2025.

1.4 PERFORMANCE REQUIREMENTS

A. Conform to Section 7.4.

1. Dust Spot Efficiency: Plus or minus 5 percent.

1.5 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions and connection requirements.

C. Shop Drawings: Indicate filter assembly and filter frames, dimensions and connection requirements.

D. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.

E. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Filters: One additional set of each type and size of disposable panel filters to be installed at the time the building is conveyed to the Owner.

1.6 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.1 FILTER MANUFACTURERS

A. American Filtration Inc.

B. AAF International/American Air Filter.

C. Camfil Farr Company.

D. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 DISPOSABLE, EXTENDED AREA PANEL FILTERS

A. Media: UL 900 Class 1, pleated, lofted, non-woven, reinforced cotton and synthetic fabric; supported and bonded to welded wire grid .

1. Frame: Cardboard.

2. Nominal size: to match equipment filter size requirements.

3. Nominal thickness: 2 inches.

B. Rating, per ASHRAE Std 52.1:

1. Dust spot efficiency: MERV 8.

2. Initial resistance at 500 FPM face velocity: 0.30 inch WG.

3. Recommended final resistance: 0.9 inch WG.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

3.2 SCHEDULES

A. Air Filter Schedule

1. Refer to plan Equipment Schedule.

END OF SECTION

SECTION 23 51 23

BREECHINGS, CHIMNEY, AND STACKS FOR CONDENSING APPLIANCES

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes:

1. Venting for the removal of products of combustion for Category II, III, IV gas burning appliances

1.2 REFERENCES

A. Underwriters Laboratories (UL):

1. UL1738

B. National Fire Protection Association (NFPA):

1. NFPA 54 - National Fuel Gas Code

1.3 QUALITY ASSURANCE

A. Comply with NFPA 54

B. Must install duct in accordance to manufacturer's listings and installation instructions.

C. Components coming in contact with the products of combustion shall carry the appropriate UL or cUL listing, mark or label.

1.4 WARRANTY

A. Condensing Appliance vent listed to UL1738 shall have a limited lifetime warranty to begin at the date of installation. Any portion of the vent repaired or replaced under warranty shall be warranted for the remainder of the original warranty period.

PART 2- PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Metal Fab, Inc.

B. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 LISTED VENTING FOR CONDENSING APPLIANCES

A. The condensing appliance vent shall be double-wall for use with Category II natural draft appliances and Category III or IV positive pressure appliances.

B. Maximum temperature shall not exceed 550° F (288° C).

C. Vent shall be listed for an internal static pressure of 6” w.g. and tested to 15” w.g. for diameters 6-36 inches and 10” w.g. for diameters 3-5.

D. Vent shall be constructed of a material tested to UL1738, .015 thickness for 3”-12” diameters, .024 thickness for 14” to 24” diameters, and .035 thickness for 26” to 36” diameters.

E. Outer casing shall be constructed of aluminized steel of .018 thickness for 3”to 12” diameters, .024 thickness for 14” to 24” diameters, and .035 thickness for 26” to 36” diameters.

F. Condensing appliances may be vented with schedule 40 PVC if approved by equipment manufacturer.

PART 3-EXECUTION

3.1 STORAGE AND CONSTRUCTION

A. Protect materials from accidental damage.

B. All supports, roof or wall penetrations, terminations, appliance connectors and drain fittings required to install the vent system shall be included.

C. Joint assembly utilizes flanged mating surfaces with a factory supplied gaskets for diameters 6” through 24”, for diameters 26” to 36” P070 sealant will be used on the flange surface. Flanges are joined with a vee band secured by tightening draw bolts. Diameters 3-5 inch utilize a snap-lock, gasketed connection.

D. Where exposed to weather, the outer closure band shall be sealed to prevent moisture from entering the space between the walls.

E. All parts exposed to the weather shall be protected by one (1) coat of corrosion and heat resistant base primer and one (1) coat of heat resistant paint unless constructed of 430, 304 or 316 stainless steel.

F. Vent shall terminate in accordance with installation instructions and local codes.

G. Installation shall conform to manufacturers installation instructions.

END OF SECTION

SECTION 23 54 00

FURNACES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Note: Equipment in this section shall be provided by Owner through a purchasing agreement. Contractor shall be responsible for installation and all accessories necessary to provide a complete and working system.

B. Forced air furnaces.

C. Controls.

1.2 RELATED REQUIREMENTS

A. Section 23 01 00 - General HVAC Provisions.

B. Section 23 07 13 - Duct Insulation: Duct Liner.

C. Section 23 31 00 - Ducts.

D. Section 23 51 23 - Breechings, Chimneys, and Stacks for Condensing Appliances.

E. Section 23 62 13 - Air Cooled Condensing Units.

F. Section 23 31 00 - Ducts.

G. Division 26 - Electrical.

1.3 REFERENCE STANDARDS

A. NFPA 54 - National Fuel Gas Code; 2024.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

E. Project Record Documents: Record actual locations of components and connections.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out 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 five years of documented experience.

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

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 WARRANTY

A. Provide five year manufacturers warranty for solid state ignition modules.

B. Provide ten year manufacturers warranty for heat exchangers.

C. Provide one year manufacturers parts warranty for entire unit.

D. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Trane Inc.

B. Daikin.

C. Rheem Manufacturing Company / RUUD.

D. Substitutions: See Section 23 01 00- General HVAC Provisions.

2.2 GAS FIRED FURNACES

A. Annual Fuel Utilization Efficiency (AFUE):0.96 ("condensing") .

B. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter, and accessories; wired for single power connection with control transformer.

1. Safety certified by CSA in accordance with ANSI Z21.47.

2. Venting System: Direct.

3. Combustion: Sealed

4. Air Flow Configuration: Upflow.

5. Air Flow Configuration: Refer to drawings.

6. Heating: Natural gas fired.

7. Accessories:

a. See schedule on drawings for required accessories.

C. Performance:

1. Refer to Furnace Schedule. Gas heating capacities are sea level ratings.

D. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

E. Primary Heat Exchanger:

1. Material: Hot-rolled steel

2. Shape: Tubular type.

F. Gas Burner:

1. Atmospheric type with adjustable combustion air supply,

2. Gas valve provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.

3. Electronic pilot ignition, with hot surface igniter.

4. Non-corrosive combustion air blower with permanently lubricated motor.

G. Gas Burner Safety Controls:

1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.

2. Flame rollout switch: Installed on burner box and prevents operation.

3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.

4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

H. Supply Fan: Centrifugal type rubber mounted with direct or belt drive with adjustable variable pitch motor pulley.

I. Motor: 1750 rpm multiple speed, permanently lubricated, hinge mounted.

J. Air Filters: 2 inch thick glass fiber, disposable type arranged for easy replacement.

K. Operating Controls

1. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.

2.3 THERMOSTATS

A. Manufacturers:

1. Trane.

2. Daikin.

3. Rheem Manufacturing Company/RUUD.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions. .

B. Room Thermostat: Low voltage, electric solid state microcomputer based room thermostat with remote sensor:

1. System selector switch (heat-off) and fan control switch (auto-on).

2. Preferential rate control to minimize overshoot and deviation from setpoint.

3. Set-up for four separate temperatures per day.

4. Instant override of setpoint for continuous or timed period from one hour to 31 days.

5. Short cycle protection.

6. Programming based on every day of the week.

7. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

8. Battery replacement without program loss.

9. Thermostat Display:

    a. Time of day.

    b. Actual room temperature.

    c. Programmed temperature.

    d. Programmed time.

    e. Duration of timed override.

    f. Day of week.

    g. System Mode Indication: Heating, cooling, fan auto, off, and on, auto or on, off.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and located correctly.

C. Verify that proper fuel supply and pressure are available for connection.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.

B. Install furnace on insulated furnace stand.

C. Install in accordance with NFPA 90A.

D. Install gas fired furnaces in accordance with NFPA 54.

E. Provide vent connections in accordance with NFPA 211.

F. Pipe drain from humidifier to nearest drain.

G. Mount air cooled condenser on 4 inch thick concrete pad. Allow minimum 6 inches on all sides of equipment.

3.3 SCHEDULES

A. Furnaces:

1. See Schedule on drawings.

END OF SECTION

SECTION 23 55 32

FUEL FIRED UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gas fired unit heaters.

1.2 RELATED REQUIREMENTS

A. Section 22 10 05 - Plumbing Piping.

B. Section 23 51 23 - Breechings, Chimneys, and Stacks and stacks for Condensing Appliances.

C. Section 23 31 00 - Ducts.

D. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ASHRAE Std 103 - Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2022, with Errata (2025).

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and locations and sizes of field connections.

D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

F. Warranty: Submit manufacturers warranty and ensure forms have been filled out 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 five 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.

B. Provide ten year manufacturers warranty for heat exchangers.

C. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 UNIT HEATER MANUFACTURERS

A. Modine Manufacturing Company.

B. Sterling HVAC/Mestek Technology, Inc.

C. Reznor/Thomas & Betts Corporation.

D. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 GAS FIRED UNIT HEATERS

A. Unit Heaters: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, burner, controls, and accessories:

1. Heating: Natural gas fired.

2. Discharge Louvers: Individually adjustable horizontal louvers to match cabinet finish.

B. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.

C. Supply Fan: Propeller type with direct drive .

D. Heat Exchanger: 4 pass serpentine style steel welded construction.

E. Gas Burner:

1. Atmospheric type with adjustable combustion air supply,

2. Gas valve provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.

3. Electronic pilot ignition, with hot surface igniter.

4. Non-corrosive combustion air blower with permanently lubricated motor.

5. Combination combustion air and vent system.

F. Gas Burner Safety Controls:

1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.

2. Flame rollout switch: Installed on burner box and prevents operation.

3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.

4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

G. Operating Controls

1. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.

H. Performance:

1. Ratings: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1; seasonal efficiency to ASHRAE Std 103, or as indicated on the plans.

2. Refer to Unit Heater Schedule. Gas heating capacities are sea level ratings.

2.3 ROOM THERMOSTATS

A. Manufacturers:

1. Honeywell.

2. Johnson Controls, Inc.

3. Siemens Building Technologies, Inc.

4. Substitutions: See Section 23 01 00 - General HVAC Provisions.

B. Adjustable Room Thermostat: High voltage, to control burner operation, and to maintain temperature setting.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that space is ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available.

C. Verify that proper fuel supply is available for connection.

3.2 INSTALLATION

A. Install in accordance with NFPA 90A and NFPA 90B.

B. Install gas fired units in accordance with NFPA 54 and applicable codes.

C. Provide vent connections in accordance with NFPA 211. Refer to Section 23 51 23.

D. Install unit heaters with vibration isolation.

E. Provide connection to electrical power systems; refer to Division 26.

3.3 SCHEDULES

A. Fuel Fired Unit Heaters

1. Refer to plan Schedule.

END OF SECTION

SECTION 23 62 13

AIR COOLED CONDENSING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Note: Equipment in this section shall be provided by Owner through a purchasing agreement. Contractor shall be responsible for installation and all accessories necessary to provide a complete and working system.

B. Condensing unit package.

C. Condensing unit package.

D. Charge of refrigerant and oil.

E. Controls and control connections.

F. Refrigerant piping connections.

G. Motor starters.

H. Electrical power connections.

1.2 RELATED REQUIREMENTS

A. Section 23 23 00 - Refrigerant Piping and Specialties.

B. Section 23 54 00 - Furnaces.

C. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.

B. AHRI 365 (I-P) - Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units; 2009.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

D. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.

E. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.4 PERFORMANCE REQUIREMENTS

A. Condenser:

1. Refer to plan Schedule.

B. Electrical Characteristics:

1. Refer to plan Schedule.

1.5 SUBMITTALS

A. Section 23 01 00 - General HVAC Provisions: Procedures for submittals.

B. Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams. Make submission with air handling units with coils to ensure capacities are complementary.

C. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.

D. Design Data: Indicate pipe and equipment sizing.

E. Manufacturer's Instructions: Submit manufacturer's complete installation instructions.

F. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

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

1.6 QUALITY ASSURANCE

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. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

1.8 WARRANTY

A. Provide a five year warranty to include coverage for refrigerant compressors.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Trane.

B. Rheem Manufacturing Company / RUUD.

C. Daikin.

D. Subsitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 MANUFACTURED UNITS

A. Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.

B. Construction and Ratings: In accordance with AHRI 210/240. Test in accordance with ASHRAE Std 23.

C. Construction and Ratings: In accordance with ARI 210/240, ARI 365, and UL 207. Testing shall be in accordance with ASHRAE Std 23.

D. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.

2.3 CASING

A. House components in welded steel frame with steel panels with weather resistant, baked enamel finish.

B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners .

2.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig, and dehydrate. Seal with holding charge of nitrogen.

B. Coil Guard: Hail Guard.

2.5 FANS AND MOTORS

A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.

B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor or 3 phase, with permanent lubricated ball bearings and built in thermal overload protection.

C. Horizontal discharge, double width, double inlet forward curved centrifugal type condenser fans, equipped with roller or ball bearings with grease fittings extended to outside of casing, V-belt drive with belt guard.

2.6 COMPRESSORS

A. Compressor: Hermetic reciprocating type or hermetic scroll type.

B. Mounting: Statically and dynamically balance rotating parts and mount on rubber-in-shear vibration isolators.

C. Motor: Constant speed 1800 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Furnish with starter.

2.7 REFRIGERANT CIRCUIT

A. Provide each unit with one refrigerant circuit or two independent refrigerant circuits, factory supplied and piped. Refer to Section 23 23 00.

B. For each refrigerant circuit, provide:

1. Filter dryer replaceable core type.

2. Liquid line sight glass and moisture indicator.

3. Thermal expansion valve for maximum operating pressure.

4. Insulated suction line.

5. Suction and liquid line service valves and gage ports.

6. Liquid line solenoid valve.

7. Charging valve.

8. Discharge line check valve.

9. Compressor discharge service valve.

10. Condenser pressure relief valve.

2.8 CONTROLS

A. On unit, mount weatherproof steel control panel, NEMA EN 10250, containing power and control wiring, factory wired with single point power connection.

B. For each compressor, provide across-the-line or part winding starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the-line starter with starter relay.

C. Provide safety controls arranged so any one will shut down machine:

1. High discharge pressure switch (manual reset) for each compressor.

2. Low suction pressure switch (manual reset) for each compressor.

3. Oil Pressure switch (manual reset).

D. Provide the following operating controls:

1. Five minute off timer prevents compressor from short cycling.

2. Low ambient temperature controls.

3. Hot gas bypass sized for minimum compressor loading bypasses hot refrigerant gas to evaporator.

4. Low ambient thermostat to lock out compressor at low ambient temperatures.

E. Provide controls to permit operation down to 0 degrees F ambient temperature.

1. Thermostat to cycle fan motors in response to outdoor ambient temperature.

2. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.

3. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.

4. Electronic control consisting of mixing damper assembly, controlled to maintain constant refrigerant condensing pressure.

PART 3 EXECUTION

3.1 INSTALLATION

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

B. Complete structural, mechanical, and electrical connections in accordance with manufacturer's installation instructions.

C. Provide for connection to electrical service.

D. Install units on concrete base as indicated.

E. Provide connection to refrigeration piping system and evaporators. Refer to Section 23 23 00. Comply with ASHRAE Std 15.

3.2 SYSTEM STARTUP

A. Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.

B. Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.

C. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

D. Provide cooling season start-up, and winter season shut-down for first year of operation.

3.3 SCHEDULES

A. Air Cooled Condensing Units

1. As scheduled on drawings.

END OF SECTION

SECTION 23 74 33

PACKAGED ROOFTOP DEDICATED OUTDOOR AIR UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Note: Equipment in this section shall be provided by Owner through a purchasing agreement. Contractor shall be responsible for installation and all accessories necessary to provide a complete and working system.

B. Packaged Rooftop air conditioners with integral heat recovery.

1.2 REFERENCES

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. AMCA 99-Standards Handbook

C. AMCA 210-Laboratory Methods of Testing Fans for Rating Purposes

D. AMCA 500-Test Methods for Louver, Dampers, and Shutters.

E. AHRI 340/360 - Unitary Large Equipment

F. NEMA MG1-Motors and Generators

G. National Electrical Code.

H. NFPA 70-National Fire Protection Agency.

I. SMACNA-HVAC Duct Construction Standards-Metal and Flexible.

J. UL 900-Test Performance of Air Filter Units.

1.3 SUBMITTALS

A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics and connection requirements.

B. Product Data:

1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, and electrical characteristics and connection requirements.

2. Provide computer generated fan curves with specified operating point clearly plotted.

3. Manufacturer's Installation Instructions.

1.4 OPERATION AND MAINTANENCE DATA

A. Maintenance Data: Provide instructions for installation, maintenance and service

1.5 QUALIFICAITONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.

B. Startup must be done by trained personnel experienced with rooftop equipment with integral heat recovery.

C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept products on site and inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Daikin Applied - Rebel

B. Approved equal.

2.2 GENERAL DESCRIPTION

A. Furnish as shown on plans, Daikin Applied Rebel Single zone Heating and Cooling Unit(s) model DPS. Unit performance and electrical characteristics shall be per the job schedule.

B. Configuration: Fabricate as detailed on prints and drawings:

1. Return plenum / economizer section
2. Heat recovery section - Core fixed plate heat exchanger.
3. Filter section
4. Cooling coil section
5. Supply fan section
6. Gas heating section.
7. Condensing unit section

C. The complete unit shall be cETLus listed.

D. The unit shall be ASHRAE 90.1-2016 compliant and labeled.

E. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.

F. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

G. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

H. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

I. Warranty: The manufacturer shall provide 12-month parts and labor warranty beginning at the time of building acceptance. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at building acceptance. Manufacturer will take into account temporary usage as required by other sections of the project manual as opposed to his “standard” warranty terms.

2.3 CABINET, CASING, AND FRAME

A. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0, and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.

B. Exterior surfaces shall be constructed of pre-painted galvanized steel for aesthetics and long term durability. Paint finish to include a base primer with a high quality, polyester resin topcoat of a neutral beige color. Finished panel surfaces to withstand a minimum 1000-hour salt spray test in accordance with ASTM B117 standard for salt spray resistance.

C. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

D. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.

2.4 OUTDOOR/RETURN AIR SECTION

A. Unit shall be provided with an outdoor air economizer section. The economizer section shall include outdoor, return, and exhaust air dampers. The economizer operation shall be fully integral to the mechanical cooling and allow up to 100% of mechanical cooling if needed to maintain the cooling discharge air temperature. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include moisture eliminator filters to drain water away from the entering air stream. The outside and return air dampers shall be sized to handle 100% of the supply air volume. The dampers shall be parallel blade design. Damper blades shall be gasketed with side seals to provide an air leakage rate of 1.5 cfm / square foot of damper area at 1” differential pressure in according with testing defined in AMCA 500. A barometric exhaust damper shall be provided to exhaust air out of the back of the unit. A bird screen shall be provided to prevent infiltration of rain and foreign materials. Exhaust damper blades shall be lined with vinyl gasketing on contact edges. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. A comparative enthalpy control shall be

provided to sense and compare enthalpy in both the outdoor and return air streams to determine if outdoor air is suitable for “free” cooling. If outdoor air is suitable for “free” cooling, the outdoor air dampers shall modulate in response to the unit’s temperature control system.

B. Unit shall be provided with a 100% outdoor air hood. The 100% outdoor air hood shall allow outdoor air to enter from the back of the unit, at the draw-through filter section. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include a bird screen to prevent infiltration of foreign materials and a rain lip to drain water away from the entering air stream.

C. Daikin Applied UltraSeal low leak dampers shall be provided. Damper blades shall be fully gasketed and side sealed and arranged vertically in the hood. Damper leakage shall be less than 1.5 CFM/Sq. Ft. of damper area at 1.0 inch static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers. Control of the dampers shall be from a factory installed actuator.

D. Control of the outdoor dampers shall be by a factory installed actuator. Damper actuator shall be of the modulating type. Damper to open when when supply fan starts, and close when supply fan stops.

E. Provide a field installed Duct/Space mounted C02 sensor. Outside air damper position will modulate between the Demand Control Ventilation Limit (minimum position setpoint) and the Ventilation Limit (maximum non-economizer position setpoint) to satisfy the space requirements. Damper position will be controlled to the greater of the two command signals, either minimum outside air flow or space IAQ (CO2).

2.5 ENERGY RECOVERY

A. Enthalpy Wheel

1. Unit shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the rooftop unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.

2. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the

manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.

3. The rooftop unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the rooftop unit to facilitate cleaning.

4. The unit shall have 2" Merv 7 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.

5. The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

6. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.

7. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.

8. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.

9. The exhaust air fan shall be a direct drive SWSI plenum fan. The exhaust fan shall be sized for the airflow requirements per the construction schedule. The unit controller shall control the exhaust fan to maintain building pressure. A VFD shall be provided for the exhaust fan motor or the exhaust fan motor shall be an ECM motor.The rooftop unit shall have single point electrical power connection and shall be ETL listed.

10. The control of the energy recovery wheel shall be an integral part of the rooftop unit's DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the rooftop units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.

11. The rooftop unit with the energy recovery wheel shall incorporate the economizer operation. The energy recovery wheel shall have a bypass damper. When the unit is in the economizer mode of operation the energy recovery wheel shall stop and the bypass dampers shall be opened. The outdoor air shall be drawn through the bypass dampers to reduce the pressure drop of the outdoor airstream.

12. The rooftop unit DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall stop the wheel. When in the frost control mode the wheel shall be jogged periodically and not be allowed to stay in the stationary position.

B. Core Fixed Plate Heat Exchanger

1. Unit shall be equipped with a fixed plate energy recovery core including a bypass damper on the outside air path. If the RTU has an economizer internal to it then the bypass damper will open when the unit enters the economizer operating state and close when the unit leaves the economizer operating state.

2. When the outside air is below 32F (adjustable) the bypass damper will open for 5 minutes (adjustable) every 60 minute period (adjustable). Exhaust air continues to run though the core during this time to remove frost buildup.

3. The ERV core shall transfer both sensible and latent energy between the incoming fresh air stream and the exhaust stale air stream.

4. The ERV core shall be in either a cross-flow or counter cross-flow orientation and have no moving parts.

5. The ERV core shall be certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. Products not currently AHRI certified will not be accepted.

6. The ERV core shall achieve the minimum effectiveness value as indicated in the schedule.

7. The fresh air stream must have complete separation from the stale air stream to prevent cross contamination.

8. The ERV core shall have Exhaust Air Transport Ratio of 0.5% as tested to AHRI 1060 (EATR) to prevent cross-over of gases, contaminants or odors.

9. The ERV core's Outdoor Air Correction Factor (OACF) shall not exceed 1.0 as tested to AHRI 1060 (OACF) Standard.

10. The ERV core shall not be degraded or promote the growth of mold and bacteria with a rating of zero in testing according to ISO846 A and C.

11. The ERV core must be able to tolerate freezing temperatures of -30°C (-22°F and not have an increase in EATR or decrease in performance after being frozen.

12. The ERV core must be able to tolerate high temperatures of +60°C and not have an increase in EATR or decrease in performance at these elevated temperatures.

13. The ERV core must be freeze tolerant tested to 40 freeze thaw cycles from -20¬o C to +20o C while maintaining the energy recovery effectiveness and EATR rating of 0.5%.

14. The ERV core must be water washable to remove dust and contaminants.

15. The ERV core must be flame proof and comply with UL 723 with a flame spread index that shall not be over 25 and a smoke index that shall not be over 50.

16. The ERV cores should have particulate filters positioned before the incoming air streams.

17. Accepted manufacturer: CORE Energy Recovery Solutions or approved equal, subject to compliance with requirements

2.6 EXHAUST FAN

A. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.

B. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

C. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor. Areas served by these units are to be adjusted to keep spaces at a slight negative pressure

2.7 FILTERS

A. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 construction filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

2.8 COOLING COIL

A. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.

B. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.

C. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.

D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.

E. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

F. A drain pan over flow safety shall shut off the unit and issue a warning before over flow occurs.

2.9 HOT GAS REHEAT

A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser

B. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.

C. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.

D. Each coil shall be factory leak tested with high-pressure air under water.

2.10 SUPPLY FAN

A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additonal maintenance.

B. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.

C. Supply fan and motor assembly combinations larger than 8 hp or 22” diameter shall be internally isolated on 1” deflection, spring isolators and include removable shipping tie downs.

D. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.

E. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

2.11 VARIABLE AIR VOLUME CONTROL

A. The unit controller shall proportional control the ECM motors on the supply fan based on space temperature. The unit controller shall increase/decrease the speed of the supply fan in order to maintain the space temperature within its setpoint and deadband. The unit controller shall provide discharge air temperature control with the compressor modulation.

2.12 HEATING SECTION

A. The rooftop unit shall include a natural gas heating section. The gas furnace design shall be one natural gas fired heating module factory installed downstream of the supply air fan in the heat section. The heating module shall be a tubular design with in-shot gas burners.

B. RTU heating module shall be complete with furncace controller and control valve capable of modulating operation. Turn down ratio to be as indicaed on drawings.

C. The heat exchanger tubes shall be constructed of stainless steel.

D. The module shall have an induced draft fan that will maintain a negative pressure in the heat exchanger tubes for the removal of the flue gases.

E. Each burner module shall have two flame roll-out safety protection switches and a high temperature limit switch that will shut the gas valve off upon detection of improper burner manifold operation. The induced draft fan shall have an airflow safety switch that will prevent the heating module from turning on in the event of no airflow in the flue chamber.

F. The factory-installed DDC unit control system shall control the gas heat module. Field installed heating modules shall require a field ETL certification. The manufacturer's rooftop unit ETL certification shall cover the complete unit including the gas heating modules.

2.13 CONDENSING SECTION

A. Outdoor coils shall be cast aluminum, micro-channel coils. Plate fins shall be protected and brazed between adjoining flat tubes such that they shall not extend outside the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

B. Outdoor coils shall have seamless copper tubes, mechanically bonded into aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A

sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.

C. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25~120°F. Mechanical cooling shall be provided to 25º F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.

D. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite materia

E. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.

F. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.

G. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.

H. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

2.14 ELECTRICAL

A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature

sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

B. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.

2.15 CONTROLS

A. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.

B. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

C. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.

D. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.

E. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.

F. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:

1. Return air temperature.
2. Discharge air temperature.
3. Outdoor air temperature.
4. Space air temperature.
5. Outdoor enthalpy, high/low.
6. Compressor suction temperature and pressure
7. Compressor head pressure and temperature
8. Expansion valve position
9. Condenser fan speed
10. Inverter compressor speed
11. Dirty filter indication.
12. Airflow verification.
13. Cooling status.
14. Control temperature (Changeover).
15. VAV box output status.
16. Cooling status/capacity.
17. Unit status.
18. All time schedules.
19. Active alarms with time and date.
20. Previous alarms with time and date.
21. Optimal start

22. Supply fan and exhaust fan speed.

23. System operating hours.

    a. Fan

    b. Exhaust fan

    c. Cooling

    d. Inndividual compressor

    e. Heating

    f. Economizer

    g. Tenant override

G. The user interaction with the keypad shall provide the following:

1. Controls mode

    a. Off manual

    b. Auto

    c. Heat/Cool

    d. Cool only

    e. Heat only

    f. Fan only

2. Occupancy mode

    a. Auto

    b. Occupied

    c. Unoccupied

    d. Tenant override

3. Unit operation changeover control

    a. Return air temperature

    b. Space temperature

c. Network signal

4. Cooling and heating change-over temperature with deadband
5. Cooling discharge air temperature (DAT)
6. Supply reset options
    a. Return air temperature
    b. Outdoor air temperature
    c. Space temperature
    d. Airflow (VAV)
    e. Network signal
    f. External (0-10 vdc)
    g. External (0-20 mA)
7. Temperature alarm limits
    a. High supply air temperature
    b. Low supply air temperature
    c. High return air temperature
8. Lockout control for compressors.
9. Compressor interstage timers
10. Night setback and setup space temperature.
11. Building static pressure.
12. Economizer changeover
    a. Enthalpy
    b. Drybulb temperature
13. Currently time and date
14. Tenant override time
15. Occupied/unoccupied time schedule

16. One event schedule

17. Holiday dates and duration

18. Adjustable set points

19. Service mode

    a. Timers normal (all time delays normal)

    b. Timers fast (all time delays 20 sec)

H. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:

1. Zone sensor with tenant override switch

2. Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)

I. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:

1. Airflow

2. Outside air temperature

3. Space temperature

4. Return air temperature

5. External signal of 1-5 vdc

6. External signal of 0-20 mA

7. Network signal

2.16 ROOF CURB

A. A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high and include a nominal

2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.

