



MCKEE & ASSOCIATES
ARCHITECTS, INC.

Project Manual

VOLUME NO. 2 of 2



A New Auditorium

for

Straughn School

for the

Covington County Board of Education

Andalusia, Alabama

Project No: **2020.168**
April 8, 2022

Alabama Division of Construction Management No.2021657
Public School & College Authority (PSCA) No. 9345

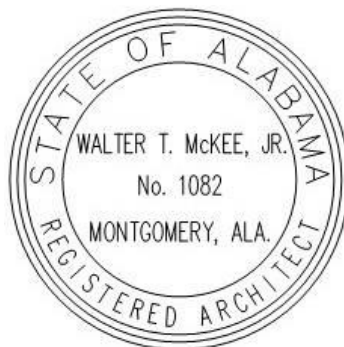


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SECTION 09250 - GYPSUM DRYWALL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Types of work include:
 - 1. Gypsum drywall at walls and ceilings.
 - 2. Drywall finishing (joint tape-and-compound treatment).

1.3 QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where gypsum drywall systems with fire- resistance ratings are indicated, provide materials and installations which are identical with those of applicable assemblies tested per ASTM E 119 by fire testing laboratories acceptable to authorities having jurisdiction.
 - 1. Provide fire-resistance rated assemblies identical to those indicated by reference to GA File No.'s. in GA "Fire Resistance Design Manual" or to design designations in UL "Fire Resistance Directory" or in listing of other testing and agencies acceptable to authorities having jurisdiction.
- B. Gypsum Board Terminology Standard: GA-505 by Gypsum Association.
- C. Single-Source Responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product specifications and installation instructions for each gypsum drywall component, including other data as may be required to show compliance with these specifications.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store material inside under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.
- C. Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal corner beads and trim from being bent or damaged.

1.6 PROJECT CONDITIONS

- A. Environmental Requirements, General: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum board.
- B. Cold Weather Protection: When ambient outdoor temperatures are below 55 degrees F maintain continuous, uniform, comfortable building working temperatures of not less than 55 degrees F for a minimum period of 48 hours prior to, during and following application of gypsum board and joint treatment materials or bonding of adhesives.
- C. Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
 - 1. Gypsum Board and Related Products:
 - a. Georgia-Pacific Corp.
 - b. Gold Bond Building Products Div., National Gypsum Co.
 - c. United States Gypsum Co.
 - d. CertainTeed Corporation
 - e. Lafarge North America
 - B. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS

- A. Gypsum Wallboard: ASTM C 36, of types, edge configuration and thickness indicated below; in maximum lengths available to minimize end-to-end butt joints.
 - 1. Provide Type "X" fire-resistant at all locations unless otherwise where identified by a UL Listing or Classification or as denoted on the drawings.
 - 2. Provide Type "C", fire-resistant where identified by a UL Listing or Classification where denoted on the drawings.
 - 3. Impact/Penetration Resistant Type "X" fire-resistant at locations as identified on the drawings. Equal to Hi-Impact Brand 2000 Fire Shield by National Gypsum. Tested in accordance with ASTM C36/C 1396 Type X, ASTM E 695, ASTM D 1037, ASTM D4977 and ASTM D 4060.
 - 4. Provide Type "MR" moisture resistant, where gypsum board is shown at all wet areas (Restrooms, etc.) install 5/8" moisture resistant gypsum board at all wet walls where plumbing fixtures are shown.
 - 5. Thickness: 5/8" unless otherwise indicated.
 - 6. Edges: Manufacturer's standard.

2.3 TRIM ACCESSORIES

- A. General: Provide manufacturer's standard trim accessories of types indicated for drywall work, formed of galvanized steel unless otherwise indicated, with either knurled and perforated or expanded flanges for nailing or stapling, and beaded for concealment of flanges in joint compound. Provide corner beads, L-type edge trim-beads, U-type edge trim-beads, special L-kerf-type edge trim-beads, and one-piece control joint beads.
- B. Non-Beaded Trim: Non-beaded trim shall not be used, except with specific approval by the Architect.

2.4 JOINT TREATMENT MATERIALS

- A. General: ASTM C 475; type recommended by the manufacturer for the application indicated, except as