B. See other plan details or schedules or other specification sections that may modify the height, pitch, or gasketing of the curb from this “standard” curb description.

END OF SECTION

SECTION 23 81 27

SMALL SPLIT-SYSTEM HEATING AND COOLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Note: Equipment in this section shall be provided by Owner through a purchasing agreement. Contractor shall be responsible for installation and all accessories necessary to provide a complete and working system.

B. Indoor ductless fan & coil units.

C. Controls.

1.2 RELATED REQUIREMENTS

A. Division 26 - Electrical: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2024, with Addendum (2026).

C. ASHRAE Std 23.1 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Condensing Units that Operate at Subcritical Pressures of the Refrigerant; 2019.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

E. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions, for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

C. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

1. Design Data: Indicate refrigerant pipe sizing.

D. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

E. Project Record Documents: Record actual locations of components and connections.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

G. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.

2. Extra Filters: Two filters for each indoor unit.

1.5 QUALITY ASSURANCE

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

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

C. Provide five year manufacturers warranty for compressors.

D. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 SUMMARY

A. This section provided for reference only. Equipment is to be provided directly by owner through a national buying agreement.

B. The contractor shall install owner furnished mini-split system(s) as shown and scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

2.2 MANUFACTURERS

A. Daikin.

B. LG.

C. Samsung.

D. Mitsubishi.

E. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.3 INDOOR UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

1. Location: High-wall.

2. Capacity: Refer to drawings.

3. Cabinet: Galvanized steel.

4. Finish: White.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with AHRI 210/240and UL 207.

2. Manufacturer: System manufacturer.

2.4 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

1. Comply with AHRI 210.

2. Refrigerant: R-32 or R-454B

3. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

4. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23.1and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Accessories: Filter drier, high pressure switch (manual reset), low pressure switch (automatic reset), service valves and gage ports, thermometer well (in liquid line).

1. Provide thermostatic expansion valves.

D. Operating Controls:

1. Control by room thermostat to maintain room temperature setting.

2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

E. Mounting Pad: Refer to Detail on plans.

2.5 ACCESSORY EQUIPMENT

A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:

1. System selector switch (heat-off-cool) and fan control switch (auto-on).

2. Set-up for four separate temperatures per day.

3. Instant override of setpoint for continuous or timed period from one hour to 31 days.

4. Short cycle protection.

5. Programming based on every day of the week.

6. Selection features including degree F or degree C display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

7. Battery replacement without program loss.

8. Manufacturers:

a. Provided by Control Contractor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and in correct location.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A.

C. Install refrigeration systems in accordance with ASHRAE Std 15.

D. Pipe drain from cooling coils to nearest drain.

3.3 SCHEDULE

A. Refer to plan Schedule.

END OF SECTION

SECTION 23 82 16

AIR COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Refrigerant coils.

1.2 RELATED REQUIREMENTS

A. Section 23 23 00 - Refrigerant Piping and Specialties.

B. Section 23 31 00 - Ducts: Installation of duct coils.

C. Division 26 - Electrical. Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; 2001 (R2011).

B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

A. See Section 23 01 00 - General HVAC Provisions.

B. Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

C. Shop Drawings: Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

D. Certificates: Certify that coils are tested and rated in accordance with ARI 410.

E. Warranty: Submit manufacturer's 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 five years of documented experience.

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

B. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.7 WARRANTY

A. Provide five year manufacturer warranty for coils.

B. All warranties to begin at Date of Substantial Completion as accepted by the Owner.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Same as equipment supplier.

B. Substitutions: See Section 23 01 00 - General HVAC Provisions.

2.2 REFRIGERANT COILS

A. Tubes: 5/8 inch OD seamless copper arranged in parallel or staggered pattern, expanded into fins, brazed joints.

B. Fins: Aluminum continuous plate type with full fin collars.

C. Casing: Die formed channel frame of 16 gage galvanized steel with 3/8 inch mounting holes on 3 inch centers. Provide tube supports for coils longer than 36 inches.

D. Headers: Seamless copper tubes with silver brazed joints.

E. Liquid Distributors: Brass or copper venturi type distributor with seamless copper distributor tubes, 5/16 inch outside diameter; maximum 12 circuits per distributor.

F. Testing: Air test under water at 300 psi for working pressure of 250 psi; clean, dehydrate, and seal with dry nitrogen charge.

G. Configuration: Down feed with bottom suction to prevent trapping of oil.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturers written instructions.

B. Install in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.

2. Provide frames for maximum three coil sections.

3. Arrange supports to avoid piercing drain pans.

4. Provide airtight seal between coil and duct or casing.

5. Refer to Section 23 31 00.

C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.

D. Install coils level.

E. Make connections to coils with unions and flanges.

F. Insulate headers located outside air flow as specified for piping. Refer to Section 23 07 19.

3.2 SCHEDULES

A. Heating and Cooling Coils: Same as equipment manufacturer.

END OF SECTION

SECTION 26 00 10

GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Furnish and install all electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Specifications and drawings are complimentary except that, in case of conflict, the most stringent will govern.

B. Judgment shall be exercised to install electrical work in a practical manner to function properly, simplify future maintenance, and to fit building construction and finish. Items not shown or specified which are required to produce a complete, operative and finished system shall be provided.

C. The electrical plans are a guide to the Contractor to show general arrangement of conduit and wiring and equipment required. If any error omissions or obscurities appear therein, which are questionable, do not conform to good practice, or appear contrary to the purpose and intent of the work, the Contractor shall promptly notify the Architect and Engineer and apply for directions before construction. The exact location of conduit runs and lengths shall be determined by the Contractor in the field.

D. The drawings may be superseded by later revised or detailed drawings or specification addenda prepared by the Architect. The Contractor shall conform to all reasonable change without extra cost to the Owner. All items not specifically mentioned in the specifications or noted on the drawings, but which are obviously necessary to make a complete working installation, shall be included.

E. Examine the premises in accordance with Division 1 and Division 2 of the specifications.

F. The Owner may furnish some equipment. Electrical Contractor is responsible to check the drawings and specifications for equipment that will be furnished by the Owner. Furnish the electrical connections, etc., on all Owner furnished equipment.

G. Should the particular equipment which any bidder proposes to install, require other space conditions than those indicated on the drawings, arrange for such space with the Engineer before submitting a bid. Should changes become necessary because of failure to comply with this clause, install the changes without additional expense.

H. Where electrical equipment is installed that causes electrical noise interference with other electrical systems installed under this contract, equip the offending equipment

with isolating transformers, filters, shielding or any other means as required for the satisfactory suppression of the interference as determined by the Engineer.

I. Comply with National Electric Code, NFPA, appropriate Building Code, and all local, state, and national ordinances.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. The General Conditions and Supplementary General Conditions of the contract are an integral part of Division 26 of the Specifications. Carefully note its contents in performance of the work.

B. The General Requirements as included in Division 1 of the Specifications are an integral part of Division 26. Carefully note its contents in performance of the work.

C. Examine all of the contract drawings and specifications, field verify existing conditions, or otherwise determine the extent of related work in other divisions before submitting a quotation for the work in this division. Coordinate the work in this division with work in other divisions through the Electrical Contractor. No extra payment will be made for additional work required by failure to coordinate the work. Should drastic changes from original drawings be necessary, the Contractor shall notify the Architect and secure written approval and agreement from the Architect on necessary adjustments.

D. The architectural, mechanical and structural plans and specifications, including Information to Bidders and other pertinent documents issued by the Architect or Engineer are a part of this Specification and the accompanying electrical plans. Comply with them in every respect. Examine all the above carefully.

1. Failure to comply does not relieve the Contractor of responsibility nor may it be used as a basis for additional compensation due to omission of architectural, mechanical and structural details from the electrical drawings.

E. Related work in other divisions requiring cooperation and coordination with this division includes, but is not limited to, the following:

1. Power arranged under Division 1.

2. Perform all cutting and patching as required under Division 1.

3. Furnish all sleeves, inserts, anchors and supports required by this work to be installed in concrete or masonry and coordinate with the respective trades under Division 3 and 4 for proper locations and installation.

4. Flash and seal roof penetrations in accordance with Division 7. Furnish locations and sizes and coordinate the installation with the respective trade.

5. Perform painting of electrical equipment and materials in finished areas as required under Division 9. Touch up or prime any surfaces required in this division in accordance with Division 9. Provide factory finishes as specified in other sections of this division.

6. Install branch circuits and make final connections to any equipment requiring electric power that is furnished and installed by the Contractor or by the Owner. Perform the electrical work according to approved shop drawings.

7. Install empty raceways and outlet boxes or branch circuits for equipment to be furnished by others and installed after completion of the contract.

8. Install and connect motor starters furnished under Division 23 where starters are not an integral part of the equipment. Insure that starters generally conform to the requirements of this division.

9. 120 volt control wiring is furnished and installed by the Electrical Contractor in accordance with the requirements of Division 23.

10. Mechanical equipment control conduit system furnished and installed by the Mechanical Contractor.

11. Motors are furnished and installed generally as an integral part of equipment specified under Division 23 and must conform to the requirements of this division.

1.3 FEES, PERMITS AND INSPECTIONS

A. Obtain any and all required permits in connection with this work under the Contract and pay any and all fees in connection therewith to include fees by the utility companies.

B. Under this section of work the Contractor shall, upon completion of the work, furnish a certificate of final inspection to the Architect from the inspection department having jurisdiction.

1.4 CODES AND STANDARDS

A. All work shall be done in a good workmanlike manner. Materials and workmanship shall comply with all applicable local state and federal codes including, but not limited to, the following:

1. National Electrical Code, Latest Edition (NEC).
2. Underwriters' Laboratories, Inc. (UL).
3. Institute of Electrical and Electronic Engineers (IEEE).
4. Insulated Power Cable Engineers' Association (IPCEA).
5. National Electrical Manufacturers' Association (NEMA).
6. American Standards Association (ASA).
7. American Society for Testing Materials (ASTM).
8. State Fire Prevention Code.
9. Occupational Safety and Health Act (OSHA).
10. National Fire Protection Association (NFPA).
11. International Building Code (IBC).

B. Comply with all State and Federal ADA Accessible Guidelines in regard to accessible or handicapped features.

C. The latest specifications and standards available shall be used for the above.

D. In case of discrepancy between the applicable codes, plans and specifications, the most stringent shall govern.

E. Should the Contractor perform any work that does not comply with requirements of the applicable authorities, he shall bear all cost arising in correcting the deficiencies.

F. Equipment and materials which are not covered by UL standard will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory.

1.5 DEMOLITION

A. Coordinate all demolition with the General Contractor. All existing wiring is to be removed as necessary. Reuse existing circuits for relocated devices and light fixtures.

PART 2 PRODUCTS

2.1 QUALIFICATION (PRODUCTS AND SERVICES)

A. Approvals are required of products or services of proposed manufacturers, suppliers and installers and will be based upon submission by Contractor of certification.

B. Manufacturer's Qualifications, provide submittal information with the following: Manufacturer regularly and presently manufactures as one of the manufacturer's principal products the following items and has manufactured these items for at least five (5) years.

1. Wire and Cable - all types.
2. Light Fixtures.
3. Lighting Switches and Receptacles.
4. Dimmers.
5. Molded Case Circuit Breakers.
6. Fuses.
7. Conduit.
8. Public Address and Music System.
9. Wiring Devices.
10. Low Voltage Fusible and Non-Fusible Switches.
11. Fire Alarm Systems and Equipment.
12. Conduit Supports and Fittings.
13. Panelboards.
14. Fire Sealant.
15. Intercom System Components.

C. Manufacturer's product submitted must have been in satisfactory operation on three (3) installations similar to this project for approximately five (5) years.

D. There must be a permanent service organization maintained or trained by manufacturer which will render satisfactory service to this installation within eight (8) hours of receipt of notification that service is needed.

E. Installer must have the technical qualifications, experiences, trained personnel and facilities to install specified items including at least three (3) years of successful installation of electrical work similar to that required on this project. Approval will not be given where the experience record is one of unsatisfactory performance.

F. The lighting wholesale supplier shall have an office and a stocking warehouse within 100 miles of the project site. The distributor/manufacturer's representative shall have an office within 100 miles of the project site, and shall have on staff a full time lighting designer as well as personnel who are available to service the project after completion.

2.2 MANUFACTURED PRODUCTS

A. Insure that materials and equipment furnished is of current production by manufacturers regularly engaged in the manufacture of such items for which replacement parts should be available.

1. Items not meeting this requirement but which otherwise meet technical specifications and merits of which can be established through reliable test reports or physical examination of representative samples will be considered.

B. Provide products of a single manufacturer when more than one (1) unit of the same product is needed.

C. Equipment Assemblies and Components:

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

2. Manufacturers of equipment assemblies which include components made by others must assume complete responsibility for the final assembled unit.

3. Components must be compatible with each other and with the total assembly for the intended service.

4. Constituent parts which are similar must be the product of a single manufacturer.

5. Moving parts of any element of equipment of the units normally requiring lubrication must have means provided for such lubrication and must be adequately lubricated at factory prior to delivery.

D. Identify all factory wiring on the equipment being furnished and on all wiring diagrams.

E. Equipment and materials shall be new and shall bear the manufacturer's name, trade name and the UL label in every case where a standard has been established for the particular material.

F. Equipment and materials of the same general type shall be of the same make throughout the work to provide uniform appearance, operation and maintenance.

G. Dimensions: It shall be the responsibility of the Contractor to insure that items furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications. Dimensions are to be taken from the architectural drawings.

H. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation of equipment and materials. Notify the Architect of any conflict between any requirement of the contract documents and the manufacturer's directions and obtain the Architect's written instruction before preceding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or such written instructions from the Architect, he shall bear all costs arising in correcting the deficiencies.

I. The Contractor shall provide and install all accessories, and incidental items to complete the work, ready to use and fully operational.

2.3 EQUIPMENT RATINGS AND APPROVAL OF "EQUAL" EQUIPMENT

A. Equipment voltage ratings must be in accordance with the requirements indicated on the drawings or as specified.

B. Obtain written approval for any equipment which differs from the requirements of the drawings and specifications.

1. Furnish drawings showing all installation details, shop drawings, technical data and other pertinent information as required.

2. Approval by the Engineer of the equal equipment does not relieve the Contractor of the responsibility of furnishing and installing the equipment at no additional cost.

3. Furnish and install any other items required for the satisfactory installation of the equal equipment at no additional cost. This includes, but is not limited to, changes in branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels, and correlation with other work, subject to the jurisdiction and approval of the Engineer.

C. Equipment and materials specified herein are named to establish a standard of quality. Other material of equal quality may be substituted per Section 01 60 00 and with approval by the Architect.

D. It is the responsibility of the Contractor to investigate any desired substitutions for specified equipment prior to submission of his bid. The contractor shall be responsible for any changes required in mechanical, electrical or structural systems resulting from equipment substitutions and shall bear all costs for those changes whether the substitute equipment is named by Architect for "equal" consideration or not. All changes shall be accomplished in a manner acceptable to the Architect at no additional cost to the Owner.

E. In order to obtain prior approval on equipment or material not specified in Division 26, 27 and 28 Specifications or Equipment Schedules, Contractor MUST submit to the Engineer any proposed equipment or material ten (10) working days prior to the bid date.

2.4 EQUIPMENT PROTECTION

A. Store all materials and equipment to be installed in the work so as to insure the preservation of their quality, workability, and fitness for the work intended. Provide storage provisions for protection from the elements, rust and physical damage. Place stored materials on clean, hard surfaces above ground and keep covered at all times to insure protection from paint, plaster, dust, water and other construction debris or operations. Install heaters under the protective cover where the equipment may be damaged due to moisture and weather conditions. Keep conduit ends plugged or capped and all covers closed on boxes, panels, switches, fixtures, etc., until installation of each item. Store all plastic conduit or duct out of direct sunlight in shaded areas. Located stored materials and equipment to facilitate prompt inspection. All boxes and packaging must remain intact.

B. Protect during installation, all equipment, controls, controllers, circuit protective devices, etc., against entry of foreign matter on the inside and be vacuum clean both inside and outside before testing, operating and painting.

C. Replace damaged equipment, as determined by the Engineer, in first class operating condition or return to source of supply for repair or replacement.

D. Protect painted surfaces with removable heavy Kraft paper, sheet vinyl or equal, installed at the factory and removed prior to final inspection.

E. Repair damaged paint on equipment and materials. Finish with same quality of paint and workmanship as used by manufacturer so repaired areas are not obvious.

F. All lighting fixtures are to be stored on the project in their original factory cartons.

2.5 EQUIPMENT ACCESSORIES

A. Furnish and install all equipment, accessories, connections and incidental items necessary to fully complete all work, ready for use, occupancy and operation by the Owner.

B. Where equipment requiring different arrangement or connections from those shown is provided, install the equipment to operate properly and in harmony with the intent of the drawings and specifications.

C. Support, plumb, rigid and true to line all work and equipment included. Study thoroughly all general, structural, electrical and mechanical drawings, shop drawings and catalog data to determine how equipment is to be supported, mounted or suspended and provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper supports whether or not shown on the drawings. When directed, submit drawings showing supports.

PART 3 EXECUTION

3.1 WORK PERFORMANCE

A. Furnish and install a temporary electrical distribution system of adequate feeder sizes to prevent excessive voltage drop. Install all temporary work in a neat and safe manner. Provide temporary lighting as necessary to furnish 2.5 footcandles on all work surfaces.

B. Field coordinate with other trades in ample time to build all chases and openings, set all sleeves, inserts and concealed materials, and provide clearances that may be required to accommodate materials and equipment. Lay out electrical work so that in case of interference with other items the layout may be altered to suit conditions encountered.

C. Cutting and Patching:

1. The Electrical Contractor shall be responsible for all required cutting, patching, etc., incidental to this work and shall make all required repairs thereafter to the satisfaction of the Engineer. Do not cut into any structural element, beam or column without the written approval of the Engineer.

2. Pipes, conduits, cables, wires, wire ducts and similar equipment that pass through fire or smoke barriers shall be protected in accordance with NFPA 101.

D. Wall Penetrations: When conduit, wireways, bus duct and other electrical raceways pass through fire partitions, fire walls, or walls and floors, install a firestop that

provides an effective barrier against the spread of fire, smoke and gases. Firestop material must be packed tight and completely fill clearances between raceways and openings. Use firestop material conforming to the following:

1. All wall penetrations shall be caulked and sealed. Provide fire barrier pillows to protect the interior of conduits/sleeves passing through fire rated walls.

2. The Contractor shall furnish and install all necessary sleeves and chases for all work passing through and attaching to walls, ceilings or the roof.

3. Provide UL listed, fire rated poke through devices for floor penetrations as required by the Standard Building Code, National Fire Code and Life Safety Code.

4. Provide UL approved fire rated chases and fire sealing as required to maintain fire rating for all penetrations in fire rated walls.

5. Firestopping material must be of the latest type as supplied by leading manufacturers such as "3M".

6. Floor, exterior wall and roof seals must be watertight. Sleeve walls and floors which are cored for installation of conduit with steel tubing, grouted and the space between the conduit and sleeve filled as specified herein. Where conduits pierce the roof, refer to architectural specifications and drawings for details. Provide pourable sealant as specified by the Roofing Contractor.

E. Do not use electrical hangers and other supports for other than electrical equipment and materials. Provide not less than a safety factor of five (5) and conform with any specific requirements as shown on the drawings or in the specifications.

F. Do not deviate from the plans and specifications without the full knowledge and consent of the Engineer. Should, at any time during the progress of the work, a new or existing condition be found which makes desirable a modification of the requirements of any particular item, report such item promptly to the Engineer for his decision and instruction.

G. Notify all other contractors of any deviations or special conditions. Resolve interferences between the work of the various contractors prior to installation. Remove, if necessary, work installed which is not in compliance with the plans and specifications as specified above, and properly reinstall without additional cost to the Owner.

H. This Contractor shall furnish all necessary scaffolding, cranes, tackle, tools and appurtenances of all kinds, and all labor required for the safe and expeditious execution of his contract.

3.2 EQUIPMENT INSTALLATION AND EQUIPMENT

A. Installation:

1. "Provide" and "Install" as used on the drawings and in the specifications means furnish, install, connect, adjust and test except where otherwise specified.

2. Install coordinated electrical systems, equipment and materials complete with auxiliaries and accessories installed.

B. Equipment Location: As close as practical to locations shown on drawings.

C. Working Spaces: Not less than specified in the National Electrical Code for all voltages specified.

D. Inaccessible Equipment:

1. Where the Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, remove and reinstall equipment as directed at no additional cost.

2. "Conveniently Accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and ductwork.

E. Equipment and Materials:

1. Install new equipment and materials unless otherwise specified.

2. Insure that equipment and materials are designed to provide satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements applied to the installation and other code requirements apply to the installation in areas requiring special protection such as explosion proof, vapor-proof, water tight and weather-proof construction.

3.3 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the National Electrical Code, install identification signage which will clearly indicate information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, time clocks, contactors, separately enclosed circuit breakers, individual breakers, and

controllers in switchgear and motor control assemblies, control devices and other significant equipment.

3.4 DRAWINGS AND SPECIFICATIONS

A. The drawings and specifications indicate the requirements for the systems, equipment, materials, operation and quality. They are not to be construed to mean limitation of competition to the products of specific manufacturers.

3.5 SYSTEM VOLTAGES

A. System voltage is 120/208 volts, three-phase, four-wire.

B. System voltage is 120/240 volts, single-phase.

C. System voltages are as follows:

1. High Voltage: 480/277 volts, three phase, four-wire.

2. Low Voltage: 208/120 volts, three phase, four-wire.

3.6 SUBMITTALS

A. Obtain the Engineer's approval for all equipment and materials before purchasing or delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval is not permitted at the job site. Only equipment and material which have been approved by submittals may be used on this project. Refer to Section 26 00 10, Paragraph 2.3.E for substitutions.

B. Include in all submittals adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval must be legible and clearly identify equipment being submitted.

C. Submit within thirty (30) days after the awarding of the Contract a complete brochure of shop drawings and descriptive data of all material and equipment, or electronic files.

1. Separate submittals are allowed for lighting, switchboards, fire alarm, and intercom.

2. All other Specification sections are to be combined into one miscellaneous submittal.

3. All submittals shall be transmitted in one package.

D. Submit to the Engineer within (30) days after the awarding of the Contract, a complete set of brochures of shop drawings and descriptive data of all material and equipment proposed for the installation. All information shall be submitted electronically in "pdf" format, and shall be separated into electronic "pdf" files in three groups, lighting, switchgear and all others.

E. The submittals must include the following:

1. Information which confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.

2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring must be identified on wiring diagrams.

3. Parts list which must include those replacement parts recommended by the equipment manufacturer.

4. Approvals will be based on complete submission only.

F. Furnish shop drawings for the work involved in sufficient time so that no delay or changes will be caused. Thermofax copies are not acceptable - only permanent type prints are allowed.

G. Verify that shop drawings comply in all respects with the item originally specified. It is the Contractor's responsibility to procure the proper sizes, quantities, rearrangements, structural modifications or other modifications in order for the substituted item to comply with the established requirements.

H. Any shop drawings prepared to illustrate how equipment, conduit, fixtures, etc., can be fitted into available spaces will be examined under the assumption that the Contractor has verified all the conditions. Obtaining approval thereon does not relieve the Contractor of responsibility in the event the material cannot be installed as shown on the drawings.

I. Shop drawings need not cover detailed installation drawings prepared for the Contractor's own use, but be limited, as in the case of raceways, to necessary departures from the plans as prepared by the Engineer.

J. Submit working scale drawings of apparatus and equipment which in any way varies from these specifications and plans, to be reviewed by the Engineer before the work is started. Correct interferences with the structural conditions before the work proceeds.

K. Submit all shop drawings at the same time in a loose-leaf binder with double index as follows:

1. List the products by designated letter or number as indicated on plan sheets.

2. List the name and manufacturers whose products have been incorporated in the work alphabetically together with their addresses and the name and addresses of the local sales representative.

3. Provide indexes with sheet numbers and quantities of the products listed.

3.7 TESTS AND DEMONSTRATION

A. As equipment and materials are being installed and connected, test the installation for the following:

1. Short circuits and ground faults.

2. Insulation resistance at 500 volts DC.

3. Grounding continuity.

4. Breaker Coordination Study.

B. After tests are completed and necessary corrections are made, put each system into operation and demonstrate its performance to the satisfaction of the Owner's authorized representative.

C. Provide written documentation of tests and performance as requested by the Owner's authorized representative. The results are to be made part of the Closeout Documents.

D. Furnish all instruments, test equipment and personnel that are required for the particular test. Certify that equipment and gauges are in good working order. Remove equipment subject to damage during test from line before test is applied.

E. After installation is complete the Contractor shall conduct operating test of all electrical systems for approval by the Architect. Test shall include verification of direction of rotation for all motors. The equipment shall be demonstrated to operate in accordance with the requirements of the plans and specifications. The test shall be performed in the presence of the Architect or Engineer.

F. Provide certified test of the grounding electrode system. It shall test to 5 ohms or less.

G. Provide a breaker coordination study for all breakers to include short circuit coordination and arc flash study with factory labels (Electrical Contractor to install). The costs involved are to be included in this contract. Provide written documentation.

3.8 COMPLETION AND ACCEPTANCE

A. Upon completion of the work and before final acceptance, perform the duties and provide the documents as follows in accordance with the General Conditions, Supplementary Conditions and Division 1 of Contract.

B. Remove all rubbish, tools and surplus materials accumulated during the execution of the work in this Division.

C. Touch up any equipment or finishes damaged during delivery or installation from the work in this Division.

D. Provide a written one-year guarantee of materials and work except for items that are specified to have a longer warranty. Items that have a published or normal life expectancy of less than one year, such as incandescent lamps are to be covered by the manufacturer's guarantee.

E. Provide systems and equipment installation, operating and maintenance instructions and catalog data for transmittal to the Owner. Place the data in a loose-leaf binder which contains an index of the products listed alphabetically by name and a separate index listing the manufacturers alphabetically by name and including the manufacturer's address and the name and address of their local representative.

F. Instruct the Owner's representative in the proper operation and maintenance of the systems and their elements as required or directed to familiarize the Owner in the operation and maintenance of the systems.

3.9 RECORD DRAWINGS

A. The Contractor shall keep a neat and accurate record of field changes made during construction. Changes shall be penciled in on a separate set of drawings used only for recording changes. At completion of the project the Contractor shall deliver this set to the Architect for preparation of record drawings.

B. Record drawings shall include corrected panel schedules and riser diagram as well as all plan sheets.

3.10 FINALLY

A. It is the intention that this specifications shall provide a complete installation. All accessories and apparatus necessary for complete operational systems shall be included. The omission of specific reference to any part of the work necessary for such complete installation shall not be interpreted as relieving this Contractor from furnishing and installing such parts.

END OF SECTION

SECTION 26 05 19

WIRES AND CABLES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Wires and cables.

1.2 RELATED WORK

A. Section 26 05 53: Identification.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wire and cable shall be new, shall have size, grade of insulation, voltage and manufacturer name, permanently marked on outer covering at regular intervals.

B. Building Wiring: 95% conductivity, soft drawn conforming to requirements of the NEC and relevant ASTM specifications, copper, 600 volt insulation, dual rated THHN-THWN.

C. Branch Circuit Wiring: Conductors smaller than No. 12 AWG not permitted; No. 8 AWG and larger, stranded construction; smaller than No. 8, either solid or stranded.

D. Fire Alarm System Wiring: UL Listed plenum-rated cable for conductors installed in plenum rated spaces. Coordinate with Authority Having Jurisdiction.

E. Exterior Wiring: Bare stranded for ground, THWN-THHN for all other.

F. Use pre-insulated pressure connectors such as Scotchlock on stranded conductors No. 10 and smaller. Use approved high-pressure crimp sleeve connectors on No. 8 and larger conductors.

G. Where allowed by local inspecting authorities, type "MC" cable shall be allowed for fixture whips. It shall be installed using proper fittings and installation tools per NEC.

H. Low voltage cable is to be installed in conduit in areas with no ceiling.

PART 3 EXECUTION

3.1 INSTALLATION

A. Make conductor length for parallel feeders identical.

B. Lace or clip groups of conductors at panelboards, pull boxes and wireways.

C. Provide copper grounding conductors and straps.

D. Install wire and cable in code conforming raceway.

E. Use wire pulling lubricant for pulling No. 4 AWG and larger wire.

F. Install wire in conduit runs after concrete and masonry work is complete and after moisture is swabbed from conduits.

G. Splice only in accessible junction or outlet boxes. Install splices and taps which have mechanical strength and insulation rating equivalent-or-better than conductor and are compatible with conductor material.

H. Color code conductors to designate neutral conductor and phase as follows: 120/208V (phases) black, red, blue, (neutral) white, (ground) green; 277/480V (phases) orange, brown, yellow, (neutral) white with color stripe, (ground) green.

I. All 20 amp circuits are 2-#12, 1-#12 ground unless noted. Use #10 AWG conductors on 20 amp branch circuits which exceed 75 feet to the first outlet.

J. Install home runs as indicated on the panel schedules. Circuits may be grouped into 3-Phase home runs but in no case are more than 3 phase conductors allowed.

K. Sharing of neutrals is not allowed, to include lighting and power circuits.

L. Where conduit and wire are installed on the roof, refer to NEC Section 310.15.(B.)(2)(C) for derating/correcting factors for the distance installed from the roof.

M. No low-voltage wiring is to be visible in open ceiling areas; install in conduit.

3.2 MARKING

A. Identify circuits using wire markers at the following locations:

1. All power and lighting branch circuits and feeders at pull boxes, fixtures, outlets, motors, etc., indicating panel and circuit number at which each circuit or feeder originates.

2. All branch circuits in the panelboard gutters indicating corresponding branch circuit numbers.

3. All signal and control wires at all termination points such as cabinets, terminal boxes, equipment racks, control panels, consoles, etc. Install in accordance with approved schedules prepared by the equipment manufacturer or by the Contractor.

4. Mark both ends of all pull wires with tag reading "PULL WIRE" and numbered to refer to the same pull wire.

END OF SECTION

SECTION 26 05 26

GROUNDING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Power system grounding.

B. Communication system grounding.

C. Building ground system.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 05 34: Conduit.

1.3 REGULATORY REQUIREMENTS

A. Install complete grounding system for the building(s) and all electrical equipment in accordance with National Electrical Code, Section 250.

PART 2 PRODUCTS

2.1 GROUNDING

A. Provide copper grounding conductors for grounding connections sized according to NEC.

PART 3 EXECUTION

3.1 POWER SYSTEM GROUNDING

A. Install NEC sized ground conductor, #12 AWG minimum, in all branch circuit and equipment conduits.

B. Bonding Jumpers: Provide green insulated wire, size correlated with over-current device protecting the wire. Connect to neutral only at service neutral bar.

C. Bonding Wires: Install bonding wire in flexible conduit connected at each end to a grounding bushing.

D. No strap type grounding clamps shall be used. All connections shall be made only after surfaces have been cleaned or ground to exposed metal.

E. The building structural steel shall be grounded as follows:

1. All locations noted on the plans or if not shown, at approximately 75 foot intervals where structural columns are located.

2. All grounding locations are to be made with 1/0 bare copper wire with exothermic welds or Burndy "HyGround" to the column, to in-footing rebar, and to a 3/4" x 8' copper ground rod. Include "Eupher" grounds at all locations shown with grounding symbol.

F. Provide one 1-1/0 bare copper ground wire from the electrical service, and from nearest branch panel, grounding electrode, in 1 1/4" conduit, to the location of each telephone terminal board and Data Room. Provide "Intersystem Bonding Termination" bars at these locations and at the electrical meter where applicable. Termination bars in data or telephone rooms are to be equal to Chatsworth Products, Inc; Model 40153-020. Ground all equipment and metal parts using #6 bare copper ground from this terminal bar.

G. Bond the neutral (grounded conductor) to ground at one location only once per building at the building's main service disconnect. Bond per NEC Article 250.

H. Ground cable trays per N.E.C.

END OF SECTION

SECTION 26 05 29

SUPPORTING DEVICES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Conduit supports.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

A. Single Runs: Galvanized conduit straps or ring bolt type hangers with specialty spring clips. All "Caddy" and "B-Line" hangers are approved.

B. Multiple conduits running horizontally at the same grade and elevation may be supported by trapezes of channels suspended on rods. All support components shall be adequate size for loaded weights being supported. Provide conduit racks with 25% spare capacity.

C. Perforated strap iron or wire shall not be used for supporting conduits or equipment.

D. Where large conduits are supported beneath bar joist, hanger rods shall be secured to angle irons of adequate size. Each angle shall span two or more joist to distribute the weight properly.

E. Supports shall be installed within three (3) feet of each coupling or connector.

F. Vertical Runs: Channel support with conduit fittings, clamp type supports where conduits penetrate floors.

2.2 ANCHOR METHODS

A. Hollow Masonry: Toggle bolts or spider type expansion anchors.

B. Solid Masonry: Lead expansion anchors or preset inserts.

C. Metal Surfaces: Machine screws, bolts or welded studs.

D. Wood Surfaces: Wood screws.

E. Concrete Surfaces: Self drilling anchors or power driven studs.

2.3 METAL FRAMING SYSTEMS

A. Provide metal framing systems for electrical equipment and conduits as required for proper support spacing and approved for the purpose. Powerstrut, Unistrut, Kindorf or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads required.

B. Install horizontal supports at eight feet (8') on centers, at fittings and corners, and as required for proper support.

C. Provide a complete installation with all channels, accessories, screws, nuts, washers, inserts, springs, clamps, hangers, clips, fittings, brackets framing fittings, post bases and brackets to provide a structural rigid support or mounting system.

D. On the roof, provide B-Line DB series roof top support bases. Provide two supports per 10' length of conduit. Conduit to be 24" off the roof, minimum. Provide 1/2" rubber pads under the B-Line support blocks. Coordinate to be higher than other trades' piping on the roof. Install conduit in the ceiling space below where possible.

END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.1 WORK INCLUDED

A. Conduit and couplings.

B. Flexible conduit.

1.2 RELATED WORK

A. Section 26 05 53: Identification.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit/Elbows: Rigid steel threaded ANSI C80.1; electrical metallic tubing ANSI C80.3, Schedule 40 PVC.

B. Couplings/Connectors: Threaded; liquid-tight; compression gland. Set screw type products are not allowed.

C. Flexible Conduit: Aluminum or steel armor, plastic jacketed type with liquid-tight connectors used only at motor/equipment terminations. Connectors are to be metal.

D. Metal Clad Cable: Type "MC" cable may be used where allowed by local codes for fixture whips only.

E. PVC or High Density Polyethylene Conduit: HDPE or PVC conduit is acceptable for underground and innerduct applications.

2.2 TYPE

A. Utilize rigid steel conduit (3/4" minimum) in the following locations:

1. In concrete.

2. In exterior locations.

3. Areas subject mechanical abuse.

B. Utilize electrical metallic tubing in other locations, 3/4" minimum. Only E.M.T. is allowed in walls. E.M.T. may be Steel or Aluminum.

C. Make connections to motors and equipment with PVC jacketed flexible conduit and liquid-tight connectors. Minimum size 1/2" for motor connections. Use 3/8" Greenfield flexible conduit only for fixture wiring. Provide sufficient length of flexible conduit to avoid transmission of vibration. Install straps per NEC.

D. PVC conduit may be used for underground service entrance conduits and all low voltage under-slab applications. It is not to be installed exposed. Elbows for service conduits and panel feeders are to be galvanized rigid.

E. Flexible conduit is not allowed within walls.

F. Only service entrance conduits and panel feeder conduits may be installed under the slab, Exception being for floor boxes, cabinets and equipment located away from wals.

G. Conduit on the roof is rigid aluminum.

2.3 MARKING

A. All empty conduit shall be left with a pull string for future use, and shall be permanently marked on each end with like numbers.

B. Mark the conduits and boxes mentioned in this Section paragraph 2.2F as to circuits included and on the record drawings.

C. All low voltage conduit (temperature control, lighting control, telephone/data, etc.) shall be blue.

D. All fire alarm conduit shall be red.

PART 3 EXECUTION

3.1 INSTALLATION

A. All wiring systems shall be installed in raceways consisting of galvanized steel tubing, PVC conduit, HDPE conduit, rigid galvanized steel, flexible steel conduit or neoprene covered flexible steel conduit.

B. Water tight junction boxes, fittings, expansion joints, compression fittings (for use with all electrical tubing), conduit hubs, etc., shall be provided, for all electrical systems wherever construction dictates, including, but not limited to, outdoor locations.

C. Flexible conduit used in outdoor locations or indoor locations where exposed to continuous or intermittent moisture shall be liquid tight, neoprene covered and UL listed. All fittings for such applications shall be liquid tight, nylon insulated throat type as manufactured by Thomas and Betts, Series 5331, or approved equal.

D. Sufficient slack shall be provided in all flexible conduit connections to reduce the effects of vibration.

E. Insulated bushings shall be used where rigid conduit is installed in any enclosure or junction box. In addition, insulated bushings shall be used on all conduits 1 1/4-inch and larger.

F. All conduit bends shall have a radius greater than or equal to that stipulated by the NEC.

G. Install conduit concealed in all areas excluding mechanical and electrical rooms and conduit to fixtures in rooms without ceilings.

H. For exposed runs, attach surface mounted conduit with clamps.

I. Coordinate installation of conduit in masonry work.

J. Install conduit free from dents and bruises. Plug ends to prevent entry of dirt or moisture.

K. All conduit systems shall be installed complete and shall be cleaned out before installation of conductors.

L. Alter conduit routing to avoid structural obstructions, minimizing crossovers.

M. Seal conduit with glass fiber where conduits leave heated area and enter unheated area.

N. Provide flashing and pitch pockets making watertight joints where conduits pass through roof or waterproofing membranes. Provide pourable sealant as approved by the Roofing Contractor.

O. Install UL approved expansion fittings complete with grounding jumpers where conduits cross building expansion joints (review architectural and structural drawings and coordinate with General Contractor to determine expansion joint locations). Provide bends or offsets in conduit adjacent to building expansion joints where conduit is installed above suspended ceilings.

P. Avoid routing conduit through public spaces with exposed structure where possible.

Q. Route all exposed conduits parallel or perpendicular to building lines. Coordinate all exposed conduit locations with the Architect prior to rough-in.

R. In exposed ceiling areas stub conduits feeding devices in walls out of the wall as high as possible at bottom of structure or bond beam, whichever is higher.

S. Allow minimum of 6-inch clearance at flues, steam pipes and heat sources. Allow 12-inch clearance at telephone conduits. Where possible, install horizontal raceway runs above water and steam piping.

T. Install conduit system from cabinets to boxes, boxes to outlet and outlet to outlet in such a manner as to be electrically continuous throughout.

U. Make bends or offsets with approved bender or hickey.

V. Where conduits are stubbed up for low voltage cabling or future use, do so neatly; furnish with nylon pull string, conduit caps and labeling on each end.

W. Securely support conduits from the structure using approved type clamps, hangers and assemblies. Space supports according to manufacturer's recommendations and accepted practice. Do not support conduits from ceiling suspension system. In no case exceed support spacing per NEC maximum.

X. Avoid installing conduit on the roof. Where necessary, support conduits via B-Line type DB supports and the appropriate strut straps. Support twice per 10' length of conduit. Use supports which hold conduit 24 inches above roof. Conduit on the roof is rigid aluminum. Provide 1/2" rubber pads under the conduit supports.

Y. Leave a nylon pull string in all empty conduits. Terminate empty conduit stubouts with bushing manufactured for that purpose.

Z. Install properly sized grounding conductor in all conduit.

AA. Elbows for service and panel feeders are to be galvanized rigid conduit.

BB. No conduit may be installed in slab. Conduit for stub-ups and panel feeders are to be installed with the top of the conduit at a minimum of four inches under the slab. Bed with one-half inch washed rock. Conduit for floor boxes is to be installed coming out of the bottom of the floor box and installed under slab.

CC. Provide conduit for all low voltage cable installed in areas which have no ceiling or hard ceilings.

DD. All data/telephone conduits are to be "home-run" to an area above an accessible ceiling. No "Daisy Chaining" allowed.

EE. No "Daisy Chaining" of fixtures is allowed.

FF. Seal conduits where they transition from underground distribution system to the interior of a building or structure, refer to N.E.C. 225.27.

GG. Where conduit penetrates walk-in coolers or freezers it shall be non-metallic. All fittings, conduit, and boxes touching the wall of the coolers or freezers shall be non-metallic. On the non-conditioned side of the penetration provide a “seal-off” fitting and pour it with the recommended sealant after the installation of wiring. All spaces around the penetrations shall be sealed with the appropriate type sealant as recommended by the equipment manufacturer. This shall apply to low voltage wiring as well as line voltage wiring.

END OF SECTION

SECTION 26 05 37

OUTLET AND PULL BOXES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Outlet boxes.

B. Pull and junction boxes.

1.2 RELATED WORK

A. Section 26 05 53: Identification.

B. Section 26 27 26: Wall Switches, Receptacles and Plate Covers.

C. Section 27 10 05: Conduit for Telephone/Data and TV Raceway System.

PART 2 PRODUCTS

2.1 MATERIALS

A. Boxes: Hot dip galvanized, 1.25 oz/sq.ft. or cadmium plated, conforming to UL requirements.

B. Interior Boxes: Pressed sheet steel blanked for conduit.

C. Exterior Boxes: Corrosion-resistant cast, deep type, with face plate gasket and corrosion-resistant fasteners.

D. For Ceiling: 4" square boxes for receiving three or less 3/4" conduits.

E. For Flush Mounting in Walls: 4" square boxes with matching plaster cover for single or two gang outlets. For larger boxes, use solid type or special units, with flush plates.

F. Surface Mounted: 4" square.

G. Pull Boxes and Junction Boxes: Metal construction, conforming to National Electrical Code, with screw-on or hinged cover.

H. Flush Mounted Pull Boxes: Provide overlapping covers with flush head cover retaining screws, prime coated.

I. For floor boxes, refer to the electrical legend on the plans.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount outlet boxes flush in areas other than mechanical rooms, electrical rooms, above removable ceilings, and on exposed structure in rooms without ceilings.

B. Do not install boxes back-to-back in same wall, allow 6" minimum horizontal spacing between boxes.

C. Do not use sectional or handy boxes unless specifically requested.

D. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes to prevent condensation in boxes.

E. For outlets mounted above counters, benches and splashbacks, coordinate location and mounting heights with built-in units. Adjust outlet mounting height to agree with required location for equipment served.

F. Securely mount each outlet box to metal studs with outlet box mounting supports. Secure to at least two studs or install box stabilizers as manufactured by "B-Line" and "Caddy".

G. Do not install more than three 3/4" conduits into one 4" outlet box. Do not use more than one extension ring on a box.

H. For heights of outlets above the finished floor in permanent partitions, use the following unless otherwise noted: To Center of Device:

1. Convenience Receptacles: 18" or as directed.
2. Brackets: As directed.
3. Switches: 46" or as directed.
4. Telephone Outlets: 18" or as directed.
5. Other Outlets: As directed or indicated.
6. Over Counters: 6" above countertop, horizontal at windows or where indicated.
7. Fire Alarm Pull stations: Minimum 42” and Max 48” measured vertically, from the floor level to activating handle or lever.
8. Fire Alarm Audio Visual Device: 80” to top of box

I. Locate pull boxes and junction boxes above removable ceiling or in electrical rooms, utility rooms or storage areas.

J. Install pull boxes of the proper size and depth to accommodate the required conduits and wires.

K. When installing outlet boxes in fire rated walls, provide fire blocking material on the back side of the boxes.

L. Coordinate box mounting height with brick courses, where applicable.

M. Study all devices and light fixtures, providing and installing applicable outlet and back boxes as necessary.

N. Boxes for fire alarm systems are to be painted red.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide and install identification markers.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 05 34: Conduit.

C. Section 26 05 37: Outlet and Pull Boxes.

D. Section 26 24 16: Panelboards.

E. Section 26 28 18: Motor and Circuit Disconnects.

PART 2 PRODUCTS

2.1 MATERIALS

A. Provide nameplates of laminated phenolic plastic with engraved letters 3/16" high at push-button stations, thermal overload switches, receptacles, wall switches and similar devices where the nameplate is attached to the device plate. At all other locations, make lettering 1/4" high, unless otherwise detailed on the drawings. Securely fasten nameplates to the equipment. Motor nameplates may be non-ferrous metal not less than 0.03" thick, die stamped.

B. Pre-marked, self adhesive, wrap around type markers, manufacturers: Brady, T&B, E-Z Code.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Equip the following items with nameplates:

1. All motors, motor starters, motor control center, push-button stations, control panels, time switches.

2. Disconnect switches, fused or unfused, switchboards and panelboards, circuit breakers, contactors or relays in separate enclosure.

3. Power receptacles where the nominal voltage between any pair of contacts is greater than 150 volts.

4. Wall switches controlling outlets for lighting fixtures or equipment where the outlets are not located within sight of the controlling switch.

5. Special electrical systems at junction and pull boxes terminal cabinets and equipment racks.

B. Adequately describe the function of or use of the particular equipment involved. Where nameplates are detailed on the drawings, use inscription and size of letters as shown. Include on nameplates for panelboards and switchboards the panel designation, voltage and phase of the supply. The name of the machine or the motor nameplates for a particular machine must be the same as the one used on all motor starter, disconnect and push button station nameplates for that machine.

C. The Contractor shall provide typed panel schedules for all electrical panels. Schedules shall reflect actual wiring incorporating all field changes. Copies of Panel Schedules from the construction drawings are not acceptable.

1. Panel Schedules shall reflect room numbers as depicted by the Owner as well as construction numbers.

D. Label all junction boxes with a black permanent marker indicating circuit number and distribution panel or motor control center feeding the circuits contained therein.

E. At each panel, provide a phenolic plastic plate with 1/4-inch high engraved letters, stating the voltages in the panel, the color code of the wires in the panel, power supply origination, the arc flash hazard, and the date of the installation. Attach to the panel cover with stainless steel bolts, locknuts and nuts or locking nuts. At the main disconnect, provide a label noting the available fault current and date of installation.

F. All breakers within each panel are to be labeled.

G. All underground conduits are to be labeled as to each end.

END OF SECTION

SECTION 26 05 73

OVERCURRENT PROTECTIVE DEVICES

PART 1 GENERAL

1.1 WORK INCLUDED

A. Fuses.

B. Molded-case circuit breakers.

1.2 RELATED WORK

A. Section 26 24 16: Panelboards.

B. Section 26 28 18: Motor and Circuit Disconnects.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Fuses:

1. Bussman.

2. Littlefuse.

B. Breakers and Relays:

1. Eaton.

2. General Electric.

3. Siemens.

4. Square D.

2.2 CIRCUIT BREAKERS

A. General: Except as otherwise indicated, provide circuit breakers and ancillary components, of types, sizes, ratings and electrical characteristics indicated, which comply with manufacturer's standard design, materials, components and construction in accordance with published product information and as required for a complete installation.

B. Molded-Case Circuit Breakers: Provide factory assembled molded-case circuit breakers of frame assembled molded-case circuit breakers of frame size voltage and

interrupting ratings as indicated on the drawings. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole and ampere ratings and indicated. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick break action and positive handle indication. Construct breakers for mounting and operating in any physical position and operating in an ambient temperature of 40 Deg. C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

C. Any overcurrent protection device rated 1200A or higher shall be furnished with an enegy-reducing maintenance switching feature with local status indication. This feature shall be furnished with the overcurrent device by the manufacturer.

D. Tandem circuit breakers are not acceptable.

2.3 FUSES

A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings and average time-current and peak let through current characteristics indicated, which comply with manufacturers' standard design, materials and construction in accordance with published product information and with industry standards and configurations.

B. Class RK1 and Class J Current Limiting Fuses: Provide UL Class RK1 and Class J current limiting fuses rated 200,000 RMS symmetrical interrupting current for protecting motors and equipment, equal to Buss LPN-RK or LPS-RK.

PART 3 EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES

A. Install overcurrent protective devices as indicated in accordance with the manufacturer's written instructions and with recognized industry practices to insure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

B. Coordinate with other work, including electrical wiring work as necessary to interface installation of overcurrent protective devices.

C. Fasten circuit breakers without mechanical stresses, twisting or misalignment being exerted by clamps, supports or cabling.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short circuits. Correct malfunctioning units and then demonstrate compliance with requirements.

END OF SECTION

SECTION 26 21 02

UNDERGROUND DISTRIBUTION

PART 1 GENERAL

1.1 DESCRIPTION

A. Work in contract: As indicated on plans.

B. Work not in contract:

1. Service transformer(s): Provided by serving utility.

2. Primary conductors: Provided by serving utility.

1.2 SUBMITTALS

A. Shop drawings:

1. Pull Boxes.

B. Product data:

1. Specification comparison.

2. Duct bank conduit separation.

C. Project information:

1. Test reports.

1.3 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Store conduit to avoid warping or deterioration.

B. Store plastic conduit on flat surface protected from direct rays of sun.

1.4 JOB CONDITIONS

A. Protect existing utilities and structures as indicated in Section 26 00 10.

B. Avoid overloading. Keep surcharge sufficient distance back from edge of excavation to prevent slides or caving. Maintain and trim excavated materials in such a manner to be as little inconvenience as possible to public and adjoining property owners.

C. Provide full access to public and private premises, to fire hydrants, at street crossings, sidewalks and other points as designated by Engineer to prevent serious interruption of travel.

PART 2 PRODUCTS

2.1 DUCT SYSTEM

A. Primary duct system: Multiple (or single) 4-inch single, round-bore PVC conduits, coordinate with the local utility company.

1. Rigid PVC conduit: As specified in Section 26 05 34.

2. Separators: Concrete, plastic or other non-metallic, non-decaying material.

B. Pull wire: 1/4-inch heavy nylon cord or 1/4-inch pull tape, free of kinks and splices.

2.2 PULL BOXES

A. Conduit pull boxes equal to Quazite # PC1324 BB12/00, cover # PC1324CA-17. Modify size to match quantity of conduits used. Space per NEC.

B. Provide gravel bed with drainage and install per manufacturer's instructions.

2.3 BACKFILL MATERIAL

A. Backfill material:

1. 1/2 inch washed rock.

PART 3 EXECUTION

3.1 EXCAVATING AND TRENCHING - GENERAL

A. Remove and dispose of materials determined by Civil Engineer to be unsuitable.

B. Trench, backfill and compact for all underground utilities.

3.2 TRENCH EXCAVATION

A. Excavate trenches by open cut method to depth necessary to accommodate the work.

1. Permission may be granted for tunnel work for crossing under crosswalks, driveways or existing utility lines.

B. Open no more than 300 LF of trench at one time, or less, as required by Engineer. Failure to comply may necessitate shutdown of entire project until backfilling is performed.

C. Carry rock excavations minimum of 12 inches below indicated grades.

D. Avoid over-excavating below indicated grades unless required to remove unsuitable material.

E. Back-fill over-excavations with 1/2 inch rock.

F. Trench size: Excavate only sufficient width to accommodate free working space.

1. Cut trench walls vertically from bottom of trench to top of conduit.

G. Keep trenches free of water.

3.3 EXISTING UTILITIES

A. Protect all existing utilities.

B. Pay fees for all new services.

3.4 INSTALLATION OF PRIMARY AND SECONDARY DUCT SYSTEM

A. Install duct lines so that top of conduit is not less than 30 inches for secondary ducts and 48 inches for primary ducts below finished grade or finished paving at any point.

B. Accomplish changes in direction of runs exceeding total of 10 degrees, either vertical or horizontal, by long sweep elbows.

1. Manufactured bends: Minimum radius of 48 inches for primary ducts of 4 inches in diameter and larger, 24 inches for secondary ducts.

C. Thoroughly clean conduit before using or laying.

D. Lay no conduit in water or in unsuitable weather or trench conditions.

E. During construction and after duct line is completed, plug ends of conduits to prevent water washing into conduit or manholes.

1. Take particular care to keep conduits clear of concrete, dirt, and any other substance during course of construction.

F. After duct line has been completed, pull standard flexible mandrel not less than 12 inches long, with diameter approximately 1/4 inch less than inside diameter of conduit, through each conduit. Then pull brush with stiff bristles through each conduit to make certain that no particles of earth, sand, or gravel have been left in line.

G. Pneumatic rodding may be used.

H. Install nylon pull string in all unused new ducts.

1. Extend minimum of 3 feet into each manhole or above pads beyond ends of ducts.

I. Encase each secondary conduit completely in concrete not less that 3 inches beyond any surface of conduit.

1. Do not place concrete until conduits have been inspected by Architect/Engineer.

J. Provide uniform spacing between conduits: Not less that 3.5 inches.

1. Place separators on maximum 4 feet centers.

2. Securely anchor ducts to prevent movement during placement of concrete.

K. Make conduit joints in accordance with manufacturer's recommendations for conduit and coupling selected.

1. Make plastic conduit joints by brushing plastic solvent cement on inside of plastic coupling fitting and outside of conduit ends.

2. Slip conduit and fitting together with quick one-quarter-turn twist to set joint tightly.

L. Coordinate service conduits entering the building with the Structural Engineer.

3.5 BACKFILLING

A. Do not backfill until all tests are performed on system, and system complies with specified requirements.

B. Hand or pneumatic tamp backfill around and over pipe in lifts not exceeding 8 inches loose thickness.

C. Compact to density specified, so pipe will not be injured.

D. Exercise care in backfilling operations to avoid displacing pipe joints either horizontally or vertically and to avoid breaking pipe.

E. Do not water flush for consolidation.

3.6 COMPACTION

A. Compact all trench backfill in areas under paved roads, parking areas, sidewalks and other structures as directed by Civil Engineer to at least 95 percent of maximum dry density.

B. In locations where trench will not be under paved areas, compact backfill to minimum 90 percent of maximum dry density.

C. Remove materials which cannot be compacted as specified.

D. Backfill with 1/2 inch washed rock.

END OF SECTION

SECTION 26 22 00

TRANSFORMERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Extent of transformer work is indicated by drawings and schedules.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's data on power/distribution transformers, including certification of transformer performance efficiency at indicated loads, percentage regulation at 100% and 80% power factor, no-load and full-load losses in watts.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers:

1. HEVI-DUTY.
2. Acme.
3. Square "D".
4. Eaton.
5. General Electric.

2.2 POWER/DISTRIBUTION TRANSFORMERS

A. General: Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer. Ground step-down transformer secondaries as indicated on the drawings. Do not ground to water pipes.

2.3 DRY-TYPE DISTRIBUTION TRANSFORMERS

A. Transformers 225 KVA or less: Provide factory assembled, general purpose, air cooled, dry type distribution transformers where shown, of sizes, characteristics and rated capacities indicated; three phase, 60 Hz, 4.5% impedance with 480 volts primary and 208Y120 volts secondary. Provide primary winding with 6 taps, 2 above and 4 below full rated voltage for a de-energized tap-changing operation. Insulation to be in

accordance with NEMA ST20 Standards for a 220 degree C UL Component Insulation System and rate for continuous operation at rated KVA. Transformers are to be rated at 150 degrees C temperature rise at standard sound levels. They shall comply with TP1/TP2 Standards.

B. Provide wiring connectors suitable for copper wiring. Mount transformers on ribbed neoprene vibration isolation pad. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap. Provide transformers with fully enclosed sheet steel enclosures. Apply manufacturer's standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for floor mounting, unless noted otherwise.

PART 3 EXECUTION

3.1 INSTALLATION OF TRANSFORMERS

A. Install transformers as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and IEEE standards and in accordance with recognized industry practices and insure that products fulfill requirements.

B. Coordinate transformer installation work with electrical raceway and wire/cable work, as necessary for proper interface.

C. Install units on vibration mounts; comply with manufacturer's indicated installation method. Connect transformer with flexible conduit for both primary and secondary feeders.

D. Connect transformer units to electrical wiring system. Comply with requirements of other Division 26 sections. Wiring connections to be in strict conformity with NEC.

E. Provide all disconnects necessary per NEC.

3.2 GROUNDING

A. Provide tightly fastened equipment grounding and bonding connections for transformers as indicated. Ground secondary windings to building steel, as per NEC 250.

3.3 TESTING

A. Upon completion of installation of transformers, energize primary circuit at rated voltage and frequency from normal power source and test transformers including, but not limited to, audible sound levels, to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at the site, then retest to

demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Branch circuit panelboards.

1.2 REGULATORY REQUIREMENTS

A. Construct panelboards to UL standards and provide UL labels.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Eaton.

B. General Electric.

C. Siemens.

D. Square D.

2.2 ENCLOSURES

A. Panels: Surface (or flush) mounted complete with hinged trim with outer door lock and metal directory frame.

B. Panel Can: Galvanized, painted to match trim.

C. Keys: Provide two keys for each panel. Make keys interchangeable for panels on this project.

2.3 120/208 AND 277/480 VOLT PANELBOARDS

A. Panelboards: Three phase, 4-wire, solid neutral design with sequence style bussing, full capacity neutral and bare uninsulated grounding bar bolted to enclosure, composed of an assembly of bolt-in-place molded case automatic air circuit breakers with thermal and magnetic trip and trip free position separate from either "ON" or "OFF".

B. Furnish and install power and distribution panelboards, equipped with thermal magnetic molded case circuit breakers of frame, trip ratings and interrupting capacities, as shown on the panelboard schedule, manufactured in accordance with the

latest NEMA standards, listed by Underwriters' Laboratories, Inc. and bearing the UL label.

C. Panelboard Main Bus, Main Lugs and/or Main Breaker: Copper only with current ratings as shown on the panelboard schedule. Current density in accordance with Underwriters' Laboratories requirements. Bus mounting for circuit breakers of the bolted connection type and accommodating any combination of circuit breaker units without further modification, wiring lugs suitable for copper conductors.

D. Circuit Breakers: Quick make and quick break trip free on overload or short circuit; multi-pole breakers with common trip, wiring terminals suitable for the type conductor specified, bolt-on connections to the bus.

E. Steel Box: As specified by Underwriters' Laboratories standards, end walls removable, size of wiring gutters in accordance with Underwriters' Laboratories standards, trim of code-gauge steel with primer and durable enamel finish, trim doors equipped with spring latch and cylinder lock keyed alike. Each individual circuit to be clearly numbered on the face of the panelboard and a directory for circuit identification provided.

F. Where noted on the plans, provide "SPD" units.

1. On main service equipment provide units equal or better than 125 kA per mode, minimum.

2. On sub panels provide units equal to 80 kA per mode, where called for.

3. All units to be built in to the panels called for. Provide with phase indicating lights and disconnecting means.

G. Switchboards are to be supplied with copper bus and standard electronic metering. Where switchboards have main breakers, provide with lightning arrestors and loss of phase protection.

H. The panelboard wholesale supplier shall have an office and a stocking warehouse within 100 miles of the project site. The distributor/manufacturer's representative shall have an office within 100 miles of the project site, and shall have on staff a full time designer as well as personnel who are available to service the project after completion.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide mounting brackets, busbar drillings and filler pieces for unused spaces.

B. Prepare and affix typewritten directory to inside cover of panelboard indicating loads controlled by each circuit. Label with construction and permanent room numbers.

C. Provide 4-inch housekeeping concrete pads for all floor mounted units which are located inside the building or outdoors.

D. At each panel, provide a phenolic plastic plate with 1/4-inch high engraved letters, stating the voltages in the panel and the color code of the wires in the panel and the available fault current and date of installation. Attach to the panel cover with stainless steel bolts, locknuts and nuts or locking nuts.

E. Arc flash warning labels are to be equal to Brady # 121130 ot Y972346.

END OF SECTION

SECTION 26 27 26

WALL SWITCHES, RECEPTACLES, AND PLATE COVERS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Wall switches.

B. Receptacles.

C. Plate covers.

1.2 RELATED WORK

A. Section 26 05 26: Grounding.

B. Section 26 05 37: Outlet and Pull Boxes.

C. Section 26 05 53: Identification.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Arrow Hart.

B. Bryant.

C. Eagle.

D. General Electric.

E. Hubbell.

F. Leviton.

G. P&S.

H. Substitutions: See Section 26 00 10 - General Electrical Provisions.

2.2 WALL SWITCHES

A. Acceptable Devices

1. Single Pole Switch: Type 1221, or equal.

2. Double Pole Switch: Type 1222, or equal.

3. Three-way Switch: Type 1223, or equal.

4. Four-way Switch: Type 1224, or equal.

5. Dimmers: Lutron "NOVA" Series or equal; size as required per the circuit wattage, 600 watt minimum. Provide type for the fixtures being dimmed.

6. Two-pole switches used to control two loads, like lights and exhaust fans in restrooms, must be "rated" for that duty.

7. Keyed Switches: Provide four keys per switch.

B. Materials

1. 120/277 Volt Switches: Quite slow make, slow break design, toggle handle with totally enclosed case, rated 20 ampere, specification grade. Provide matching two pole, three-way and four-way switches.

2. Color: Coordinate with the Architect.

3. Dimmers: Electronic switching type with toroid filter coil to eliminate RF interference.

4. Two-pole switches used to control two loads, like lights and exhaust fans in restrooms, must be "rated" for that duty.

5. Provide metal barrier between gangs in boxes, where adjacent switches have a potential in excess of 300V between conductors.

2.3 RECEPTACLES

A. Device: Receptacles In General Use Areas of Project: All receptacles shall be commercial grade and shall be "Tamper Resistant."

1. Duplex Receptacle: Type BR20TR, or equal.

2. Duplex Receptacle, GFCI: Type GFTR20, or equal.

3. Single Receptacle: Type 5361, or equal.

4. Special Outlets: See Plans.

5. Isolated Ground Receptacle: Type 5362IG, or equal.

B. Devices

1. Standard Duplex Receptacle: Nema 5-20R. Full gang size, polarized, duplex, parallel blade, U grounding slot, rated at 20 amperes, 125 volts, designed for split feed service.

2. Nameplates: Provide engraved or embossed plastic for receptacles other than standard duplex and standard single receptacles indicating voltage, phase and amperes.

3. Isolated ground outlets to be orange, emergency circuit devices to be red, all other device colors to be coordinated with the Architect.

4. Exterior receptacles are to be "GFI" and rated as "weather resistant".

C. Devices: Receptacles in Hospital/Healthcare applications shall be extra heavy duty "Hospital Grade."

1. Duplex Receptacle: Type 8300, or equal.

2. Tamper Resistant: Type 8300SG, or equal.

3. Tamper Resistant, GFCI: Type GFR8300TR, or equal.

D. Devices: Receptacles in Industrial applications shall be extra heavy duty.

1. Duplex Receptacle: Type 5362, or equal.

2. Duplex Receptacle, Weather Resistant: Type 5362WR, or equal.

3. Single Receptacle, Weather Resistant: Type 5361WR, or equal.

2.4 PLATE COVERS

A. Materials

1. Stainless Steel: Type 302 or 304, No. 4 finish, 0.040 inches thick, accurately die cut, protected with release paper.

2. Cast Metal: Die cast profile, ribbed or strength, flash removed, primed with grey enamel, furnished complete with four mounting screws.

3. Gaskets: Resilient rubber or closed cell foam urethane.

4. Nylon: High-performance, molded nylon.

5. Stamped Metal: For use on 4" square boxes.

B. Device

1. Flush Mounting Plates: Beveled type with smooth rolled outer edge.

2. Surface Box Plates: Beveled, steel, pressure formed for smooth edge to fit box.

3. Weatherproof Plates: CAST METAL, gasketed; for receptacles, provide the weatherproof "while in use" type.

4. Where two-gang boxes are required for single gang devices, provide special plates with device opening in one gang and second gang blank.

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate switch mounting location with architectural detail and heights as noted on plans.

B. Run separate neutral for each lighting circuit.

C. Install switches at 46" to center above finished floor, coordinate with brick layers where applicable.

D. Mount receptacles at mounting heights specified on the plans, 18" to center of the box unless noted otherwise.

E. Connect all devices using pigtails. Do not through-wire on device terminals.

F. Mount outlets for electric water coolers and other similar permanently installed plug connected equipment behind equipment according to approved installation drawing, coordinate with the equipment installer.

G. Install coverplates on wiring devices level and with all four edges in contact with finished surface.

H. Use stainless steel plates or nylon plates, color to match devices as specified by the Architect, in all interior areas unless noted. Use steel plates in mechanical and utility type areas.

END OF SECTION

SECTION 26 28 18

MOTOR AND CIRCUIT DISCONNECTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide and install motor and circuit disconnects.

1.2 REGULATORY REQUIREMENTS

A. Conform to National Electrical Code and to applicable inspection authority.

1.3 REFERENCES

A. Underwriters' Labs, Inc. Annual Product Directories.

B. Classification of Standard Types of Non-ventilated Enclosures for Electric Controllers, National Electrical Manufacturers Association.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Eaton.

B. General Electric.

C. Hubbell.

D. Leviton.

E. Square D.

2.2 EQUIPMENT

A. Provide motor and circuit disconnects with UL label.

B. Single Phase 120 Volt Disconnect Switches: Double pole toggle switch, Leviton MS302.

C. Provide with lockable covers.

D. Three-Phase Motor Disconnect Switches and Single Phase 240 Volt Disconnect Switches: 2 or 3 pole heavy duty fusible or non-fusible as shown, 250 or 480 volt as required in NEMA Type 1 or 3 enclosures. Provide with lugs for suitable wire range,

with ground lug, copper current carrying parts, silver-tungsten contacts, reinforced fuse clips for type R rejection fuses.

E. Provide NEMA "4/4X" type disconnects within the kitchen area.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install motor and circuit disconnect as recommended by manufacturer and as required by Code.

B. Where required by local authorities, install disconnects for all roof mounted equipment separate from that equipment. Furnish (galvanized) "Unistrut" or angle iron mounting stands with B-Line DB series roof top support base. Coordinate with the equipment supplier and Roofing Contractor.

END OF SECTION

SECTION 26 41 13

STRUCTURAL LIGHTNING PROTECTION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

A. Provide a complete lightning protection system for the building(s) or structures included on the contract drawings. The system shall provide safety for the building, the buildings contents and occupants by preventing damage caused by lightning. The design of this system is to be in strict accordance with this section of the specifications and all contract drawings that apply.

B. The lightning protection system shall be installed by a firm actively engaged in the installation of Master Labeled Lightning Protection Systems and shall be so listed by Underwriters Laboratories Inc. The completed system shall comply with the latest editions of the Installation Requirements for Lightning Protection Systems, UL96A and of the National Fire Protection Association's Lightning Protection Standard, NFPA 780.

C. The work covered under this section of the specification consists of furnishing labor, materials and services required for the completion of a functional and unobtrusive lightning protection system approved by the architect, engineer and Underwriters Laboratories Inc.

1.2 REFERENCES:

A. The completed lightning protection system shall comply with the latest issue of the following standards and form a part of this specification.

1. NFPA 780, Standard for the Installation of Lightning Protection Systems.

2. UL 96A, Installation Requirements for Lightning Protection Systems

1.3 SUBMITTALS:

A. Shop drawings shall be submitted to the architect and engineer for approval prior to commencement of the installation. Shop drawing are to show the extent of the system layout designed specifically for the building(s) or structures included in the contract drawings along with details of the products to be used in the installation.

B. All design drawings are to be stamped and signed by a licensed Professional Engineer (P.E.) in the State where the project is located.

1.4 QUALITY ASSURANCE:

A. The installing contractor shall furnish a certificate of completion from an authority having jurisdiction upon completion of the installation.

PART 2 - PRODUCTS

2.1 STANDARD

A. All materials used in the installation shall be new and shall comply in weight, size and composition as required by UL 96A and NFPA 780 and shall be labeled or listed by Underwriters Laboratories Inc. for use in lightning protection systems. The system furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection equipment. The manufacturer shall be listed by UL as a recognized manufacturer of lightning protection components.

2.2 ACCEPTABLE MANUFACTURER

A. Harger Lightning & Grounding.

B. Bonded Systems.

C. Thompson Lightning Protection, Inc.

D. Or Approved Equal.

2.3 MATERIALS

A. Class I materials shall be used on structures that do not exceed 75 feet in height and Class II materials shall be used on structures that are 75 feet or higher above average grade.

B. Copper materials shall not be mounted on aluminum surfaces including Galvalume, galvanized steel and zinc; this includes these materials that have been painted.

C. Aluminum materials shall not come into contact with earth or where rapid deterioration is possible. Aluminum materials shall not come into contact with copper surfaces.

2.4 AIR TERMINALS

A. Air terminals shall project a minimum of ten inches above the object or area it is to protect and shall be located at intervals not exceeding 20'-0” along ridges and along the perimeter of flat or gently sloping roofs (flat or gently sloping roofs include roofs that have a pitch less than 3:12). Flat or gently sloping roofs exceeding 50'-0” in width

shall be protected with additional air terminals located at intervals not exceeding 50'. Air terminals shall be located within two feet of roof edges and outside corners of protected areas.

B. Air terminals shall be installed on stacks, flues, mechanical units and other metallic objects not located within a zone of protection and which have an exposed metal thickness less than 3/16 of an inch. Objects having an exposed metal thickness 3/16 of an inch or greater shall be connected to the lightning protection system as required by the specified standards using main size conductor and bonding plates having a minimum of 3 square inches of surface contact area.

C. Air terminal bases shall be securely fastened to the structure in accordance the specified standards including the use of adhesive that is compatible with the surface it is to be used on or stainless steel fasteners.

D. Main conductors shall be sized in accordance with the specified standards for Class I or Class II structures and shall provide a two way horizontal or downward path from each air terminal to connections with the ground system. Conductors shall be free of excessive splices and no bend of a conductor shall form a final included angle of less than neither 90 degrees nor have a radius of bend less than 8 inches.

E. Down conductors shall be sized in accordance with the specified standards and in no case shall be smaller than the main roof conductor. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure. In no case shall a structure have fewer than two down conductors. Where down conductors are installed exposed on the exterior of a structure and are subject to physical damage or displacement, guards shall be used to protect the conductor a minimum of 6 feet above grade. Metallic guards shall be bonded at each end.

F. In case of structural steel frame construction, down conductors may be omitted and roof conductors shall be connected to the structural steel frame at intervals not exceeding 100 feet along the perimeter of the structure.

2.5 ROOF PENETRATIONS

A. Roof penetrations required for down conductors or for connection to structural steel framework shall be made using thru-roof assemblies with solid riser bars and appropriate roof flashing. Conductors shall not pass directly through the roof. The roofing contractor shall furnish and install the materials required to properly seal all roof penetrations of the lightning protection components and any additional roofing materials or preparations required by the roofing manufacturer for lightning conductor runs to assure compatibility with the warranty for the roof including roof pads that may be required to protect the roof under each of the lightning protection components.

2.6 GROUND TERMINATIONS:

A. Ground electrodes shall be copper clad steel and a minimum 5/8” diameter and 10 feet long. A ground electrode shall be provided for each down conductor. The down conductor shall be connected to the ground electrode using a bronze ground rod clamp having a minimum of 1 ½” contact between the ground electrode and the conductor measured parallel to the axis of the ground electrode, or by an Ultraweld exothermically welded connection. Ground electrodes shall be located a minimum of 2 feet below grade and shall be installed below the frost line where possible (excluding shallow topsoil conditions).

B. Where the structural steel framework is utilized as the down conductor for the system, ground terminals shall be connected to columns around the perimeter of the structure at intervals averaging not more than 60 feet apart. Columns shall be grounded using either bonding plates having 8 square inches of surface contact area or by Ultraweld exothermically welded connections.

C. All ground electrodes shall be interconnected with a ground loop conductor on structures that exceed 60 feet in height. The ground loop conductor shall be sized in accordance with the specified standards and in no case shall be smaller than the main roof conductor.

2.7 EQUIPOTENTIAL GROUNDING

A. Common interconnection of all grounded systems within the building shall be ensured by interconnecting to the lightning protection system using main size conductor and fittings.

B. This interconnection shall include but is not limited to the electrical service, telephone and antenna system grounds as well as all underground metallic piping systems including water, gas and sewer. Interconnection to a gas or water line shall be made on the customer's side of the meter.

C. Grounded metal bodies located within the required bonding distance as determined by the bonding distance formula in the latest edition of NFPA-780 Standard for the Installation of Lightning Protection Systems shall be bonded to the lightning protection system using the required bonding conductors and connections.

2.8 SURGE PROTECTION

A. Surge suppression shall be provided at all power service entrances and at entrances of conductive signal, data and communication services.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The installation shall be installed by an UL listed lightning protection installation company.

3.2 COORDINATION

A. Coordinate the installation of the lightning protection system with other trades

B. Coordinate all roof penetrations, fasteners and adhesive with the roofing contractor prior to installing any materials on the roof.

3.3 INSPECTION AND CERTIFICATION

A. New Structures:

1. Upon completion of the installation of the lightning protection system the contractor shall furnish a certificate of completion from an authority having jurisdiction.

B. Additions or Renovations:

1. If the protected structure is an addition to or is attached to an existing structure that does not have a functioning lightning protection system, the contractor shall certify that the new system installed complies with the specified standards and shall advise the owner on the lightning protection work required on the existing structure so that a certificate of completion from an authority having jurisdiction may be obtained.

2. If the protected structure is an addition to or is attached to an existing structure that does have a lightning protection system the contractor shall advise the owner of any additional work that may be required in order to bring the existing lightning protection system into compliance with the specified standards and thus qualify to be re-inspected in order to receive a certificate of completion from an authority having jurisdiction.

END OF SECTION

SECTION 26 51 00

INTERIOR BUILDING LIGHTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Installation of luminaires, supports and accessories.

B. Emergency lighting units.

C. Exit signs.

D. Lamps.

E. Ballasts, drivers, and accessories.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 05 29: Supporting Devices.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with General Conditions including pertinent physical characteristics and complete photometric data reports from independent testing laboratory.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Instructions for each product. Installation manuals are required.

1.5 COORDINATION

A. Confirm compatibility and interface of other materials with luminaire and ceiling system. Report discrepancies to the Engineer/Architect and defer ordering until clarified.

B. Supply plaster frames, trim rings and backboxes to other trades.

C. Coordinate with Division 23 to avoid conflicts between luminaires, supports, fittings and mechanical equipment.

D. Conform to requirements of NFPA 70.

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

F. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

G. The lighting wholesale supplier shall have an office and a stocking warehouse within 100 miles of the project site. The distributor/manufacturer's representative shall have an office within 100 miles of the project site, and shall have on staff a full time lighting designer as well as personnel who are available to service the project after completion.

H. Any substitutions to the light fixture schedule shall be proven, by the manufacturer at the discretion of the Engineer, to be of equal or superior quality, material, and performance than the specified light fixtures. All requests for substitutions shall be submitted along with fixture specification sheets, photometric calculations and electronic ies files 10 days prior to bid opening date for review. Substitutions shall be requested in writing only, accompanied by the above listed electronic ies files. Substitutions will not be considered if they are indicated or implied in shop drawing submission without previous formal request. Substitutions will not be considered if they require substantial revision of the contract documents. The Contractor shall be responsible for any and all additional costs required by modifications to architectural, structural, mechanical or electrical facilities, devices, systems, etc. resulting from the approved substitution.

I. Light fixtures and ballasts are to comply with the fixture schedule and the Specifications.

PART 2 PRODUCTS

2.1 LUMINAIRES

A. Acceptable Manufacturers

1. Provide products of manufacturers as listed in the lighting fixture schedule or equal, subject to compliance with requirements.

2. Fixtures are to be supplied in manufacturer's standard cartons.

3. Substitutions: See Section 26 00 10 - General Electrical Provisions.

B. Fluorescent Luminaires

1. Pre-treat housing and finish in high reflectance baked white powder paint on exposed and reflective surfaces giving reflectance of 90% minimum average. Paint shall be applied after fabrication.

2. Reflective end plates may be 20 gauge metal.

3. Provide full 22 gauge steel housing.

4. Provide hinged frames with fully enclosed spring loaded cam latches and T-type hinges, removable for cleaning without tools. Support lay-in lenses on four sides with flip ends on short dimension.

5. Provide gasketing, stops and barriers to form light traps and prevent light leaks.

6. Design luminaire to dissipate ballast and lamp heat.

7. Use formed or ribbed backplates, endplates, reinforcing channels.

8. Provide virgin acrylic diffusers, 0.125" thick nominal, number 12 pattern, 7.8 oz. weight per square foot.

9. Furnish products as indicated in Fixture Schedule, or equal.

C. Recessed Luminaires

1. Recessed Incandescent Luminaires: Pre-wired type with junction box forming an integral part of the assembly.

2. Supply recessed luminaire complete with trim type required for ceiling system installed. Before ordering, confirm ceiling construction details and architectural finish for each area. Supply with "IC" type housing or gyp board hat over the fixture, where insulation will cover.

3. Minimum depth of recessed fluorescent luminaires 4 3/8" including mounting yokes or bridges. Minimum distance from backface of luminaire or lens to center of lamp - 2.5".

4. Fixtures shall be delivered to the job site in factory provided individual cartons.

5. All damaged fixtures are to be replaced

2.2 LAMPS

A. Acceptable Manufacturers

1. General Electric.

2. Osram/Sylvania.

3. Philips.

B. Incandescent Lamps

1. Incandescent Lamps: standard A-19, A-21 type; R30, R40 reflector type spot/flood/PAR/PARQ as specified in the Fixture Schedule. Provide special lamps as noted in the Schedule. All incandescent lamps shall be 130 volt.

C. Fluorescent Lamps

1. Fluorescent Lamps: T8, rapid start type, equal to General Electric "Trimline" or Sylvania "Octron" 48-inch lamps to be F32T8/841K/RS (F032/841K) and 6-inch U lamps to be F31T8/841K/RS/U6 (FBO31/841K/U6).

2. Fluorescent Lamps: T5 equal to General Electric "Starcoat" or Sylvania "Pentron" 48 inch lamps to be F24T5/841K.

3. Fluorescent Lamps: T5HO equal to General Electric "Starcoat" or Sylvania "Pentron" 48 inch lamps to be F54T5HO/841K.

4. Note lamp color specifications on the fixture schedule, minimum CRI shall be 75.

D. LED Lamps

1. LED Lamps: Manufacturers must have Energy Star/DLC rating or shall offer LM-80 and TM-21 test reports to the public online.

2. LED estimated useful life: Minimum of 50,000 hours at 70% lumen maintenance, calculated based on LM-80 test data.

3. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers.User serviceable LED lamps and drivers shall be accessible and replaceable from the room side.

4. Light fixture provider shall provide all low voltage control wiring for dimmable fixture.

5. Note lamp color specifications on the fixture schedule, minimum CRI shall be 80.

6. All light fixtures shall be provided with a 5 year warranty on the LED and driver system.

2.3 BALLASTS AND DRIVERS

A. Provide ballasts that meet standards of an electrical testing laboratory and the Certified Ballasts Manufacturers' Association.

B. Acceptable Manufacturers:

1. Universal.

2. Philips/Advance.

3. Osram/Sylvania.

C. Fluorescent Ballasts

1. Interior Ballasts: 120 or 277 volt fluorescent ballasts shall operate from 90 to 145 volt and 200 to 305 volt respectively. They shall be electronic and designed to operate all fluorescent lamps as specified; they shall meet Category A Transient Voltage Protection Requirements; they shall be programmed start for use with occupancy sensors or instant start otherwise; power factor shall be greater than 99% and THD shall be less than 10%; they shall meet FCC Class A specifications for EMI/RFI; they shall be sound ratio A; they shall contain no PCB's and output to the lamps shall be above 42kHz.

2. Emergency fluorescent ballast shall be manufactured by a company with a minimum of five (5) years service. They shall be factory installed and tested, to include red pilot lights. They shall be manufactured by Bodine Mfg. and be rated at 1100 lumens, minimum.

3. HID ballasts for indoor fixtures shall be "encapsulated" for the best sound rating available.

4. Provide ballast/lamp combinations which provide the Owner with five-year warranties on both.

D. LED Drivers

1. LED drivers shall be electic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 " Electronic Drivers for LED Devices, Arrays, or System". LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.

2. Dimmable LED drivers shall be 0-10V type unless otherwise noted on the schedule. Dimmable LED drivers shall be capable of dimming without LED strobling or flicker across their full drimming range.

3. Emergency LED drivers shall be manufactured by a company with a minimum of five (5) years service. They shall be factory installed and tested, to include red pilot lights. They shall be manufactured by Bodine Mfg. and be rated at 1100 lumens, minimum.

PART 3 EXECUTION

3.1 INSTALLATION

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

B. Provide spare lamps in the amount of 5% of the total count, or 5 each type, whichever is the greater number.

C. All incandescent lamps shall be replaced at the Date of Substantial Completion.

D. Provide ballasts of compatible design to lamps specified.

E. No "Daisy Chaining" of fixtures is allowed.

F. Install fixtures securely, in a neat and workmanlike manner.

G. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

H. Support all luminaires independent of ceiling framing, directly from building structure by rod hangers and inserts or suspension wire, two per fixture.

I. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

J. Install recessed luminaires to permit removal from below.

K. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

L. Install clips to secure recessed grid-supported luminaires in place.

M. Install wall mounted luminaires, emergency lighting units, and exit signs at height as scheduled.

N. Manufactured wiring systems are approved. Provide submittals per Specifications.

3.2 RECESSED LUMINAIRES

A. Perform field inspection, testing, and adjusting in accordance with Section 26 00 10.

B. Install recessed luminaires to permit removal from below to gain access to outlet or pre-wired fixture box.

C. Install an accessible junction box not less than two feet away from the fixture and connect to it by not less than four feet nor more than six feet of flexible conduit, using type of fixture wire approved for this purpose.

D. Mount in suspended ceiling with exposed tee bar grid system, support directly from the building structure by a minimum of two support wires.

E. Hold insulation back from all fixtures by three (3) inches and clear on top.

F. A disconnecting means is required for all ballasted luminaires with double ended lamps. Install per NEC 410.130(G).

3.3 ALIGNMENT

A. Aim and adjust luminaires.

B. Align luminaires, clean diffusers and replace burned out lamps prior to final acceptance.

3.4 FIRE RATED CEILINGS

A. Where recessed fixtures will penetrate either fire-rated ceilings or fire rated gypsum board located above suspended ceilings, the fire-rated ceiling or gypsum board shall be continuous over and around the fixture housing and outlet box. Coordinate the ceiling and fixture installations to insure a continuous fire rated ceiling.

3.5 FINALLY

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

D. Relamp luminaires that have failed lamps at Substantial Completion and all lamps that have been energized during construction for more than 500 hours.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Installation of luminaires, supports and accessories.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cables.

B. Section 26 51 00: Interior Building Lighting.

1.3 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. Submit shop drawings and product data in accordance with General Conditions including pertinent physical characteristics and complete photometric data reports from independent testing laboratory.

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Instructions for each product.

1.5 COORDINATION

A. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide products of manufacturers as listed in the lighting fixture schedule, or equal.

B. LED Lamps

1. LED Lamps: manufacturers must have Energy Star/DLC rating or shall offer LM-80 and TM-21 test reports to the public online.

2. LED estimated useful life: Minimum of 50,000 hours at 70% lumen maintenance, calculated based on LM-80 test data.

3. LED fixtures shall be modular and allow for separate replacment of LED lamps and drivers.

4. Light fixture provider shall provide all low voltage control wiring for dimmable fixture.

5. All light fixtures shall be provided with a 5 year warranty on the LED and driver system.

6. Note lamp color specifications on the fixture schedule, minimum CRI shall be 80.

7. All exterior light fixtures shall be, at a minimum, IP64 rated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install fixtures securely on poles and pole bases as shown on the plans.

3.2 FINALLY

A. Remove dirt and debris from enclosures.

B. Clean photometric control surfaces as recommended by manufacturer.

C. Clean finishes and touch up damage.

END OF SECTION

SECTION 27 10 05

CONDUIT FOR TELEPHONE/DATA AND TV RACEWAY SYSTEM

PART 1 GENERAL

1.1 WORK INCLUDED

A. Telephone/Data and TV raceway system.

1.2 RELATED WORK

A. Section 26 05 19: Wires and Cable.

B. Section 26 05 34: Conduit.

C. Section 26 05 37: Outlet and Pull Boxes.

D. Section 26 05 53: Identification.

1.3 SYSTEM DESCRIPTION

A. At TV locations, provide a 4" outlet box and plaster ring with 3/4" raceway to above a drop ceiling in an accessible area. Leave a pull string in each raceway. End each stub up with a 90-degree elbow. Mount as shown on the plans.

B. At all telephone/data locations, provide a 4" outlet box and plaster ring with 1" raceway to an accessible area above a ceiling. Leave a pull string in each raceway. End each stub-up with a 90-degree elbow.

PART 2 PRODUCTS

2.1 MATERIALS

A. Conduit: Refer to Section 26 05 34.

B. Outlet and Pull Boxes: Refer to Section 26 05 37.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide an insulated throat connector or plastic bushing where raceways are stubbed out above the ceiling, including a 90-degree elbow on the end of the conduit.

B. Provide a stainless steel blank cover plate for any outlet location which is not to be used. Allow for this quantity to be 50% of total data outlets.

C. Provide conduit for all low voltage wiring which is installed in areas which have no ceiling or hard ceiling.

D. All device plates are to be stainless steel.

END OF SECTION

SECTION 27 10 11

STRUCTURED TELCOMMUNITCATIONS CABLING AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. 1. Contractor will give particular attention to the Quality Assurance criteria as established in Specifications, all testing requirements, any minimum performance requirements and any Guarantees and Service requirements.

B. Contractor will be responsible for the cost of replacing any lost survey markers. Contractor will provide ALL OTHER FIELD ENGINEERING, LAYOUT AND SURVEYING required for the complete installation and/or erection of their work. Construction Manager may, at its discretion, check the Contractor's layout for conformance to contract documents. Construction Manager will provide any required permanent survey monuments.

C. Inspection and/or testing services will be included as part of the Contractor’s work for the Contract Price as specified in the Scopes of Work. Contractor will be required to cooperate fully with the Inspection/Testing Agency. Contractor will allow the Inspection/Testing Agency adequate time and notice to inspect all completed work. Construction Manager shall cause the Inspection/Testing Agency to perform its services in a timely manner after Contractor notifies Construction Manager that its work has been completed in a specific area and while ladders and scaffolding are still in position. This Contractor will be responsible for scheduling all inspections and reviews by all concerned building authorities in a timely manner.

D. Contractor will be responsible for all costs incurred for inspection, retesting or rework caused by the contractor’s incorrect layout or failure to pass the initial inspection of its work.

E. Contractor will be responsible for keeping the surrounding area outside of the bounds of the jobsite clean from its work. If during the course of Contractor’s work, Contractor or their employees removes dirt, trash or debris from the jobsite and disposes of it in an unsatisfactory manner, then Contractor will clean such dirt, trash or debris as directed by Construction Manager, Architect, or by any governing agency.

1.2 SUBMITTALS

A. Contractor will provide shop drawings and submittals to the Construction Manager within two weeks of notification by Construction Manager, issuance of a Letter of Intent, or a Subcontract Agreement unless arrangements to the contrary have been

made prior to such time. In any event, complete and fully dimensioned shop drawings of required quantities are to be submitted in a timely manner so as not to delay the Project Schedule. A minimum of three (3) week turnaround time, from the time the drawings arrive in the Construction Manager's field office until they are ready to be returned to Contractor, shall be allowed for review of submittals. Delays caused by the Contractor or from other sources that become known to the Contractor should be brought to the attention of the Construction Manager sufficiently in advance to allow the Construction Manager reasonable time to prevent such delays. Contractor is responsible for obtaining their own field dimensions where required. Any additional expediting or shipping costs required to procure material per the project schedule which are a direct result of the Contractor failing to submit items on-time will be the responsibility of the Contractor. Should the Contractor fail to make the submission within this deadline, the Construction Manager will have the right, upon 72 hour written notice, to outsource or self-preform the compilation of all product data, color selections, warranties, material information and shop drawings per the contract documents. Cost of this compilation will be deducted from the Contractor’s subcontract amount.

B. Contractor will maintain up-to-date "as built" drawings at the site at all times during the performance of its work. Contractor will assist the Construction Manager in maintaining an up to date as-built drawing. Upon completion of the work and prior to release of retention, Contractor shall transpose all "as built" information, including the dimensioned location of significant concealed items of its work, on a set to be provided by the Construction Manager.

C. Contractor will cooperate with Construction Manager and other subcontractors whose work might interfere with the Contractor's Work, and will participate in the preparation of coordination drawings and schedules in areas of congestion, specifically noting and advising Construction Manager of any such areas of actual or potential interference. In the event that the completed work of any trade has to be removed, replaced of modified due to the Contractor's neglect in coordinating or completing its work as required, the cost for such remedial activities will be exclusively that of the negligent Contractor.

1.3 DELIVERY, STORAGE, AND HANDLING

A. All loading, off-loading, hoisting and stocking of materials, equipment or supplies is the sole responsibility of the Contractor. Contractor will provide a separate mobile hoist, forklift, or other equipment for loading or moving of its materials unless prior arrangements are made with the Construction Manager.

B. Contractor will re-compact any previously compacted fill, which has been excavated or otherwise disturbed in the performance of Contractor's work in strict conformance with the Contract Documents.

C. Construction Manager will require documentation by the soils testing lab that Contractor's recompaction meets the requirements of the Contract Documents.

D. All marking on concrete or other surfaces shall be kept to a minimum; however, when marking is required, it shall be done with materials which are compatible with future finishes and will not bleed through future finishes.

E. Contractor is responsible for connecting all Construction Manager and/or Owner furnished equipment to any services that Contractor provides.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

A. All approved manufacturers for copper cable, termination hardware, lightening protection, miscellaneous hardware and electronics are listed below

B. PRODUCT SPECIFICATIONS

1. Copper Cable

a. Mohawk M58281 enhanced Category 6CMP blue cable used for workstation data and voice cabling. This cable will be installed between the communications closet and each workstation. Termination at the workstation will be on RJ45 station outlets and 48 port patch panels in the closets.

1) Data cables installed to floor boxes are to be rated for exterior use.

b. Mohawk M58286 enhanced Category 6 CPM Green cable used for IP clock cabling. This cable will be installed between the communications closet and each Clock. Termination at the workstation will be on RJ45 and 48 port patch panels in the closets.

c. Mohark M58283 enhanced Category 6 CPM Yellow cable used for Wireless Access Point cabling. This cable will be installed between the communications closet and each Wireless Access Point location. Termination at the workstation will be on RJ45 and 48 port patch panels in the closets

d. Mohark M58283 enhanced Category 6 CPM Red cable used for Security Camera cabling. This cable will be installed between the communications

closet and each Security Camera location. Termination at the workstation will be on RJ45 and 48 port patch panels in the closets

e. Belden Cat 6 SlimLine Boot Patch Cord, 7 ft, Yellow – 4 pair, 24 AWG, 7 foot UTP stranded copper patch cord for connection of wireless Access point equipment.

f. Belden Cat 6 SlimLine Boot Patch Cord, 7 ft, Green – 4 pair, 24 AWG, 7 foot UTP stranded copper patch cord for connection of IP clocks.

g. Belden Cat 6 SlimLine Boot Patch Cord, 7 ft, Blue – 4 pair, 24 AWG, 7 foot UTP stranded copper patch cord for connection of Work Station equipment.

h. Belden Cat 6 SlimLine Boot Patch Cord, 7 ft, Red – 4 pair, 24 AWG, 7 foot UTP stranded copper patch cord for connection of Work Station equipment.

2. Termination Hardware

a. Belden AX102249- Single gang Quad port white faceplate used for mounting of Cat 6 Jacks/ modules.

b. Belden AX104193 – Cat6 Jack Category 6 connector module used for termination of Category 6 workstation data cables.

c. Belden - Blank module used to fill the unused unit space in the single gang faceplate.

d. Belden AX102652- Single gang low profile surface box used as workstation box for the modular furniture areas.

e. Belden AX103255- 48 Port Category 6 patch panel used in communications closets for termination of Category 6 workstation data cables.

f. Belden AX104121 – 106 Frame for Floor Boxes

g. Belden AX104231 – Stainless Steel Faceplate

3. Miscellaneous hardware

a. Rack Technologies Part # WR6624 - 19" wall mounted 5' high used for mounting data and fiber optic patch panels, wire management panels.

b. ICC – part # ICCMSCMA81 -- black 4x5 Vertical Finger Duct Panel- Wire management panel used for management of patch cables within the equipment racks.

c. Cablofil Firestop Part # SSS-100 – Fire stop putty used to seal any penetrations of sleeves or conduits used for communications cabling.

d. ICC Part #ICCMSLST05 - 12" ladder rack (and associated hardware) used to distribute cabling within the communications closets.

e. Panduit Part # F3X2LG6 - Duct used for cross connect management of wall mounted punch blocks.

4. Data Network Electronics

a. APC Smart UPS model # SMT1500RM2U, to be placed in each IDF/MDF, with the exact numbers to be determined before the award. For the purposes of this bid assume one UPS for each data closet.

5. Fiber

a. Belden # B9W039T single mode Tight Buffer fiber optic cable

b. Belden AX105208-S1 – SC Fiber SM Tip

c. Belden AX100041 – 1U LIU

d. Belden AX100098 – SC Fiber Adapter

6. Coax

a. Mohawk M71005 – Coaxial Plenum Cable

b. G6.2 Belden FSNS6U – F Connector

c. G6.3 Belden AX102907 – F Connector Insert

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Comply with latest editions and addenda of TIA/EIA-568, TIA/EIA-569, ANSI/J-STD-607, NFPA 70, and SYSTEM DESIGN as specified in PART 2.

B. Contractor is to furnish and install a communications cable plant. Communication work includes, but is not limited to speaker cabling throughout the school, wireless access points, communication equipment rooms, main distribution frames and service entrances, interior communications pathways, exterior communications pathways, backbone cabling, horizontal cabling, testing, identifying, training, etc.

C. Furnish and install all equipment, cable, components and accessories necessary to complete cable work, including fiber optic, copper cable, hangers, patch panels, connectors, conduit, cable trays(not specifically called out as by others), ladder racks, CAT 6 inserts, faceplates, jacks, terminations, etc. per the intent of the contract documents.

D. Contractor is to furnish sleeving or plenum rated cables as may be required per the contract documents.

E. The contractor shall provide and install all copper cable, connectors, patch panels, 7' patch cables, racks, punch blocks and associated hardware required to supply a complete cable plant, as defined in this RFP, to the District.

F. All cable, connectors, patch panels, punch blocks and equipment racks shall be installed in accordance with manufacturer's specifications.

G. Ladder rack will be required in the communications closets only. For the purposes of this bid assume 15 feet of ladder rack is to be installed per communications closet.

H. Where there is no ladder rack, workstation cabling must be supported by a using the cable support product provided or adding additional cable support every 5 feet where needed. All cable is to be neatly dressed into its termination point. In certain areas workstation cabling to modular furniture groups will be fed from the floor below.

I. Free standing equipment racks are to be securely mounted to the floor and grounded. Any sleeves or conduit penetrations must be fire stopped subsequent to cable installation.

J. Workstation outlets will be installed into surface boxes at modular furniture stations and into the drywall in hard wall offices. It is the contractor's responsibility to provide and install a box eliminator in the offices where an electrical back box does not exist.

K. As-built drawings are to be provided showing cable path and workstation outlet numbers with closet and port numbers.

3.2 INSTALLATION OF EQUIPMENT AND CABLING

A. Cabling:

1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.

2. Do not over-cinch or crush cables.

3. Do not exceed manufacturer's recommended cable pull tension.

4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.

B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:

1. At Distribution Frames: 120 inches.

2. At Outlets - Copper: 12 inches.

3. At Outlets - Optical Fiber: 39 inches.

C. Copper Cabling:

1. Category 6: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.

D. Fiber Optic Cabling:

1. Prepare for pulling by cutting outer jacket for 10 inches from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.

2. Support vertical cable at intervals as recommended by manufacturer.

E. Floor-Mounted Racks and Enclosures: Permanently anchor to floor in accordance with manufacturer's recommendations.

F. Field-Installed Labels: Comply with TIA/EIA-606 using encoded identifiers.

1. Cables: Install color coded labels on both ends.

2. Outlets: Label each jack on its face plate as to its type and function, with a unique numerical identifier.

3. Patch Panels: Label each jack as to its type and function, with a unique numerical identifier.

4. Number each cable as to building/rack/cable sequence.

3.3 TESTING

A. Comply with inspection and testing requirements of specified installation standards.

B. Visual Inspection:

1. Inspect cable jackets for certification markings.

2. Inspect cable terminations for color coded labels of proper type.

3. Inspect outlet plates and patch panels for complete labels.

C. Testing: Copper Cabling and Associated Equipment:

1. Test backbone cables after termination but before cross-connection.

2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.

3. Test operation of shorting bars in connection blocks.

4. Category 6 Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay. Test each pair for short circuit continuity, short to ground, crosses, reversed polarity.

D. Testing: Fiber Optic Cabling:

1. Backbone: Perform optical fiber end-to-end attenuation test and manufacturer's recommended test procedures; perform verification acceptance tests.

E. Finally

1. Provide labeling on both ends of each cable.

2. Provide riser diagrams with all cables labeled.

3. Provide all patch cables and jumper cables necessary for a complete installation.

4. All server equipment is by the Owner.

5. All testing to be certified and report made part of the Closeout Documents.

6. System shall be complete and fully functional.

F. Category 6 certification tests results are to be supplied in a format that can be read by any standard word processor or spreadsheet.

G. Manufacturer’s product specification sheets must be submitted for every product to be used in this cable plant within 1 week of project award

H. All workstation, copper and fiber distribution cables, workstation outlets, patch panels and punch blocks must be clearly labeled in accordance with the labeling

specifications schematic to be provided by the District at a date prior to the beginning of installation.

I. Only machine generated labels will be accepted.

J. Provide and install UPS at each rack.

K. Data work excludes switches, hubs, and routers, servers, workstations & printers

L. Contractor to provide testing for a complete and operational network system. All workstation cabling and all voice distribution cabling will be tested for continuity and polarity. The contractor shall replace any defective workstation or voice cabling. All enhanced Category 6 workstation cable and enhanced Category 6 data tie cable will be tested for Line Mapping (opens, shorts, reversals), attenuation, distance, near end and far end crosstalk (NEXT), mutual capacitance and signal to noise ratio (SNR). All tests must pass nominal TIA/EIA requirements for Category 6 certification. A certified MDIS contractor using WireScope 155 or LanCat 6 equipment must perform certification testing.

M. Contractor to provide and install a complete wiring and patch panel system for wireless access points in the locations within this bid package including plenum rated cable where required, 7’ loops at drop locations, testing, ladder rack, racks, hangers as required by local code enforcement agencies, labeling, etc. for a complete installation.

N. Data cables which support TIA/EIA 568-B.2-1 ISO/IEC 11801:2002 CAT 6 , IEC 61156-5, EN50173, and RoHS Compliant standards Supports IEEE 802.310BASE-T (ETHERNET), 100BASE-T (FAST ETHERNET),AND 1000BASE-T (GIGABIT ETHERNET), applications Includes non-metallic cross separator allowing for stronger signal strength and less vulnerability to noise interference

O. All cable paths shall run in such a fashion as to avoid any light fixtures or other devices which might produce transient EM or PF "noise" by a minimum of 18". All cable will be pulled through provided hooks and installed rings.

P. All cables must be pulled in such a manner as to avoid loops, kinks, and excess slack and shall be supported above the ceiling.

Q. A tension of no greater than 25 lbf shall be placed on the cable during pulling.

R. All apparatus in closets shall be secured in such a fashion as to accommodate equipment and maintain a relative amount of security as deemed necessary by the Network Administrator.

S. Any service slack shall be located in ceilings and secured

T. All cables shall be terminated by a certified MDIS according to standards set forth in ANSI TIA/EIA 568A standards. All termination points shall be 11O termination at both patch panel and modular jack using the 568B wiring scheme.

U. All cables, workstation outlets and patch panels shall be labeled in accordance with the following procedure: Cables: Within 12" of termination point, Workstations: On paper insert provided with wall plate. Patch panels: On space provided on patch panels, Icons: As instructed by the Network Administrator.

V. Multiple IDF/MDF shall be connected via 6 strand single mode fiber optic cable for connectivity to the switches or routers. The fiber optic cables will terminate in an LIU.

W. Contractor shall include one data drop to each projector location including 3' service loops at each drop location, testing, ladder rack, racks, hangers as required by local code enforcement agencies, labeling, etc. for a complete installation.

X. One (1) Enhanced Category 6 UTP data cable shall be installed to the business office IDF for a fax machine.

Y. Furnish and install all equipment, and accessories necessary to complete intercom work.

Z. Testing for a complete and operational intercom system.

AA. Furnish and install two each Cat 6 cable to the elevator machine room for elevator call out and also to fire alarm panels as required.

BB. Contractor shall apply for, pick-up, and pay for any permits related to their work. The building permit will be provided by others. In addition, Contractor will include any overtime inspection fees as necessary

CC. All work shall be done in accordance with applicable regulatory agencies, including, but not limited to: NEC - Article 800 Communications Circuits, Local Electrical Codes and Ordinances, NFPA, NEMA, TIA/EIA - 568 Commercial Building Wiring Standards, 568 TSB 40 Twisted Pair Connecting Categories, ANSI - X3T9.5 FDDI Standard, IEEE, FCC, UL, and OSHA

DD. Contractor shall meet all system grounding requirements.

EE. Provide boom lifts, scissor lifts, scaffolds, ladders, etc., as required to access your work.

FF. Contractor shall provide their own layout.

GG. Submit for approval any methods proposed to use to attach their work to, or support it from, the structure or other work.

HH. Contractor shall provide any anchors, embedment's, miscellaneous iron, supports, bracing, etc., required for their work unless shown on the structural drawings. Any calculations required are to be done by a registered engineer.

II. Provide independent supports for all low voltage work. Paint own support wires before installation to identify them as being for your use only (other contractors will do the same).

JJ. Provide field layout of all penetrations, and all other work that passes through walls by the schedule start date for wall framing in the related areas if they are not already installed.

KK. Contractor shall provide temporary protection of their work from weather, dust, etc., until final acceptance.

LL. In addition to electrical drawings, see architectural drawings for all required quantities and types of data outlets, fixtures, etc. Allow for greater quantity.

MM. Installation of work in more than one area at a time may be required.

NN. Allow for any costs associated with expediting and special freight for the delivery of all equipment per the construction schedule.

OO. Contractor shall familiarize themselves with the requirements of other contractors and shall coordinate their work with others to provide the best possible combined installation.

PP. Equipment shall be installed in accordance with manufacturer's written specifications and instructions.

QQ. Submit final shop drawings reflecting the results of space coordination with other contractors.

RR. Contractor shall identify in their shop drawings any elements of work which will have to be left out until the final pieces of their work are installed or shall break down and reassemble their work as required or make other arrangements at their cost.

SS. Contractor shall identify on their shop drawings any work that, by code requires rated enclosures but are not shown and provided for on the contract drawings. Such enclosures shall be provided by others. Any out of sequence costs incurred due to Contractor's failure to question or identify potential missing enclosures will be the Contractor's responsibility.

TT. Prior to layout of core walls by others, Contractor shall coordinate their in-wall rough-in and support requirements with the wall types specified and shall advise the Construction Manager. in writing of any dimensional or structural support discrepancies; otherwise Contractor shall be responsible for costs to revise the work, including reframing, etc.

UU. Contractors shall coordinate their work with each other to allow installation of all exposed work in coordinated symmetrical patterns, or to comply with architectural reflected ceiling plans.

VV. Except as otherwise specifically noted in the contract documents, Contractor shall provide rough in and final connections, as appropriate to their trade, for work installed by other contractors and Owner. Where appropriate, equipment is to be placed near its final location for final connections by Contractor, and then set in its permanent location, leveled, etc., by Contractor furnishing and installing that equipment.

WW. Identify cables and/or conductors by point numbers at each cable end.

XX. Cable to be installed in an orderly and uniform fashion, tie-wrapped together and in such a manner to permit ease of access for maintenance and testing.

YY. Provide secure wire terminations and splices.

ZZ. Contractor will be responsible for protection of ceiling grid system when performing above ceiling work and pulling wires.

AAA. Furnish proper grounding of cabling and devices to achieve maximum signal-to-noise ratios.

BBB. Coordinate size, number and routing of all raceways with Security Consultant.

CCC. Provide hoisting of all materials and equipment.

DDD. Contractor is responsible for all sound attenuation or insulation requirements for its work shown or specified in the contract documents.

EEE. Penetrations shall be furnished and installed by Contractor. Sealing of floor, wall and ceiling penetrations as required by the contract documents and/or regulatory agencies, whichever is stricter.

FFF. Furnish access panels required for Contractor’s work for installation by others.

GGG. Test and troubleshoot all work prior to punch list.

HHH. Remove all markings from exposed concrete floors used to layout work covered under this contract.

III. Remove all packaging and labels.

JJJ. Final cleaning of exposed surfaces.

KKK. Provide all cleanup of your work daily and remove all debris offsite.

LLL. Contractor shall submit for approval a proposed program for training Owner's authorized agent(s) in the operation and maintenance of the work. Such program shall be in conformance with the contract documents and shall involve Contractor's and/or manufacturer's personnel as specified.

MMM. There will be designated field representatives with complete responsibility for their work scope, including crew sizes, scheduling, punch list, etc.

NNN. Contractor shall provide fiber optic backbone system from head end data room IDF to IDFs in the individual data rooms and exterior buildings.

1. Internal IDF 6 strand single mode fiber optic cable

2. External Buildings 12 and 24 Strand single mode fiber optic cable as noted on plan sheets.

OOO. Fiber Optic Cable shall be tight buffered FDDI specification single mode fiber optic cable used for fiber optic backbone. Termination will be on SC connectors which will be installed into LIUs.

PPP. All fiber shall be tested and certified in accordance with the cable manufactures requirements to maintain warranties.

QQQ. Contractor shall pull a string with each fiber optic cable

END OF SECTION

SECTION 28 13 01

ACCESS CONTROL SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations in connection with the installation of the Building Access Control System for the Bentonville School District as shown on the drawings and as herein specified.

B. This Specification Section is included for reference only. The system described is to be provided by the Owner under separate contract.

C. The requirements of the conditions of the Contract, Supplementary Conditions and General Requirements apply to the work specified in this section.

D. Additionally, the entire installed system and all integrated system operations shall be within the guidelines of International Building Code, National Electric Code, Fire Code, NFPA 72 and NFPA 101, and all local and national codes/ordinances.

1.2 SYSTEM OVERVIEW

A. The design of the Access Control System shall include devices and equipment to monitor and control access of cardholders to restricted areas, detect and deny unauthorized attempted entries within specific buildings or areas, annunciate alarms, and generate reports. The system shall also include devices and equipment to detect 'changes of state' for alarm points such as dry contacts. Once incorporated with the daily operations of the designated facility, the system shall detect and deny unauthorized entry into restricted areas, while granting entry to individuals who have proper access rights. The system is to be designed and configured to provide operational flexibility, reliable performance, and ease of use.

B. The provided system shall include software and all hardware which is the exact match to the existing systems in place at Bentonville Schools.

1.3 SYSTEM DESCRIPTION

A. Product: Access Controller

1. The access controller shall be Keri with embedded Mercury Security firmware in “NXT” controllers.

2. Power controllers/Power supplies are “Altronix” ACM series.

3. Card readers are Schlage model “MT11” contactless smart card readers.

1.4 QUALIFICATIONS

A. Manufacturer: shall be Keri Systems, Inc.

B. Installer is to be State Systems Inc Fire and Security.

C. State Systesms Inc Fire and Security is to be contracted by the owner to provide and install the access control system.

1.5 SUBMITTALS

A. Submit Manufacturer product data sheets for all proposed devices and equipment.

B. Provide wiring diagrams, equipment ratings, dimensions, and finishes for all proposed devices and equipment.

C. If submittals, upon review, are found not to conform with the requirements of these specifications; the Contractor shall be responsible for the Owner's extra expenses for the provision and installation as called for in this specification. Approval of the submittals by the Owner shall, in no case, relieve the Contractor of the responsibility to meet the requirements of the specification.

1.6 PROJECT RECORD (AS-BUILT) DRAWINGS

A. The Contractor shall provide and maintain on the site an up-to-date record set of approved shop drawings.

B. Record drawings shall include all device locations and types of hardware installed.

C. Upon completion of the work, and final acceptance by the local authority, the Contractor shall submit record drawings to the Owner and the Engineer.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit Manufacturer data sheets for all equipment installed.

B. Include operating, installation, and routine maintenance instructions.

C. Include Manufacturer letter stating the date of installation on which the system is operational.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Keri Systems, Inc.

B. Substitutions: None allowed.

2.2 PRODUCTS

A. Controller system.

B. Computer hardware as necessary.

C. Controller cabinet as required.

D. Low profile, vandal resistant proximity card readers.

E. Proximity card printer.

1. Schlage

a. Model MT11 unless otherwise noted on the drawings.

F. Proximity Card Portable Reader, with download capabilities.

2.3 WIRE AND CABLE

A. All wire and cable shall be in strict compliance with local codes and the provisions of NEC Article 760 A and C for Power-limited Fire Protective Signaling Circuits. If required, the installation and control panel may be reclassified as Non Power-limited, per the provisions in NEC 760 Section C, providing all the requirements of NEC 760 A and B are met, and all identification of Power-limited circuits are removed from the control panel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation of equipment and devices that pertain to other work in the contract shall be closely coordinated with all other trades. Refer to architectural door hardware specifications for additional information.

B. The Contractor shall clean all dirt and debris from the inside and the outside of the Access Control equipment after completion of the installation.

C. Provide and install the system in accordance with the plans and specifications, all applicable codes and the Manufacturer's recommendations. All wiring shall be installed in accordance with all applicable codes and standards. Upon completion of installation, the Contractor shall so certify, in writing, to the Owner and the Engineer.

D. Provide and install DITEK type "DTK-HW" surge protective devices on each power supply panel.

3.2 FIELD QUALITY CONTROL

A. The completed Access Control system shall be fully tested in accordance with the manufacturer's recommendations, by the Installer, in the presence of the Owner's representative. Upon completion of a successful test, the Installer shall so certify, in writing, to the Owner and Engineer.

B. The Manufacturer shall provide on-site technical installation support.

3.3 MANUFACTURER'S FIELD SERVICES

A. Include on-site services of a certified technician to provide technical installation support for panel start up, program editing, troubleshooting of the access control system and assistance to the Installer for one complete final system checkout in accordance with the Field Quality Control section of the specifications. The Manufacturer shall also provide one training session, four hour minimum, with the Owner, or Owners Representative, upon completion of installation for instruction of system operation.

END OF SECTION

SECTION 28 32 04

EMERGENCY COMMUNICATION, AND LIFE SAFETY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract apply to this section.

B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications.

C. Division 01 General Requirements

D. Division 07 Thermal and Moisture Protection, Section 078413 Penetration Fires-topping

E. Division 08 Openings, Section 087100 Door Hardware

F. Division 14 Conveying Equipment, Section 14 28 16 Elevator Controls

G. Division 21 Fire Suppression, Section 21 13 01 Fire-Suppression Sprinkler Systems

H. Division 23 Heating Ventilating and Air Conditioning, Section 23 09 93 Sequence of Operations for HVAC Controls

1.2 SUMMARY - FIRE AND ECS

A. Dunk Fire and Security is to be contracted by the owner to provide and install the fire alarm system.

B. Provide all permits, labor, equipment, materials and services to furnish and install a fully tested functional, UL Listed, code compliant, intelligent addressable networked fire alarm, mass notification and active smoke control system including but not limited to all initiation and notification appliances, all raceways and wiring, connection to a central monitoring station.

C. The fire alarm system supplied under this specification shall utilize modular low voltage design with direct wired, node to node, peer-to-peer network communications. The system shall utilize independently addressed, fire detection devices, input/output control modules, audio amplifiers, telephone communications and notification appliances as described in this specification. Network panels shall contain the required user interfaces for all functions.

D. The emergency communication system supplied under this specification shall consist of a new Central Control Station (CCS) that shall provide the command and control for all buildings. The CCS shall also provide annunciation for all ECS and fire alarm events as required by UL 864, UL 2572 and this specification.

E. The system shall be designed for interior building audibility of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be designed to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio.

F. A dedicated TCP/IP fiber optic network shall be provided to connect the CCS to the ACU/FACP panels located in remote buildings.

G. All equipment shall be new and the current products of a single manufacturer, actively engaged in the manufacturing and sale of digital fire detection devices for over ten years.

H. Also included are system wiring, fiber optic cable, raceways, pull boxes, terminal cabinets, mounting boxes, and any accessories and miscellaneous items required for a code compliant system.

I. The system drawings show the intended of coverage and suggested device locations. Final device quantity, location, and AHJ approval are the responsibility of the contractor.

J. The final system shall be complete, tested, and ready for operation as described elsewhere in this specification, before owner acceptance.

K. Strict conformance to this specification is required to ensure that the installed and programmed system will function as designed, is compatible with existing systems, and will accommodate the future requirements and operations of the building owner. All specified operational features must be met without exception.

1.3 RELATED WORK - FIRE AND ECS

A. The contractor shall coordinate work in this section with all related trades. Work and/or equipment provided in other sections and related to the fire alarm/mass notification system shall include, but not be limited to:

1. Sprinkler water-flow and supervisory switches shall be furnished and installed by the fire protection contractor, but wired and connected by the electrical contractor. Modification of existing sprinkler devices to accommodate monitoring by the new fire alarm system shall be the responsibility of the fire alarm system installing contractor.

2. Duct smoke detectors shall be furnished, wired and connected by the electrical contractor. The HVAC contractor shall furnish necessary duct opening to install the duct smoke detectors.

3. New air handling and smoke exhaust system fan control circuits and status contacts to be furnished by the HVAC control equipment.

4. Elevator recall control circuits to be provided by the elevator control equipment. Modifications to the existing elevator controls to accommodate ANSI A17.1 shunt trip activation shall be provided by the elevator controls contractor. Any shunt trip circuit breakers and related wiring required for ANSI A17.1 compliance shall be provided by the electrical contractor (see power riser for more details).

5. Dry pipe/deluge sprinkler system release valve control circuits and supervision contacts shall be provided by the dry pipe/deluge sprinkler system control equipment.

6. Kitchen hood extinguishing systems status monitoring.

7. Fire pumps (manual, automatic and special service) status monitoring.

    a. Pump failure (fail to start) indication.

    b. Pump running indication.

    c. Phase reversal indication

8. Emergency generator status monitoring

    a. Running indication.

    b. Fail to start indication.

9. Gravity tank water level and fill pump status monitoring

    a. Water level high indication.

    b. Water level low indication.

    c. Fill Pump running indication.

10. Existing IP network interface

    a. Coordinate with the owner's IT department for interconnection between the owner's existing TCP/IP network and the TCP/IP network equipment supplied under this contract.

11. High Power Speaker Array

    a. Installation of HPSA support structures.

1.4 REFERENCES

A. Codes-General

1. All work and materials shall conform to all applicable federal, state and local codes and regulations governing the installation. If there is a conflict between the referenced standards, federal, state or local codes, and this specification, it is the bidder's responsibility to immediately bring the conflict to the attention of the engineer for resolution. National standards shall prevail unless local codes are more stringent.

2. The bidder shall not attempt to resolve conflicts directly with the local authorities unless specifically authorized by the engineer.

B. Fire and MNS/ECS Codes

1. The equipment and installation shall comply with the provisions of the following codes and standards unless the authority having jurisdiction has adopted an earlier version:

2. National Fire Protection Association (NFPA)

    a. NFPA 70 - 2011 National Electric Code®

    b. NFPA 72 - 2010 National Fire Alarm Code®

    c. NFPA 90A - 2012 Installation of Air-Conditioning and Ventilating Systems

    d. NFPA 92A - 2009 Smoke-Control Systems Utilizing Barriers and Pressure Differences

    e. NFPA 92B - 2009 Smoke Management Systems in Malls, Atria, and Large Areas

    f. NFPA 101- 2012 Life Safety Code®

3. Underwriter's Laboratories, Inc

    a. UL 864 - Control Units for Fire Protective Signaling Systems.

    b. UL 268 - Smoke Detectors for Fire Protective Signaling Systems.

    c. UL 268A - Smoke Detectors for Duct Applications.

d. UL 217 - Single and Multiple Station Smoke Alarms

e. UL 521 - Heat Detectors for Fire Protective Signaling Systems.

f. UL 228 - Door Closers-Holders, With or Without Integral Smoke Detectors.

g. UL 464 - Audible Signaling Appliances.

h. UL 38 - Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

i. UL 346 - Water-flow Indicators for Fire Protective Signaling Systems.

j. UL 1971 - Signaling Devices for the Hearing-Impaired.

k. UL-1480 - Speakers for Fire Alarm, Emergency, and Commercial and Professional Use

l. UL 1481 - Power Supplies for Fire Protective Signaling Systems.

m. UL 1711 - Amplifiers for Fire Protective Signaling Systems.

n. UL 1635 - Digital Alarm Communicator System Units

o. UL-1638 - Signaling Appliances - Private Mode Emergency and General Utility Signaling

p. UL 2572 - Control and Communication Units for Mass Notification Systems

4. Note: Control equipment shall listed to both UL 864 and UL2572 standards.

5. Factory Mutual (FM) approval

6. International Code Council

   a. International Building Code

   b. International Fire Code

   c. International Mechanical Code

7. Federal Codes and Regulations

   a. Americans with Disabilities Act (ADA)

8. Electrical Industries Association

a. EIA-232-D: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

b. EIA-485: Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

C. Definitions and Abbreviations

1. ACU: Autonomous Control Unit.
2. ADA: Americans with Disabilities Act.
3. AFF: Above Finished Floor.
4. AHJ: Authority Having Jurisdiction.
5. Approved: Unless otherwise stated, materials, equipment or submittals approved by the Authority or AHJ.
6. Circuit: Wire path from a group of devices or appliances to a control panel or transponder.
7. CCS: Central Control Station.
8. CPU: The central computer of a multiplex fire alarm or voice command control system.
9. ECS: Emergency Communication System.
10. FACP: Fire Alarm Control Panel.
11. FCC: Fire Command Center.
12. FM: FM Global (Factory Mutual)
13. FSCP: Firefighter's Smoke Control Panel.
14. HPSA: High Power Speaker Array.
15. HVAC: Heating Ventilating and Air Conditioning.
16. IDC: Initiating Device Circuit.
17. LCD: Liquid Crystal Display.
18. LED: Light Emitting Diode.
19. LOC: Local Operating Console.

20. MN: Mass Notification.
21. MNEC: Mass Notification Emergency Communications.
22. NAC: Notification Appliance Circuit.
23. NFPA: National Fire Protection Association.
24. NICET: National Institute for Certification in Engineering Technologies
25. NRTL: Nationally Recognized Testing Laboratory
26. PTR: Printer.
27. RCP: Remote Control Panel
28. SLC: Signaling Line Circuit.
29. Style 1: As defined by NFPA 72, Class B.
30. Style 4: As defined by NFPA 72, Class B.
31. Style 6: As defined by NFPA 72, Class A.
32. Style 7: As defined by NFPA 72, Class A.
33. Style B: As defined in NFPA 72, Class B.
34. Style D: As defined in NFPA 72, Class A.
35. Style Y: As defined in NFPA 72, Class B.
36. UL or ULI: Underwriters Laboratories, Inc.
37. UL Listed: Materials or equipment listed and included in the most recent edition of the UL Fire Protection Equipment Directory.
38. Zone: Combination of one or more circuits or devices in a defined building area, i.e. 3 speaker circuits on a floor combined to form a single zone.

1.5 GENERAL FIRE AND ECS - SYSTEM DESCRIPTION

A. The system supplied under this specification shall be a new UL Listed modular fire alarm & mass notification network that uses independently addressed fire detection devices, input/output control modules, amplifiers and speakers.

B. The fire network shall utilize token ring, peer-to-peer communications. The network shall consist of one main and multiple remote Autonomous Control Unit/Fire Alarm

Control Panels (ACU/FACP). To enhance survivability, each ACU/FACP shall be an equal, active functional member of the network, capable of making all local decisions and initiating network tasks for other panels. In the event of an ACU/FACP failure or communications failure between units, ACU/FACPs shall be capable of forming sub-networks and remain operational between communicating units. Master/slave system configurations shall not be considered as equal.

C. The system shall be fully field programmable such that virtually any combination of system output functions may be correlated to any type of input event(s). Inputs may be combined using Boolean logic, be time dependent or under manual control, as defined by required system operation. All software operations are to be stored in a non-volatile programmable memory within the fire alarm control panels. There shall be no limit, other than maximum system capacity, as to the number of addressable devices which may be in alarm simultaneously.

D. Addressable smoke detector sensitivity settings for both pre-alarm and alarm activation shall be automatically individually configurable for both daytime and nighttime operation. Addressable smoke detectors shall be UL listed for automatic sensitivity testing.

E. Ease of maintenance shall be facilitated by the use of panel based and PC based system diagnostics.

1. The system shall automatically test smoke detector sensitivity, eliminating the need for manual sensitivity testing.

2. Ground fault detection and annunciation shall be by individual module address for supervised input and output devices.

3. System test operation shall be configurable by individual addressable devices, and not disable entire circuits.

4. The system shall be capable of generating a graphical map of connected all addressable devices to aide in circuit troubleshooting.

5. Placement supervision of addressable devices shall couple a device’s location (not its address) to the programmed system response.

F. The system shall provide a one-way multi-channel emergency communication sub-system for the distribution of emergency messages to facility occupants.

G. The system shall support CO and security detection devices with appropriate independent annunciation and signal processing.

H. The mass notification network shall connect the main ACU/FACP or Central Command Station (CCS) to all remote ACU/FACPs. The CCS shall be capable of initiating live and prerecorded audio messages to any combinations of ACU/FACPs connected to the network, as detailed under the Performance Requirements section of this specification.

I. System ACU/FACPs and LOCs shall utilize configurable message routing and selective event messaging to direct event information only to the required system displays and printers as determined by the event type and location.

1.6 GENERAL REQUIREMENTS

A. Comply with the provisions of NFPA 72 and the operational requirements of this specification.

B. The system shall identify all off normal conditions and log each condition into the system as an event.

1. The system shall automatically display on the control panel Liquid Crystal Display (LCD) the first (oldest) event of the highest priority by type. The event priority shall be alarm, supervisory, trouble, and monitor.

2. The system shall utilize four event queues, and shall not require event acknowledgment by the system operator. Labeled, color coded indicators shall be provided for each type of event queue: alarm - red, supervisory - yellow, trouble - yellow, monitor - yellow. When an unseen event exists for a given type, the indicator shall be lit.

3. For each event, the display shall include the current time, the total number of events, the type of event, the time the event occurred and up to a 42 character custom user description.

4. The user shall be able to review each event queue by simply selecting scrolling keys (up-down) for the event type.

5. New alarm, supervisory, or trouble events shall sound a distinct, silenceable audible signal at the control panel.

6. The LCD shall show the number of active alarm, supervisory, trouble and monitor events

7. The LCD shall show the system time and the number of active and disabled points in the system.

8. Specific input/output devices shall operate in accordance with the alarm, supervisory, trouble, monitor sections that follow and the input/output matrix.

C. All critical systems, sub-systems and circuits shall be monitored for integrity. System faults shall be annunciated.

D. Strobes shall be synchronized on each floor.

E. Batteries shall be sized to support the system for 24 Hrs. of standby operation followed by 15 minutes of alarm operation at the end of the 24 Hour period.

F. Off premises reporting of the loss of AC mains power to any system component shall be automatically delayed for a period of time acceptable to the AHJ to reduce traffic at the central monitoring station due to wide-area power failures.

G. The system shall provide configurable service groups to facilitate “one man” testing of the system based on the physical layout of the building. Each service group shall be capable of supporting any combination of system devices, independent of the circuit on which they are installed. Systems that disable entire circuits, circuits serving multiple floors or fire zones for testing shall not be considered as equal. Activated devices on a service group shall be capable of initiating alternative system test responses to facilitate system maintenance and minimizing occupant disturbances while in test mode.

H. Event processing and display shall be prioritized as follows:

1. Fire alarms

2. Supervisory events

3. Trouble events

4. Monitor events

1.7 ALARM OPERATION - ECS

A. Signals shall be prioritized and processed in accordance with UL 2572 as indicated below:

1. Special suppression pre discharge alarm (CO2, FM200, or other total flooding gaseous suppression system)

2. Mass Notification (ECS)

3. Fire Alarm/Life Safety

4. Other

B. Only the Central Control Station, a building's Autonomous Control Unit/Fire Alarm Control Panel (ACU/FACP), or a Local Operations Console (LOC) shall be capable of initiating emergency communication system. No automatic operation shall be permitted.

C. Operation of any Emergency Communication System functions by a user at a building ACU/FACP or LOC shall be indicated at the CCS.

D. Operation of any ECS functions by a user at the CCS shall be indicated at the ACU/FACP(s) and LOC(s) that the respective building system(s) is in the MNEC mode.

E. The CCS, ACU/FACP(s) and LOC(s) shall display the following information:

1. Power On indication.

2. The status of all signaling zones.

3. The off-normal status of all control switches.

4. The off-normal status of all circuits and functions monitored for integrity.

F. The system shall observe the following priorities for evacuation and relocation signals:

1. The FACP shall not automatically override mass notification messages.

2. The mass notification system shall not override signals indicating the pre-discharge warning of special fire suppression systems.

3. Live pages shall override previously and subsequently initiated signals to the operator selected areas.

4. Message sources shall be prioritized as follows:

a. Live local mass notification and fire evacuation messages.

b. Live remote mass notification and fire evacuation messages.

c. Automatic pre-recorded mass notification and fire evacuation messages.

d. Non-emergency messages.

G. The system shall be capable of live voice page from the CCS, a ACU/FACP, or a LOC

H. Upon the alarm activation of any area smoke detector, heat detector, manual pull station, sprinkler water-flow, duct smoke detector, the following functions shall automatically occur:

I. The system shall remain in the alarm mode until all initiating devices are reset and the fire alarm panel is manually reset and restored to normal.

J. The internal audible device shall sound at the control panel or command center.

K. Display the alarm event on the graphical workstation.

L. The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date.

M. All system activity/events shall be documented on the system printer and logged into system history.

N. Any remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.

O. The following audio messages and actions shall occur simultaneously:

1. An evacuation message shall be sounded on fire floors (zones) immediately above and below (adjacent to) the fire floor (zone) (general alarm evacuation). It is the intent of this message to advise occupants hearing this message that they are near danger and should leave the building via the stairs (nearest exit) immediately.

2. Activate visual strobes on the fire floors (zones) immediately above and below (adjacent to) the fire floor (zone) (general alarm evacuation). The visual strobe shall continue to flash until the system has been reset. The visual strobe shall stop operating when the "Alarm Silence" is pressed.

3. An alert message shall be sounded on the remainder of building. It is the intent of this message to advise occupants to prepare for evacuation if necessary.

4. An instructional message shall be sounded in the stairwells instructing occupants to move carefully and quickly down the stairs to exit the building and to exit to a safe floor if you encounter smoke in the stairwell.

5. An instructional message shall be sounded in the elevator cabs. It is the intent of this message to advise elevator occupants that an emergency exists, the elevator has been directed to the ground floor, and that occupants should quickly exit the building.

6. An instructional message shall be sounded in the lobby. It is the intent of this message to advise lobby occupants to leave the lobby and clear the area for arriving firefighters.

7. An instructional message shall be sounded in the concourses connected to the building's lobby. It is the intent of this message to prevent new entries into the lobby by advising occupants not to attempt to enter the lobby of the affected building.

8. Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.

9. The notification appliance dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.

P. Transmit signal to the building automation system.

Q. Transmit signal to the central monitoring station with point identification.

R. Activate automatic smoke control sequences.

1. Activate emergency lighting control.

S. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.

T. Activation of elevator lobby or elevator equipment room smoke detectors shall initiate recall of the bank of elevators to the 1st floor and lockout the elevator controls. Activation of the first floor elevator lobby smoke detector shall recall shall be to an alternate floor, and lockout the elevator controls.

U. Activation of heat detectors in elevator shafts and machine rooms shall activate the elevator power shunt trip circuit breaker.

V. All stairwell/exit doors shall unlock throughout the building.

W. All self-closing fire/smoke doors held open shall be released.

1.8 SUPERVISORY OPERATION

A. Upon supervisory activation of any sprinkler valve supervisory switch, water-flow duct smoke detector, elevator shunt trip supervision, the following functions shall automatically occur:

1. The internal supervisory event audible device shall sound at the control panel.

2. Display the event on the graphical workstation and display a pictorial image.

3. The LCD display shall indicate all applicable information associated with the supervisory condition including; zone, device type, device location and time/date.

B. All system activity/events shall be documented on the system printer and logged to system history.

C. Any remote or local annunciator LCD/LED's associated with the supervisory zone shall be illuminated.

D. Transmit signal to the central monitoring station with point identification.

1.9 TROUBLE OPERATION

A. Upon activation of a trouble condition or signal from any device or internal system integrity monitoring function on the system, the following functions shall automatically occur:

1. The internal panel audible device shall sound at the control panel.

2. Display the event on the graphical workstation and display a pictorial image.

3. The LCD keypad display shall indicate all applicable information associated with the trouble condition including; zone, device type, device location and time/date.

B. Trouble conditions that have been restored to normal shall be automatically removed from the trouble display queue and not require operator intervention. This feature shall be software selectable and shall not prevent the logging of trouble events to the historical file.

C. All system activity/events shall be documented on the system printer and logged to system history.

D. Any remote or local annunciator LCD/LED's associated with the trouble zone shall be illuminated.

E. Transmit a trouble signal to the central monitoring station with point identification.

1.10 SUBMITTAL GENERAL

A. The contractor shall not purchase any equipment for the specified system until the owner has approved the project submittals in their entirety and has returned them to the contractor.

B. Approved submittals allow the contractor to proceed with the installation and shall not be construed to mean that the contractor has satisfied the requirements of these specifications.

C. Each submittal shall include a detailed list of variations that the submittal may have from the requirements of the contract documents.

D. The contractor shall provide specific notation on each shop drawing, sample, data sheet, installation manual, etc. submitted for review and approval, of each variation.

E. Any conflicts in the contract documents and/or with Authority Having Jurisdiction (AHJ) requirements shall be submitted to the owner in writing 7 days prior to bid.

F. Submittals shall be approved by authorities having jurisdiction prior to submitting them to the Architect.

1.11 SUBMITAL BOOKS

A. Submit for approval one submittal book in PDF format to the consulting engineer for review and comment.

B. Submittal books shall meet the following requirements:

1. Shall include:

a. Cover sheet that shows the project address, system type, and contractor.

b. Table of contents

1) Provide a list of all types of equipment and components provided. This shall be incorporated as part of a table of contents, which will also indicate the manufacturer's part number, the description of the part, and the part number of the manufacturer's product datasheet on which the information can be found.

c. Product data sheets, as detailed elsewhere in this specification

d. Provide description of operation of the system (sequence of operation), similar to that provided in Part 2 of this section of the specifications. The description shall be specific to this project, and shall provide individual sequences for every type of alarm, supervisory, or trouble condition, which may occur as part of normal or off-normal system use.

e. B-size (black line) reduced shop drawings, as detailed elsewhere in this specification.

f. System calculations, as detailed elsewhere in this specification.

g. Installation instructions.

h. Provide samples of various items when requested.

i. Copies of all licenses, documents and certifications, as detailed elsewhere in this specification.

2. Additional copies may be required at no additional cost to the project.

1.12 PRODUCT DATA

A. System components proposed in this specification shall be UL listed to operate together as a system. The supplier shall provide evidence, with his submittal, of listings of all proposed equipment and combinations of equipment.

B. For each product submitted provide the following information:

1. Manufacturer's catalog data, to include material description, agency approvals, operating characteristics, electrical characteristics, dimensions, mounting requirements and accessories.

a. Product data sheets for system components shall be highlighted to indicate the specific products, features, or functions required to meet this specification.

b. Alternate or as-equal products submitted under this contract shall provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Manufacturer's product installation sheets: A copy of the documentation that is required to be shipped with all listed products by UL.

1.13 BATTERY CAPACITY - DESIGN CALCULATIONS

A. Provide battery capacity calculations for each power supply that uses batteries for secondary power. Identify all loads. Identify any loads shed during alarm operation. Use the manufacturer's recommended methods and/or forms.

1.14 24 VDC NOTIFICATION APPLIANCE CIRCUITS

A. For each 24VDC NAC, provide worst case voltage drop calculations. The load shall be treated as a lump sum at the end of the circuit. Worst case power supply terminal voltage shall include all applicable internal power supply losses. Using 85% of nominal circuit voltage (20.4VDC) shall not be accepted as lowest terminal voltage

without manufacturer's published documentation stating there are no internal losses in the power supply.

1.15 AUDIO (SPEAKER) NOTIFICATION APPLIANCE CIRCUITS - INTERIOR

A. The system shall be designed for interior building audibility level of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be designed to maintain Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio.

B. Provide dB loss calculations for all audio (speaker) notification appliance circuits. Circuits shall be designed for no more than 0.5 db loss based on lump-sum load method.

C. All areas required to meet intelligibility requirements shall be modeled in a recognized computer modeling program such as EASE by Renkus-Hienz. All modeling output data shall be part of the submittal.

1.16 FIBER OPTIC CIRCUITS

A. Provide optical fiber loss (budget) calculations per segment of optical fiber. Fiber loss per segment shall not exceed 80% of equipment manufacturer's permitted loss.

1.17 SHOP DRAWINGS

A. Submit for approval one set of shop drawings in PDF format to the consulting engineer for review and comment. Drawings shall be either D-size or E-size blue line drawings and of a sufficient resolution to be completely read. Additional copies may be required at no additional cost to the project.

B. Contained in the title block of each drawing shall be symbol legends with device counts, wire tag legends, circuit schedules for all addressable and notification appliance circuits, the project name/address, and a drawing description which corresponds to that indicated in the drawing index on the coversheet drawing. A section of each drawing title block shall be reserved for revision numbers and notes.

C. Shop drawings shall meet the following requirements:

1. Shop drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by the manufacturer of the submitted equipment in fire-alarm system design.

b. NICET-certified fire-alarm technician, Level III minimum or Arkansas registered Professional Engineer.

c. Coversheet with project name, address and drawing index.

d. General notes drawing with peripheral device backbox size information, part numbers, device mounting height information, and the names, addresses, point of contact, and telephone numbers of all contract project team members.

e. Provide device floor plans for all areas served by the fire alarm system. Utilize the CAD Files provided by the consulting engineer in the preparation of the floor plans. Floor plans shall indicate accurate locations for all control and peripheral devices. Drawings shall be NO LESS THAN 1/8-INCH SCALE. If individual floors need to be segmented to accommodate the 1/8" scale requirements, KEY PLANS and BREAK-LINES shall be provided on the plans in an orderly and professional manner.

    1) All addressable devices shall be shown. Coordinate the device address with the same device shown on the riser diagram.

    2) Identify all notification appliances with a circuit and item number. Coordinate the circuit and item number with the same device shown on the riser diagram.

    3) Show all raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.

    4) Areas required to meet intelligibility requirements shall be clearly identified. Wide area mass notification system plot drawings shall identify all project areas that must meet intelligibility requirements as well as environmentally sensitive areas on or off of the project site where system output shall be minimized.

f. Device riser diagram, which individually depict all control panels, annunciators, addressable devices, and notification appliances. Shall include a specific, proposed device description above each addressable device. Shall include a specific, discrete device address that corresponds to addresses shown on the floor plans. Drawings shall provide wire specifications, and wire identification for all conductors depicted on the riser diagram. All circuits shall have identifiers that shall correspond with those required on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.

g. Control panel drawing(s) shall show internal component placement and all internal and field terminations. Provide details indicating where conduit

connections shall be made to avoid conflicts with internally mounted batteries. For each additional fire alarm panel, a separate drawing which clearly indicated the panel designation, service and location of the control enclosure.

h. Provide typical device wiring diagrams that show all system components, and the respective field wiring. Wire type, gauge, and jacket shall be indicated. When an addressable module is used in multiple configurations for monitoring or controlling equipment, provide a drawing for each application. End-of-line resistors (and values) shall be shown.

i. Provide a fire alarm system function matrix that illustrates alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions.

j. System Calculations as detailed elsewhere in this specification.

2. Upon receipt of approved drawings from the Authority Having Jurisdiction, the supplier shall immediately forward two sets of drawings to the owner. These drawings shall either be stamped approved or a copy of the letter stating approval shall be included.

1.18 CLOSEOUT

A. Two (2) copies of the following documents shall be delivered to the building owner's representative at the time of system acceptance.

1. Project specific operating and maintenance manuals covering the system as installed. The manuals shall contain a description of the system architecture, inputs, notification signaling, auxiliary functions, annunciation, sequence of operations, expansion capability, application considerations and limitations. A generic instruction and operation manual shall not be acceptable.

2. Technical literature (manufacturer's data sheets and installation manuals/instructions) for all parts of the system, including control panels, smoke detectors, batteries, manual stations, alarm notification appliances, power supplies, and remote alarm transmission means.

3. Software and Firmware Operational Documentation:

a. The end-user shall retain complete rights and ownership to all site-specific software running in the system. The fire alarm equipment supplier shall provide hard and soft copies of the software database to the end-user at the end of the warranty period. The database provided shall be useable by any

authorized and certified distributor of the product line, and shall include all applicable passwords necessary for total and unrestricted use and modification of the database.

4. Drawings

    a. Provide “As Built” drawings of record of all the shop drawings used in the installation of the system.

    b. Refer to the Submittals - Shop Drawings section of this specification for drawing requirements.

5. Record of Completion

    a. System supplier and contractor shall provide a certified test report to verify that the system and all components functioned properly and as intended.

    b. A filled out Record of Completion similar to NFPA 72, 2007 edition figure 4.5.2.1 shall be provided.

6. Warranty

    a. Provide copies of the warranty documentation as detailed in the Warranty section of this specification.

7. Service Organization

    a. Provide the name, address and telephone of the authorized factory representative.

8. Training

    a. Conduct the required training as detailed in the Startup and Commissioning - Training section of this specification.

1.19 QUALIFICATIONS OF SUPPLIER

A. The system supplier shall have a minimum of 5 years of experience in distribution and service of the proposed equipment brand.

B. The supplier shall have successfully designed and installed similar system fire detection, evacuation voice and visual signaling control components on a previous project of comparable scope, size and complexity.

C. The supplier shall have in-house engineering and project management capability consistent with the requirements of this project. The project shall be supervised by personnel certified by NICET as fire alarm Level IV technicians.

D. The supplier shall employ qualified and manufacturer certified system designers to perform the detailed engineering design, system calculations, for all the system equipment and programming.

E. The supplier shall produce all panel and equipment drawings, submittals, and operating manuals, as detailed elsewhere in this specification.

F. The supplier shall be responsible for providing qualified on site representative(s) for coordination of system installation, and final system testing and commissioning in accordance with these specifications.

1.20 QUALIFICATIONS OF INSTALLER

A. Before commencing work, submit evidence showing that the equipment installer has successfully installed systems of the similar scope, type and design as specified.

B. The contractor/installer shall submit copies of all required Licenses and Bonds as required in the State having jurisdiction.

C. The contractor/installer shall be responsible for retaining qualified and authorized representative(s) of the system manufacturer (The Supplier) specified for detailed system design and documentation, coordination of system installation requirements, and final system testing and commissioning in accordance with these specifications.

D. The contractor/installer shall employ on staff a minimum of one NICET level III technician or a professional engineer, registered in the State of the installation.

E. Contractors unable to comply with the provisions of Qualification of Installers shall present proof of engaging the services of a subcontractor qualified to furnish the required services.

1.21 DELIVERY AND STORAGE

A. Receiving:

B. The Contractor shall be responsible for all receiving, handling, and storage of his materials at the job site.

C. Overnight storage of materials is limited to the assigned storage area. Materials brought to the work area shall be installed the same day, or returned to the assigned storage area unless previously approved by the Owner.

D. The Contractor shall remove rubbish and debris resulting from his work on a daily basis. Rubbish not removed by the Contractor will be removed by the Owner and back-charged to the Contractor.

1.22 RESPONSIBILITY

A. It shall be the contractor's responsibility to inspect the job site and become familiar with the conditions under which the work will be performed.

B. A pre-bid meeting will be held to familiarize the contractors with the project. Failure to attend the pre-bid meeting may be considered cause for rejection of the contractor's bid. The minutes of this meeting will be distributed to all attendees and shall constitute an addendum to these specifications.

1.23 INSTALLATION WORKMANSHIP AND PARTS

A. The contractor shall warranty the installation and workmanship for one (1) year and all parts for thirty-six (36) months from date of final acceptance. A copy of the manufacturer’s warranty shall be provided with closeout documentation and included with the operation and installation manuals. The full cost of maintenance, labor and materials required to correct any defect during the warranty period shall be included in the submittal bid.

B. During the warranty period, each year the contractor shall perform detector sensitivity testing and provide a report to the owner. If the system is UL Listed to perform automatic detector sensitivity testing without manual intervention, and if a detector falls outside of sensitivity window the system automatically indicates a devices trouble, then this requirement shall be waived. Documentation from UL shall be provided as proof of automatic sensitivity testing operation.

C. The system supplier shall maintain a service organization with adequate spare parts stock within 75 miles of the installation. Provide a telephone response to owner’s questions within 4 hours and on-site assistance within 24 hours.

D. Permit the owner’s fire alarm technicians to perform temporary bypasses and emergency repairs on the system without voiding the warranty.

1.24 TEST AND INSPECTION - FIRE AND ECS

A. Testing, general

1. In addition to tests required in this Section, the Contractor shall perform all electrical and mechanical tests required by the equipment manufacturer, the Architect and the Authority having jurisdiction.

2. The contractor shall perform all testing in occupied facilities at times of day that present the lowest impact and disruption to business and activities. Coordinate all testing in occupied buildings with the building owner's representative to assure that fire alarm system testing does not interrupt operations. This may require extensive after hours work to perform such testing.>

3. All equipment, instruments, tools and labor required to conduct the system tests shall be provided by the installing contractor. At a minimum, the following equipment shall be made available testing:

    a. Ladders and scaffolds as required to reach all installed equipment.

    b. Meters for reading voltage, current and resistance.

    c. Two-way communication devices

    d. Simulated smoke, heat-producing devices for heat detectors, extension poles for introducing smoke into detectors, as needed.

    e. Manufacturer's instruments to measure air flow through duct smoke detectors.

    f. Decibel meter and intelligibility testing equipment.

    g. Status and diagnostic software and PC.

4. All testing shall utilize a written acceptance test plan for testing the system components and operation in accordance with NFPA 72 and this specification. The contractor shall be responsible for the performance of the acceptance test plan, demonstrating the function of the system and verifying the correct operation of all system components, circuits, and system programming.

    a. The systems operation matrix created by the equipment supplier shall be used to identify each alarm input and verify all associated output functions.

5. The system test plan shall include but not be limited to the following:

    a. Visually inspect all wiring.

    b. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final acceptance test.

    c. System wiring shall be tested to demonstrate correct system response for the following conditions:

1) Open, shorted and grounded signal line circuits.

2) Open, shorted and grounded notification appliance circuits.

d. System indications shall be demonstrated as follows:

1) Correct message content for each alarm input at all system displays.

2) Correct annunciator light for each alarm input at each graphic display.

3) Correct history logging for all system activity.

4) Correct sensitivity for all smoke detection devices. The use of system generated sensitivity reports is acceptable in meeting this requirement.

5) Correct signals sent to the Central Monitoring Station.

e. Notification appliances shall be demonstrated as follows:

1) All alarm notification appliances actuate as programmed

2) The system shall be tested for interior building audibility of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be tested to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio. The mean value of at least 3 readings shall be required to compute the intelligibility score at each test location.

3) HPSAs shall be tested for an outside audibility level of 15 dBA-fast over ambient condition and intelligibility. Intelligibility shall be tested to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in outdoor areas during normal weather conditions. Intelligibility may be less than 0.7 CIS in areas of the zone if it can be determined that a voice signal is being broadcast and an individual could walk less than 164 feet to find a location in the zone with at least 0.7 CIS. Values of 0.65 through 0.74 shall be rounded to 0.7. The mean value of at least 3 readings shall be required to compute the intelligibility score at each test location.

4) For 24VDC NACS, measure and record the voltage at the most remote appliance on each notification appliance circuit, while operating.

f. System control functions shall be demonstrated as follows:

1) In accordance with the system operation matrix.

g. System off premises reporting functions shall be demonstrated as follows:

1) Correct information received for each alarm and trouble event

h. Secondary power supply (battery) capacity capabilities shall be demonstrated as follows:

1) System battery voltages and charging currents shall be measured and recorded at the fire alarm control panels.

2) System primary power shall be disconnected for 24 hours. At the end of that period, an alarm condition shall be created and the system shall perform as specified for a period of 5 minutes.

3) System primary power shall be restored for forty-eight (48) hours.

4) System battery voltages and charging currents shall again be measured and recorded at the fire alarm control panels.

i. Verify the "As Built" record drawings are accurate.

6. Preliminary Testing

a. Conduct preliminary tests to ensure that all devices and circuits are functioning properly. Tests shall meet the requirements of the written test plan. Correct any deficiencies, omissions or anomalies and retest the affected devices to assure proper function per the specification.

7. Acceptance Testing

a. A final acceptance test shall not be scheduled until the system manuals are provided to and approved by the owner and the following are provided at the job site:

1) "As Built" Record drawings of the system as actually installed

2) A copy of the system operation matrix.

b. The acceptance inspector shall use the system "As Built" record drawings in combination with the system operation matrix and the written acceptance test plan during the testing to verify system operation.

c. Should the system not perform to the above criteria it shall not be accepted and the Contractor shall correct all deficiencies and shall re-test the system at Contractor's expense in the presence of the Architect using the same test criteria.

d. The building owner’s representative shall witness the final tests.

e. The central monitoring station and/or fire department shall be notified before final test in accordance with local requirements.

f. Operate every installed device to verify proper operation and correct annunciation at control panel.

g. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.

8. Test Reports

9. A "Fire Alarm System Record of Completion" per the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in shall be prepared by the Contractor. Submit three (3) copies to the Architect. The report shall include, but not be limited to:

   a. A list of all equipment installed and wired.

   b. Certification that all equipment is properly installed and functions and conforms to these specifications.

   c. Sensitivity settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.

   d. Technician's name, certificate number and date.

1.25 TRAINING

A. The system supplier shall schedule and present a minimum of eight (8) hours of formal site specific instruction for the building owner, detailing the proper operation and maintenance of the installed system.

B. The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation.

C. The instruction shall cover the schedule of maintenance required by NFPA 72 and any additional maintenance recommended by the system manufacturer.

D. Copies of all training aids, presentations, etc. shall be left with the owner.

1.26 SPARE PARTS

A. The contractor shall furnish the following extra material that matches the products installed. Spares shall be packaged with protective covering for storage and identified with labels describing contents.

B. Automatic detection devices - Two (2) percent of the installed quantity of each type, no less than one piece.

C. Manual fire alarm stations - Two (2) percent of the installed quantity of each type, no less than one piece..

D. Glass rods or panels for break glass manual fire alarm stations (if used) - Ten percent of the installed quantity, but no less than two devices.

E. Audible and visible devices - One (1) percent of the installed quantity of each type, but no less than two (2) devices.

F. Keys - A minimum of three (3) sets of keys shall be provided and appropriately identified.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The manufacturer of the system equipment shall be regularly involved in the design, manufacture, and distribution of the products specified in this document. These processes shall be monitored under a quality assurance program that meets ISO 9000/9001 requirements.

B. The catalog numbers used are those of Edwards, a UTC Climate | Controls | Security Company “only”, and constitute the type and quality of equipment to be furnished. For a list of Edwards authorized fire alarm vendors, contact: edwardsmarketing@fs.utc.com.

C. Approved Products: Edwards, a UTC Climate | Controls | Security Company “ ONLY”, All panels and peripheral devices shall be of the standard product of single manufacturer and shall display the manufacturer’s name of each component. The catalog numbers specified under this section are those of Edwards, a UTC Climate | Controls | Security Company.

2.2 GENERAL - FIRE OVERVIEW- FIRE ALARM PANEL

A. All materials, equipment, accessories, devices and other facilities and appurtenances covered by these specifications or noted on the drawings shall be new, best suited for

the intended use and shall conform to applicable and recognized standards for their use, and supplied by a single manufacturer. Should any equipment provided under this specification be supplied by a different manufacturer, that equipment shall be recognized compatible by BOTH manufacturers and listed as such as required by Underwriters' Laboratories.

B. The fire alarm control panel(s) shall be a multi-processor based networked system designed specifically for fire, one-way and two-way emergency audio communications, smoke control, and guard patrol applications. The control panel shall be listed and approved for the application standard(s) as listed in the References section of this specification.

C. The control panel shall include all required hardware, software and site specific system programming to provide a complete and operational system. The control panel(s) shall be designed such that interactions between any applications can be configured, and modified using software provided by the manufacturer. The control panel(s) operational priority shall assure that life safety takes precedence among the activities coordinated by the control panel.

D. The operating controls shall be located in a dead-front steel enclosure behind a locked door with viewing window. All control modules shall be labeled, and all zone locations shall be identified. All panel modules shall be placement supervised for and signal a trouble if damaged or removed.

2.3 SYSTEM FEATURES

A. Each control panel shall include the following capabilities:

B. Supervision of the system electronics, wiring, detection devices and software

C. Up to 2500 analog/addressable input/output points

D. Network connections with up to 63 other control panels and annunciators.

E. Support multiple dialers (DACTs) and modems

F. Two communication ports

G. An internal audible signal with different patterns to distinguish between alarm, supervisory, trouble and monitor events

H. Support multiple 24 VDC and Audio NACs

I. User configurable switches and LED indicators to support auxiliary functions

J. Log up to 1740 chronological events

K. The ability to download all applications and firmware from the configuration computer at a single location on the fire network

L. A real-time clock for time stamps and timed event control

M. Electronic addressing of intelligent addressable devices

N. Provide an independent hardware watchdog to supervise software and CPU operation

O. “Dry” alarm, trouble and supervisory relay contacts

P. Control panel modules shall plug in to a chassis assembly for ease of maintenance

Q. Field wiring shall connect to the panel using removable connectors

2.4 USER ORIENTED FEATURES

A. Each control panel shall include the following user oriented features:

B. An LCD user interface control/display that shall annunciate and control system functions.

C. Provide discreet system control switches for reset, alarm silence, panel silence, drill switch, previous message switch, next message switch and details.

D. A “lamp test” feature shall verify operation of all visual indicators on the panel.

E. An authorized user shall have the ability to operate or modify system functions including system time, date, passwords, holiday dates, restart the system and clear control panel event history file.

F. An authorized user shall have the ability to disable/enable devices, zones, actions, timers and sequences.

G. An authorized user shall have the ability to activate/restore outputs, actions, sequences, and simulate detector smoke levels.

H. An authorized user shall have the ability to enter time and date, reconfigure an external port for download programming, initiate programming and change passwords.

I. An authorized user shall have the ability to test the functions of the installed system.

J. Service groups shall facilitate one-man walk testing. Service/test groups shall be capable of being configured with any combination of addressable devices, independent of SLC wiring. It shall be possible to program alternate device responses when the device’s service group is active. Devices not in an active service group shall process all events normally.

K. Provide internal system diagnostics and maintenance user interface controls to display/report the power, communication, and general status of specific panel components, detectors, and modules.

L. SLC loop controller diagnostics shall identify common alarm, trouble, ground fault, Class A fault, and map faults. Map faults include wire changes, device type changes by location, device additions/deletions and conventional open, short, and ground conditions. Ground faults on the supervised circuit wiring of remote addressable modules shall be identified by device address.

M. An authorized user shall have the ability to generate a report history for alarm, supervisory, monitor, trouble, smoke verification, watchdog, and restore activity.

N. System reports shall provide detailed description of the status of system parameters for corrective action or for preventative maintenance programs. Reports shall be displayed by the operator interface or capable of being printed on a printer.

O. An authorized user shall have the ability to display/report the condition of addressable analog detectors. Reports shall include device address, device type, percent obscuration, and maintenance indication. The maintenance indication shall provide the user with a measure of contamination of a device upon which cleaning decisions can be made.

2.5 PROGRAMMABILITY

A. A Windows-based Configuration Utility (CU) shall be used to create the site-specific system programming. The utility shall facilitate programming of any input point to any output point. The utility shall allow customization of fundamental system operations using initiating events to start actions, timers, sequences and logical algorithms.

1. Zoning of initiation devices.

2. Initiation of events by time of day, day of week, day of year.

3. Initiation of events by matrix groups (X-Y coordinate relationships) for releasing systems.

4. Initiation of events using OR, AND, NOT and counting functions.

5. Prioritizing system events.

6. Programmable activation of detector sounder bases by detector, groups of bases, or all bases.

7. Directing selected device messages to specific panel annunciators

8. Detector sensitivity selection by time of day

9. Support of 256 Central Monitoring Station accounts and directing selected device messages to any one of ten Central Monitoring Stations.

10. The configuration utility shall time and date stamp all changes to the site-specific program, and shall facilitate program versioning and shall store all previous program version data. The utility shall provide a compare feature to identify the differences between different versions of the site-specific program.

11. The configuration utility shall be capable of generating reports which detail the configurations of all fire alarm panels, addressable devices and their configuration settings including generating electrical maps of the addressable device SLCs.

12. The configuration utility shall support the use of bar code readers to expedite electronic addressing and custom programming functions.

13. Please refer to the General, System Description Section for this project's site-specific system operating requirements.

14. The fire alarm control panel shall be an Edwards 3-CPU3 and support components in an appropriately sized enclosure.

2.6 POWER SUPPLY

A. System power supply(s) shall be a high efficiency switched mode design providing multiple supervised power limited 24 VDC output circuits as required by the panel and external loads fed by the panel. Initial power supply loading shall not exceed 80% of power supply capacity in order to allow for future system expansion.

B. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition.

C. It shall be possible to parallel system power supplies to increase capacity or to provide redundant operation.

D. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functionality.

E. All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section, in 48 hours maximum.

F. All standby batteries shall be continuously monitored by the power supply. The power supply shall be able to perform an automatic load test of batteries and indicate a trouble condition if the batteries fall outside a predetermined range. Power supplies shall incorporate the ability to adjust the charge rate of batteries based on ambient temperatures. The power supply shall automatically disconnect the battery before low voltage damages the battery. Low battery and disconnection of battery power supply conditions shall immediately annunciated as battery trouble and identify the specific power supply(s) affected.

G. Batteries shall utilize sealed lead acid chemistry. Initial battery capacity shall provide 125% of calculated capacity requirements in order to allow for future system expansion.

H. All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of NFPA 70 and NFPA 72. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each control panel the disconnect serves.

I. The power supply shall be an Edwards 3-PPS/M series.

2.7 PANEL LCD AND COMMON CONTROLS

A. The system shall be designed and equipped to receive, monitor, and annunciate signals from devices and circuits installed throughout the facility.

B. Each fire alarm control panel (system node) shall be capable of supporting a backlit LCD display. The display on each system node shall be configurable to display the status of any and/or all combinations of all alarm, supervisory, trouble, monitor, or service group event messages on the network. Each LCD display on the system shall be capable of being programmed to allow control functions of any combination of nodes on the entire network. The system shall support both 168 character and 960 character LCD displays on the same network.

C. The LCD display shall provide separate alarm, trouble, supervisory, and monitor event queues of to minimize operator confusion. Receipt of alarm, trouble, and supervisory signals shall activate integral audible devices at the control panel(s) and at each remote annunciation device. The integral audible devices shall produce a sound output upon activation of not less than 85 dBA at 10 feet.

D. The LCD display shall contain the following system status indicators:

1. System Power Indicator

2. System Test Indicator
3. System CPU Fail Indicator
4. Ground Fault Indicator
5. Disabled Points Indicator
6. System Normal Indicator
7. System Common Alarm Indicator
8. System Common Trouble Indicator
9. System Common Supervisory Indicator
10. System Common Monitor Event Indicator

E. The LCD display shall contain the following system switch/indicators:

1. System Reset Switch with Indicator
2. System Alarm Silence Switch with Indicator
3. System Panel Silence Switch with Indicator
4. Drill Switch with Indicator
5. Alarm Acknowledge Switch with Indicator
6. Trouble Acknowledge Switch with Indicator
7. Supervisory Acknowledge Switch with Indicator
8. Monitor Acknowledge Switch with Indicator
9. The LCD display shall contain the following system function switches
    a. System Event Message Queue Scroll Switch.
    b. Event Details Switch (provides an additional 2000 character message about the device highlighted by the operator.)
    c. Command Menu Switch
    d. 10-Digit Keypad with Enter and Backspace switches
10. 168 Character Backlit Liquid Crystal Text Display

a. The user interface shall provide a backlit LCD that will allow custom event messages of up to 42 characters. The interface shall provide a minimum of eight lines by 21 characters and provide the emergency user hands free viewing of the first and last highest priority events. The last highest priority event shall always display and update automatically. Events shall be automatically placed in one of four easy to access queues. It shall be possible to scroll through and view specific alarm, trouble, supervisory and monitor events separately. Having to scroll through a mixed list of event types shall not be considered as equal. The total number of active and disabled events by type shall be displayed. Visual indication shall be provided of any event type that has not been acknowledged or viewed. It shall be possible to customize the designation of all user interface LEDs and Switches for local language requirements.

11. Instructional text messages shall support a maximum of 2,000 characters each.

12. The system 168 character LCD display shall be an Edwards model 3-LCD.

2.8 LEDS AND SWITCHES

A. A modular series of switches and LED indicators shall be available to customize the fire alarm control panel operation in accordance with this specification. All LED and switch functions shall be software programmable. Switches shall be configurable for momentary, maintained, toggle, or “exclusive or” operation as required by the application. LEDs shall be configurable for slow flash, fast flash or steady operation. LED/Switch modules shall be capable of mounting in any available fire panel module position. All LED/Switch modules shall be supervised. LEDs shall be available in a variety of colors to facilitate identification from a distance. The LED/Switch modules shall provide ample room for custom function text labels under a protective membrane.

B. The LED/Switch modules shall be Edwards 3-24x series, 3-12xx series, and 3-6/3S1xxx series devices.

2.9 AUDIO ANNUNCIATION AND CONTROL

A. Provide a master one-way emergency audio control unit as part of the main fire alarm control panel. The emergency audio control shall contain a paging microphone and shall be capable of generating and delivering multi-channel audio messages simultaneously over copper and/or fiber media to remote parts of the facility.

B. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store up to 32 minutes of pre-recorded audio

messages digitally as WAV files. These messages shall be automatically directed to various areas in a facility under program control. The unit shall have the capacity to store up to 200 individual audio messages and to simultaneously play back seven (7) different messages in addition to live page message.

C. During non-alarm conditions, the control unit shall continuously distribute a default audio message to all amplifiers, providing total audio path supervision. To enhance system survivability, each remote FACP cabinet containing an amplifier shall play the default audio message in the event of a fire AND a control network system failure.

D. The one-way emergency audio control shall provide control switches to direct live paging messages as follows:

1. "All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.

2. "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.

3. "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.

4. "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.

5. The system shall automatically deliver a pre-announce tone of 1000 Hz for three seconds when the emergency operator presses the microphone PTT key. A 'ready to page' LED shall flash during the preannounce phase, and turn steady when the system is ready for the user's page delivery. The system shall include a page deactivation timer which activates for 3 seconds when the emergency user release the microphone talk key. Should the user subsequently press the microphone key during the deactivation period a page can be delivered immediately. Should the timer complete its cycle the system shall automatically restore emergency signaling and any subsequent paging will be preceded by the pre-announce tone. A VU display shall indicate voice level to the emergency operator.

6. The one-way audio control unit shall be capable of supporting up to 64 remote microphone inputs and a line level audio input.

7. The fire alarm control panels shall support remote cabinets with zoned amplifiers to receive, amplify and distribute messages through speakers over supervised circuits.

8. The master one-way emergency audio control unit shall be an Edwards 3-ASU.

2.10 REMOTE MICROPHONE

A. Remote microphones shall be included in the LOCs as indicated on the drawings.

B. The remote microphone shall facilitate live page announcements over the ACU/FACP system from locations distant from the ACU/FACP. It shall be possible to connect up to 63 remote microphones to an ACU/FACP.

C. The remote microphone shall feature a Push-to-Talk switch; local and remote page active LEDs, and a trouble LED.

D. The remote microphone shall operate on filtered-regulated 24 VDC power derived from the panel power supply. Power shall be supplied directly from the ACU/FACP or listed auxiliary power supply, ensuring a reliable and monitored power source.

E. The remote microphone shall be an Edwards 3-REMIC series.

2.11 FIRE NETWORK WIRING - SIGNALING LINE CIRCUITS

A. The network inter panel wiring shall be Class B. The network media shall be copper except where fiber optic cable is specified on the drawings.

B. The system supplied under this specification shall utilize node to node, direct wired peer-to-peer network operations. The system shall utilize independently addressed, smoke detectors, heat detectors and input/output modules, intrusion detection as described in this specification. The peer-to-peer network shall contain multiple nodes consisting of the command center, main controller, remote control panels, LCD/LED annunciation nodes, and workstations. Each node is an equal, active functional node of the network, which is capable of making all local decisions and generating network tasks to other nodes in the event of node failure or communications failure between nodes.

C. When a network is wired in a Class B configuration, a single break or short on the network wiring isolates the system into two groups of panels. Each group continues to function as a peer-to-peer network working with their combined databases. When wired using a Class A configuration, a single break or short on the network wiring causes the system to isolate the fault, and network communication continues uninterrupted, without any loss of function. Should multiple wiring faults occur, the network re-configures into many sub-networks and continues to respond to alarm events from every panel that can transmit and receive network messages.

D. The copper network interface shall be an Edwards 3-RS485 series.

E. The fiber optic network interface shall be an Edwards 3-FIBMB2 with multi-mode fiber optic transceivers.

2.12 EST3 SYSTEM

A. The signaling line circuit connecting panels/nodes to intelligent addressable devices including, detectors, monitor modules, control modules, isolation modules, intrusion detection modules and notification circuit modules shall be Class A (style 6 or 7) All signaling line circuits shall be supervised and power limited.

B. When the addressable devices on a signaling line circuit cover more than one designated fire/smoke compartment, a wire-to-wire short on the circuit shall not affect the operation of the addressable devices in other fire/smoke compartments.

C. Each SLC shall support 125 addressable detector addresses and 125 module addresses. The SLC shall support 100% of all addressable devices in alarm and provide support for a 100% compliment of detector isolator bases. Initial circuit loading shall not exceed 80% in order to allow for future system expansion.

D. T-taps (branching) shall be permitted on Class B circuits. Where possible, the devices installed at the end of each branch should be easily accessible for troubleshooting, e.g. a pull station at normal mounting height.

E. The addressable device SLC module shall be UL Listed for use with code compliant, electrically sound existing wiring.

F. Each intelligent addressable device shall transmit information about its location with respect to other devices on the circuit. This information shall be used to create an "As-Built" wiring diagram as well as provide enhanced supervision of a device's physical location. The device message and programmed system output function shall be associated with the device's location on the SLC circuit location and not a device address.

G. The SLC module shall allow replacement of "same type" devices without the need to address and reload the "location" parameters on replacement device.

H. The SLC/Panels shall notify the user when programmed devices are detected on the SLC circuit. The SLC/Panels shall notify the user when the wrong device type is installed at a location configured for a different device type on the SLC circuit.

I. Should an SLC Controller CPU fail to communicate, the SLC circuit shall go into the stand-alone mode. The circuit shall be capable of producing a loop alarm if an alarm type device becomes active during stand-alone mode to enhance system integrity.

J. The addressable device signaling line circuit module shall be an Edwards 3-SDDC1 series.

2.13 NOTIFICATION APPLIANCE CIRCUITS

A. General

1. All notification circuits shall be supervised and power limited. Non-power limited circuits are not acceptable. All notification appliance circuits shall be Class A (Style "Z").

2. Initial circuit loading shall not exceed 80% in order to allow for future system expansion.

3. 24 VDC Notification Appliance circuits

a. Notification appliance circuits shall have a minimum circuit output rating of 2 amps @ 24 VDC

b. 24VDC NACs shall be polarized and provide both strobe synchronization and a horn silence signals on a single pair of wires.

4. Audio Notification Appliance Circuits

a. Audio notification appliance circuits shall be polarized and have a minimum circuit output rating of 50 watts @ 25V audio, and 35 watts @ 70V audio.

2.14 AUDIO AMPLIFIERS

A. Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any one of eight digitized audio channels as directed by system programming.

B. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall provide a selectable 25/70 Vrms output, suitable for connection to emergency speakers.

C. To enhance system survivability in the event of a total loss of audio data communications, all amplifiers shall default to the local “EVAC” tone generator channel. If the local panel has an alarm condition, then all amplifiers will sound the EVAC message on their speaker circuits. In the event of a loss of the fully digitized, multiplexed audio riser data, the audio amplifiers shall automatically default to an internally generated alarm tone which shall sound a 3-3-3 temporal pattern.

D. Amplifiers shall also include a 24 VDC notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable.

E. Provide as minimum, one twenty (20) watt audio amplifier per paging zone. Initial amplifier loading shall not exceed 80% in order to allow for future system expansion. Calculations shall assume each speaker is connected at one (1) watt.

F. Audio amplifiers shall be Edwards 3-ZA series devices.

2.15 INITIATING DEVICE CIRCUITS

A. Conventional (2-wire) initiating device circuits monitoring manual fire alarm stations, smoke and heat detectors, water-flow switches, valve supervisory switches, fire pump functions, and air pressure supervisory switches shall be Class A (Style "D" or "E")

B. Initiating device circuits monitoring magnetic security contacts, motion detectors, duress station, glass break and intrusion type devices shall be Class B (Style "A" or "B").

C. Initiating device circuits shall be configurable for latched or non-latched operation and configurable to initiate alarm, supervisory or monitor events.

D. End-of-line resistors for conventional initiating device circuits shall be covered with insulated tubing, terminated with ring lugs and display a UL label.

2.16 DACT - OFF PREMISE COMMUNICATION

A. The system shall provide off premises communications capability using a Digital Alarm Communications Transmitter (DACT) for sending system events to multiple Central Monitoring Station (CMS) receivers over conventional telephone lines.

B. The system shall provide the CMS(s) with point identification of system events using 4/2, Contact ID ID (SIA DC-05) or SIA DCS protocols. The system shall also transmit an alphanumeric system activity message, by event, to a commercial paging system provided by the owner, using TAP Pager protocol and an internal V.32BIS or greater 14.4Kbaud modem.

C. The dialer shall support up to 255 individual accounts and to send account information to eight (8) different receivers, each having a primary and secondary telephone access number. System events shall be capable of being directed to one or more receivers depending on event type or location as specified by the system design.

D. In the event of a fire alarm panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.

E. The owner shall arrange for two (2) dedicated loop-start phone lines to be terminated using two RJ31X jacks within 5 ft of the main fire alarm control panel.

F. The DACT shall be an Edwards 3-MODCOM(P).

2.17 REMOTE BOOSTER POWER SUPPLY

A. Install Remote NAC Power Supplies (boosters) at the locations shown on the drawings, as required, to minimize NAC voltage drops. Remote NAC power supplies shall be treated as peripheral NAC devices and shall not be considered fire alarm control units.

B. The NAC power supplies shall be fully enclosed in a surface mounted steel enclosure with hinged door and cylinder lock, and finished in red enamel. Door keys shall be the identical to FACP enclosure keys. The enclosure shall have factory installed mounting brackets for additional UL listed fire alarm equipment within its cabinet. Enclosures shall be sized to allow ample space for interconnection of all components and field wiring, and up to 10AH batteries. The enclosure shall have provisions for an optional tamper switch. All FACP addressable control modules required to initiate the required NAC power supply output functions shall be installed within the NAC power supply enclosure

C. Remote NAC power supply input circuits shall be configurable as Class B supervised inputs or for connection to any 6 to 45 VDC initiation source.

D. Remote booster power supplies shall provide four (4) synchronized Class B supervised or two (2) Class A, power limited, 24VDC filtered and regulated Notification Appliance Circuits (NACs). Each NAC output shall be configurable as a continuous 24Vdc auxiliary power output circuit. The booster power supply shall be capable of a total output of 10 amps.

E. The power supply NACs shall be configurable to operate independently at any one of the following rates: continuous synchronized, or 3-3-3 temporal. It shall be possible to configure the NACs to follow the main FACP NAC or activate from intelligent addressable synchronized modules. All visible and audible NACs within the facility shall be synchronized.

F. Upon failure of primary AC power, the remote power supply shall automatically switch over to secondary battery power without losing any system functions. It shall be possible to delay reporting of an AC power failure for up to 6 hours. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately annunciated as locally as battery trouble. All power supply trouble conditions (DC power failure,

ground faults, low batteries, and IDC/NAC circuit faults) shall identify the specific remote power supply affected at the main FACP. All power supply trouble conditions except loss of AC power shall report immediately. Interconnecting NAC Booster power supplies in a manner which prevents identification of an individual power supply trouble shall not be considered as an equal.

G. The remote booster power supply shall be capable of recharging up to 24AH batteries to 70% capacity in 24 hours maximum. Batteries provided shall be sized to meet the same power supply performance requirements as the main FACP, as detailed elsewhere in this specification.

H. All AC power connections shall be to the building's designated dedicated emergency electrical power circuit. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside the each remote NAC power supply the disconnect serves.

I. The remote NAC power supplies shall be Edwards model BPS/APS series devices.

2.18 LOCAL OPERATING CONSOLE - ANNUNCIATORS

A. Provide a UL864 listed semi-flush mounted local operating consoles at the location(s) shown on the drawings.

B. The LOC shall utilize standard fire alarm user interface components to provide the ability to operate the Autonomous Control Unit/Fire Alarm Control Panel functions from alternate locations within the building. The LOC shall be capable of receiving the same event information and issuing the same system commands as the ACU/FACP to which it is connected, as specified in the functional matrix elsewhere in this specification. Functions shall include initiating all pre-recorded messages and live page messages.

C. The following common indicators and controls shall be provided on the LOC.

D. The LOC shall include an integral LCD text annunciator. The LOC shall include an integral remote microphone for fire audio system paging. LOC Power, System Trouble, and Signal Silenced LEDs; and Lamp Test push buttons.

E. A modular series of switches and LED indicators shall be available to customize the fire alarm control panel operation in accordance with this specification. All LED and switch functions shall be software programmable. Switches shall be configurable for momentary, maintained, toggle, or “exclusive or” operation as required by the application. LEDs shall be configurable for slow flash, fast flash or steady operation. LED/Switch modules shall be capable of mounting in any available fire panel module

position. All LED/Switch modules shall be supervised. LEDs shall be available in a variety of colors to facilitate identification from a distance. The LED/Switch modules shall provide ample room for custom function text labels under a protective membrane.

F. The LED/Switch modules shall be Edwards 3-24x series, 3-12xx series, and 3-6/3S1xxx series devices.

G. The LOC shall be equipped with a key locked see-through door mounting. The LOC shall be powered by a battery backed up nominal 24 VDC power source.

H. The mass notification LOC remote annunciator shall be Edwards 3-ANN series.

2.19 GENERAL - PERIPHERAL COMPONENTS

A. General Requirements for Intelligent Addressable Heat, Smoke and CO Detectors

1. Each detector shall contain an integral microprocessor which shall determine if the device is normal, in alarm, or has an internal trouble. The microprocessor's non-volatile memory shall permanently store the detector's serial number, device type and system address. It shall be possible to address each intelligent device without the use of switches. Devices requiring switches for addressing shall not be considered as equal. Memory shall automatically be updated with the hours of operation, last maintenance date, number of alarms and troubles, time of last alarm, and analog signal patterns for each sensing element just before the last alarm.

2. Each detector shall be capable of identifying up to 32 diagnostic codes. This information shall be available for system maintenance. The diagnostic code shall be stored at the detector.

3. Each addressable detector on the Signaling Line Circuit (SLC) shall transmit information regarding its location with respect to other intelligent devices on the signaling line circuit to the control panel, creating an "As-Built" circuit map. The circuit mapping function shall provide location supervision of all intelligent devices on the signaling line circuit. An intelligent detector's programmed system response functions shall be associated with the detector's actual location on the signaling line circuit and not with the detector's address. After system commissioning, detectors improperly installed in the wrong location shall function according to the mapped programmed response for its location on the circuit, not its detector's address.

4. Two status LEDs shall be provided on each detector. A flashing green LED shall indicate normal operation; flashing RED shall indicate the alarm state. A steady

RED and steady GREEN shall indicate alarm state when in the stand-alone mode. LEDs shall be visible from any direction.

5. The system shall allow for changing of detector types for service replacement purposes without the need to reprogram the system. The replacement detector type shall automatically continue to operate with the same programmed sensitivity levels and functions as the detector it replaced, without the need for reprogramming. System shall display an off-normal condition until the proper detector type is installed or a change in the device type profile has been made.

6. Detectors shall be rated for operation in the following environment unless specifically noted:

    a. Temperature: 32°F to 120°F (0°C to 49°C)

    b. Humidity: 0-93% RH, non-condensing

        1) Detectors with addressing components in the base shall not be considered as equal.

7. The intelligent detectors shall be Edwards Signature Series devices.

8. Please refer to the General, System Description Section for site-specific detector operating requirements.

2.20 PHOTO-CO

A. Provide analog/addressable combination photoelectric smoke and carbon monoxide (CO) detectors at the locations shown on the drawings.

B. The combination smoke and CO detector shall provide two independent signals (smoke & CO) to the control panel for programming system responses. When mounted in a sounder base, the detector shall be capable of initiating a temporal 3-3-3 when smoke is detected or temporal 4-4-4-4 when CO is detected. Detectors that transmit a common signal to the control panel for both smoke and CO alarms shall not be considered as equals. The detector shall be listed under standards UL-268 and UL-2075.

C. Each smoke detector shall be individually programmable to operate at any one of five (5) sensitivity settings. The detector shall also store pre-alarm and alternate pre-alarm sensitivity settings. Pre alarm sensitivity values shall be configurable in 5% increments of the alarm and alternate alarm sensitivity settings respectively. The detector shall be able to differentiate between a long term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity

of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel. It shall be possible to automatically change the sensitivity of individual intelligent addressable smoke detectors for day and night (alternate) periods.

D. Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% (dirty) of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

E. The smoke chamber shall be UL listed for field replacement.

F. The electro-chemical CO sensor shall generate a CO alarm in compliance with UL-2034 requirements. The sensor shall have a nominal six-year life. When the sensor approaches the end of its useful life, it shall transmit a maintenance condition to the control panel, indicating the CO sensor board replacement is required. Only when the sensor is no longer operational shall a trouble condition be sent to the control panel. Sensors that transmit a common trouble indication for both sensor end-of-life and other causes of detector trouble shall not be considered as equal. Performing a "sensitivity" check from the panel shall report the approximate number months of CO sensor life remaining.

G. Placing the CO detector in test mode shall facilitate the use of direct injection of small quantities of CO to check detector functionality. The CO sensor board shall be UL listed as field replaceable. Replacement of the CO sensor shall not require any field calibration.

H. The Combination photoelectric smoke & CO detector shall be an Edwards SIGA2-PCOS.

2.21 PHOTOELECTRIC

A. Provide analog/addressable photoelectric smoke detectors at the locations shown on the drawings.

B. When mounted in a sounder base, the detector shall initiate a temporal 3-3-3 when smoke is detected.

C. The photoelectric smoke detector shall be suitable for direct insertion into air ducts up to 3 ft (0.91m) high and 3 ft (0.91m) wide with air velocities up to 5,000 ft/min. (0-25.39 m/sec) without requiring specific duct detector housings or supply tubes.

D. Each smoke detector shall be individually programmable to operate at any one of five (5) sensitivity settings. The detector shall also store pre-alarm and alternate pre-alarm sensitivity settings. Pre alarm sensitivity values shall be configurable in 5% increments of the alarm and alternate alarm sensitivity settings respectively. The detector shall be able to differentiate between a long term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel. It shall be possible to automatically change the sensitivity of individual intelligent addressable smoke detectors for day and night (alternate) periods.

E. Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when 80% (dirty) of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

F. The photoelectric smoke detector shall be an Edwards SIGA-PS.

2.22 DUCT SMOKE

A. Provide intelligent low profile photoelectric duct smoke detectors / remote test switches at the locations shown on the drawings.

B. The intelligent duct smoke detector shall operate in ducts having from 100ft/min to 4,000ft/min air velocity. The detector shall be suitable for operation over a temperature range of -20 to 158F° and offer a harsh environment gasket option. The detector shall utilize an air exhaust tube and an air sampling inlet tube that extends into the duct air stream up to ten (10) feet. Design of the detector shall permit sampling tube installation from either side of the detector and permit sampling tube installation in 45- degree increments to ensure proper alignment with duct airflow. Drilling templates and gaskets to facilitate locating and mounting the housing shall be provided.

C. The intelligent duct smoke detector shall obtain information from a photoelectric sensing element. The detector shall be able to differentiate between a long term drift above the pre alarm threshold and fast rise above the threshold. The detector shall monitor the sensitivity of the smoke sensor. If the sensitivity shifts outside the UL limits, a trouble signal shall be sent to the panel

D. Each detector shall utilize an environmental compensation algorithm that shall automatically adjust for background environmental conditions such as dust, temperature, and pressure. The detector shall provide a maintenance alert signal when

80% (dirty) of the available compensation range has been used. The detector shall provide a dirty fault signal when 100% or greater compensation has been used.

E. The intelligent duct smoke detector shall provide a form "C" auxiliary alarm relay rated at 2amps @ 30Vdc. The position of the relay contact shall be supervised by the control panel software. Operation of the relay shall be controlled either by its respective detector processor or under program control from the control panel as required by the application. Detector relays not capable of programmed operation independent of the detector's state shall not be considered as equal. The detector shall be equipped with a local magnet-activated test switch.

F. Each duct detector shall be installed and testing in accordance with manufacturer's instructions, including pressure differential and, velocity testing. Test results shall be submitted to the owner.

G. Remote test switches/LED indicators shall be provided below the detector on the ceiling to indicate location of the detector in non-mechanical areas, at locations indicated on the drawings.

H. The Intelligent Photoelectric Duct Smoke Detector shall be an Edwards model SIGA-SD.

I. The remote key operated test switch / LED shall be a Edwards model SD-TRK

2.23 RATE OF RISE

A. Provide intelligent combination fixed temperature / rate-of-rise heat detectors at the locations shown on the drawings.

B. The detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The detector shall utilize a low mass thermistor heat sensor and operate at a nominal fixed temperature alarm point rating of 135oF and at a temperature rate-of-rise alarm point of 15oF per minute. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of thermistor data. Systems using central intelligence for alarm decisions shall not be considered as equal.

C. The heat detector shall be rated for ceiling installation at a minimum of 70 ft centers and also be suitable for wall mount applications.

D. The Intelligent combination fixed temperature / rate-of-rise heat detector shall an Edwards SIGA-HRS.

2.24 CO

A. Provide addressable carbon monoxide (CO) detectors at the locations shown on the drawings.

B. The CO detector shall provide a signal to the control panel for programming system responses. When mounted in a sounder base, the detector shall be capable of initiating a temporal 4-4-4-4 signal when CO is detected. The detector shall be listed under standard UL-2075.

C. The electro-chemical CO sensor shall generate a CO alarm in compliance with UL-2034 requirements. The sensor shall have a nominal six-year life. Performing a "sensitivity" check from the panel shall report the approximate number months of sensor life remaining. When the sensor approaches the end of its useful life, it shall transmit a maintenance condition to the control panel, indicating the CO sensor board replacement is required. Only when the sensor is no longer operational shall a trouble condition be sent to the control panel. Detectors that transmit a common trouble indication for both sensor end-of-life and other causes of detector trouble shall not be considered as equal.

D. Placing the CO detector in test mode shall facilitate the use of direct injection of small quantities of CO to check detector functionality. The CO sensor board shall be UL listed as field replaceable. Replacement of the CO sensor shall not require any field calibration.

E. The CO detector shall be an Edwards SIGA2-COS.

2.25 STANDARD BASE

A. Provide standard detector bases suitable for mounting on either North American 1-gang, 3½ or 4 inch octagon box and 4 inch square box, European BESA or 1-gang box.

B. The bases shall utilize a twist-lock design and provide screw terminals for all field wiring connections.

C. The base shall contain no active electronics and support all Signature series detector types.

D. The base shall be capable of supporting a Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.

E. Removal of the respective detector shall not affect communications with other detectors.

F. The standard addressable detector base shall be an Edwards SIGA-SB or SB4.

G. The remote LED indicator shall be an Edwards SIGA-LED

2.26 DOUBLE ACTION SINGLE STAGE - MANUAL STATIONS

A. Provide addressable double action, single stage fire alarm stations at the locations shown on the drawings.

B. The manual station shall be suitable for mounting on North American 2 ½ (64mm) deep 1-gang boxes and 1 ½ (38mm) deep 4 square boxes with 1-gang covers. If indicated as surface mounted, provide manufacturer's surface back box.

C. The fire alarm station shall utilize red polycarbonate construction with molded, raised-letter operating instructions in a contrasting color; shall show visible indication of operation and incorporate an internal toggle switch.

D. The manual pull station will have an addressable module integral to the unit.

E. The station reset key shall match the control panel key.

F. Manual pull stations that initiated an alarm condition when opening the unit are not acceptable.

G. The addressable double action, single stage manual fire alarm station shall be an Edwards SIGA-278.

2.27 GUARDS

A. Provide manual pull station guards at the locations shown on the drawings.

B. The guard shall consist of a factory-fabricated clear polycarbonate enclosure, hinged at the top. Lifting the cover shall provide access to the manual pull station and activate an integral battery powered audible horn intended to discourage false alarms.

C. The manual pull station guards shall Edwards STI-1000 Series.

2.28 ONE INPUT MONITOR - MODULES

A. Provide addressable single input multifunction modules at the locations shown on the drawings.

B. The module shall be suitable for mounting on North American 2½” (64mm) deep 1-gang boxes and 1½” (38mm) deep 4” square boxes with 1-gang covers.

C. Each module shall provide one (1) supervised Class B input circuit configurable as one of the following “personalities.”

1. Normally-Open Alarm Latching (for alarm initiation applications)

2. Normally-Open Alarm Delayed Latching (for water-flow switch applications)

3. Normally-Open Active Non-Latching (for limit switch and monitor applications)

4. Normally-Open Active Latching (for tamper switch and supervisory applications)

5. Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuit, to the control panel. Single function modules or without individual ground fault detection identification capability shall not be considered as equal.

6. The Intelligent Single Input Module shall be an Edwards SIGA-CT1.

2.29 TWO INPUT MONITOR

A. Provide addressable dual input multifunction modules at the locations shown on the drawings.

B. The module shall be suitable for mounting on North American 2½" (64mm) deep 1-gang boxes and 1½" (38mm) deep 4" square boxes with 1-gang covers.

C. Each module shall provide two (2) supervised Class B input circuit configurable as one of the following "personalities."

1. Normally-Open Alarm Latching (for alarm initiation applications)

2. Normally-Open Alarm Delayed Latching (for water-flow switch applications)

3. Normally-Open Active Non-Latching (for limit switch and monitor applications)

4. Normally-Open Active Latching (for tamper switch and supervisory applications)

5. Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuits, to the control panel. Single function modules or without individual ground fault detection identification capability shall not be considered as equal.

6. The Addressable Dual Input Module shall be an Edwards SIGA-CT2.

2.30 NOTIFICATION CIRCUIT

A. Provide addressable notification appliance circuit modules at the locations shown on the drawings.

B. The module shall be suitable for mounting in North American 2 ½" (64mm) deep 2-gang boxes and 1 ½" (38mm) deep 4" square boxes with 2-gang covers, or European 100mm square boxes.

C. The addressable NAC module shall provide one (1) supervised Class B notification appliance circuit.

D. The NAC control module shall be configurable for the following operations:

1. 24 VDC synchronized NAC circuit, 2 amps @ 24 VDC.

2. Audio notification circuit 25Vrms @ 50 watts or 70 Vrms @ 35 watts

3. Firefighter's Telephone control with ring tone

4. The addressable notification appliance circuit module shall be an Edwards SIGA-CC1(S) or MCC1(S)

2.31 RELAY

A. Provide addressable control relay modules at the locations shown on the drawings.

B. The module shall be suitable for mounting on a North American 2 ½" (64mm) deep 1-gang box or 1 ½" (38mm) deep 4" square box with 1-gang covers.

C. The module shall provide one (1) form C dry relay contacts rated at 24Vdc @ 2 amps (pilot duty) to control external appliances or equipment. The position of the relay contact shall be confirmed by the system firmware. The relay coil shall be magnetically latched to reduce wiring and ensure 100% of the relays on the SLC can be energized at same time.

D. The addressable control relay module shall be an Edwards SIGA-CR or MCR.

2.32 WATERFLOW-TAMPER

A. Provide addressable dual input water-flow / tamper modules at the locations shown on the drawings.

B. The module shall be suitable for mounting on North American 2½" (64mm) deep 1-gang boxes and 1½" (38mm) deep 4" square boxes with 1-gang covers.

C. Each module shall provide two (2) supervised Class B input circuit configured as:

1. Normally-Open Alarm Delayed Latching for water-flow switch applications.

2. Normally-Open Active Latching for tamper switch and supervisory applications.

3. Each module shall identify and report by device address, ground faults and opens associated with its initiating device circuits, to the control panel. Modules or without individual ground fault detection identification capability shall not be considered as equal.

4. The Addressable Dual Input Module shall an Edwards SIGA-WTM.

2.33 STROBES - NOTIFICATION APPLIANCES

A. Provide low profile wall mounted strobes at the locations shown on the drawings.

B. Low profile strobes shall mount in a North American 1-gang box, and protrude less than 1" from the finished wall. The word FIRE shall be prominently displayed on the housing.

C. The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 110cd. Selected strobe rating shall be visible when the strobe is in its installed position. Amber lens strobes shall be available with outputs of 12/24/60/88cd. Light shall be evenly distributed throughout the required volume using cavity and mask "FullLight" technology to prevent hot spots. Strobes using specular reflectors shall not be considered as equal.

D. When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

E. Horn and strobe power, horn silencing, and strobe synchronization shall be accomplished over a single pair of wires. In and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

F. The strobes shall be Edwards Genesis G1 Series.

2.34 SPEAKER-WALL

A. Provide low profile wall mounted speakers at the locations shown on the drawings.

B. The low profile speakers shall mount in a North American 4" x 2 1/8" square electrical box, and protrude less than 1" from the finished wall. The word FIRE shall be prominently displayed on the housing.

C. The speaker output shall be switch selectable from the following available settings: 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker is in its installed position.

D. The speaker shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

E. The low profile wall mounted speakers shall be an Edwards Genesis G4 series.

2.35 SPEAKER-CEILING

A. Provide low profile ceiling mounted speaker at the locations shown on the drawings.

B. Speakers shall mount in a North American 4" x 2 1/8" square electrical box, or a 960A-4RF round flush box, and protrude less than 1.6" from the finished ceiling. The word FIRE shall be prominently displayed on the housing.

B. The speaker output shall be switch selectable from the following available settings: 2W (91dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (80dBA) at 10 ft. when measured in reverberation room per UL-1480. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

C. The speaker shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

D. The low profile ceiling mounted speaker shall be an Edwards Genesis GC series.

2.36 SPEAKER-STROBE-WALL

A. Provide low profile wall mounted speaker-strobes at the locations shown on the drawings.

B. The low profile speaker-strobes shall mount in a North American 4" x 2 1/8" square electrical box, without trims or extension rings, and protrude less than 1" from the finished wall. The word FIRE shall be prominently displayed on the housing.

C. The speaker output shall be switch selectable from the following available settings: 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft. when measured in reverberation room per UL-464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

D. The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 110cd. Selected strobe rating shall be visible when the speaker-strobe is in its installed position. Amber lens strobes shall be available with outputs of 12/24/60/88cd. Light shall be evenly distributed throughout

the required volume using cavity and mask “FullLight” technology to prevent hot spots. Strobes using specular reflectors shall not be considered as equal.

E. When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules

F. Horn and strobe power, horn silencing, and strobe synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

G. The low profile wall mounted speaker-strobes shall be an Edwards G4 series.

2.37 SPEAKER-STROBE-CEILING

A. Provide low profile ceiling mounted speaker-strobes at the locations shown on the drawings.

B. Speaker-strobes shall mount in a North American 4” x 2 1/8” square electrical box, or a 960A-4RF round flush box, and protrude less than 1.6” from the finished ceiling. The word FIRE shall be prominently displayed on the housing.

B. The speaker output shall be switch selectable from the following available settings: 2W (91dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (80dBA) at 10 ft. when measured in reverberation room per UL-1480. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

C. The strobe output shall be switch selectable as required by its application from the following available settings: 15cd, 30cd, 75cd & 95cd or 95cd, 115cd, 150cd, &177cd. Selected strobe rating shall be visible when the speaker-strobe is in its installed position. Amber lens strobes shall be available with outputs of 13/26/65/82cd or 82/100/130/155cd.

D. When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules

E. Strobe power and synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

F. The low profile ceiling mounted speaker-strobes shall be an Edwards Genesis GC series.

2.38 SPEAKER-STROBE-WEATHERPROOF

A. Provide low profile weatherproof speaker-strobes at the locations shown on the drawings.

B. The weatherproof speaker-strobes shall mount in a North American 4" square 1 ½"deep electrical box for indoor applications without a trim skirt and a and a 4" square 2 1/8"deep electrical box when used with a trim skirt. A factory supplied back box shall be supplied for weatherproof applications.

C. The speaker-strobe shall be suitable for wall or ceiling mount and operate in temperatures from -40 to 151 degrees F. The word FIRE shall be prominently displayed on the housing.

D. The speaker output shall be switch selectable from the following available settings:

WATTAGE	**SWITCH POSITION**	**25VRMS**	**70VRMS**
2W	T	90.0 DBA	89.7 DBA
1W	X	87.1 DBA	86.9 DBA
½ W	Y	84.0 DBA	83.9 DBA
¼ W	Z	80.8 DBA	80.8 DBA

A. Output is at 10 ft. when measured in reverberation room per UL-464. Frequency response shall be 400 to 4,000Hz. The selected speaker wattage shall be visible when the speaker-strobe is in its installed position.

B. The strobe output shall be switch selectable as required by its application from the following available settings:

1. Listing: UL1971.

    a. Location: Indoor, Clear Lens.

    b. Standard Candela Output Speaker-Strobes/ Strobe Switch Position (D): 15 CD.

    c. High Candela Output Speaker Strobe (C): 29 CD.

    d. B: 70 CD.

    e. A: 87 CD.

f. D:102 CD.

g. C: 123 CD.

h. B: 147 CD.

i. A: 161 CD.

2. Listing: UL1971.

a. Location: Indoor, Amber Lens.

b. Standard Candela Output Speaker-Strobes/ Strobe Switch Position (D): 13 CD.

c. High Candela Output Speaker Strobe (C): 25 CD.

d. B: 59 CD.

e. A: 62 CD.

f. D: 84 CD.

g. C: 101 CD.

h. B: 125 CD.

i. A: 130 CD.

3. Listing: UL 1638.

a. Location: Outdoor, Clear Lens.

b. Standard Candela Output Speaker-Strobes/ Strobe Switch Position (D): 6 CD.

c. High Candela Output Speaker Strobe (C): 12 CD.

d. B: 28 CD.

e. A: 35 CD.

f. D: 41 CD.

g. C: 50 CD.

h. B: 60 CD.

i. A: 65 CD.

4. Listing: UL 1638.

    a. Location: Outdoor, Amber Lens.

    b. Standard Candela Output Speaker-Strobes/ Strobe Switch Position (D): 5 CD.

    c. High Candela Output Speaker Strobe (C): 10 CD.

    d. B: 24 CD.

    e. A: 25 CD.

    f. D: 34 CD.

    g. C: 41 CD.

    h. B: 51 CD.

    i. A: 52 CD.

C. Selected strobe rating shall be visible when the speaker-strobe is in its installed position.

D. When multiple strobes are installed within view of each other, their outputs shall be synchronized within ten (10) milliseconds of each other for an indefinite period without the need for separate synchronization modules.

E. Horn and strobe power, horn silencing, and strobe synchronization shall be accomplished over a single pair of wires. Both the speaker and strobe elements shall provide in and out screw terminals shall accommodate 18AWG to 12 AWG wiring and have captive hardware.

F. The weatherproof speaker-strobes shall be Edwards Genesis WG4 Series.

2.39 ACCESSORIES

A. Magnetic Door Holders

1. Provide floor mounted or wall mounted fail safe electromagnetic door holders as shown on the drawings.

2. Holders shall provide approximately 25-lbf nominal holding force when energized. The units shall have an aluminized finish and contain no moving parts. The contact plate shall have an integral nylon swivel to absorb shock and adjust to any door angle.

3. Flush and semi-flush models shall be designed for concealed wiring applications and shall mount on standard 1-gang electrical box. Floor mounted electromagnet units shall consist of a floor plate, gaskets, and housing. Incoming conduit shall connect directly into floor plate. The housing and gaskets shall mount on the floor plate to form a weatherproof junction box Door holders shall be listed to UL-228.

4. All holders shall be normally be energized, and a release shall be accomplished by interrupting the circuit.

5. The electromagnetic door holders shall be Edwards 1500 series.

PART 3 EXECUTION

3.1 GENERAL

A. The entire system shall be installed in a skillful manner in accordance with approved manufacturer's installation manuals, shop drawings and wiring diagrams.

B. All work shall be performed in accordance with the requirements of NFPA 70 and NFPA 72.

C. Coordinate locations of all devices with all other divisions' drawings and specifications.

D. All fire alarm devices shall be accessible for periodic maintenance. Should a device location indicated on the contract drawings not meet this requirement, it shall be the responsibility of the installing contractor to bring it, in writing, to the attention of the Project Engineer.

E. Fasten equipment to structural members of building or metal supports attached to structure, or to concrete surfaces.

F. All systems and system components listed to UL864 Control Units for Fire Protective Signaling Systems maybe installed within a common conduit raceway system, in accordance with the manufacture's recommendations. System(s) or system components not listed to the UL864 standard shall utilize a separate conduit raceway system for each of the sub-systems.

G. No wiring except life safety system circuits and system power supply circuits shall be permitted in the control panel enclosures.

H. Any low-voltage copper wiring that leaves the protection of a building shall be provided with a compatible UL 497B listed transient protection devices where the circuit leaves the building and where it enters the next building.

I. Devices containing end-of-line resistors shall be appropriately labeled. Devices should be labeled such that removal of the device is not required to identify the EOL device.

J. Fiber Optic Cable

1. Only glass filament cable permitted. Plastic filament fiber optic cables are not acceptable.

2. ST connectors shall be used at all equipment terminations.

3. Concrete floors shall be X-rayed prior to core drilling on post tension slabs. Verify with engineer on type of slab prior to bid.

END OF SECTION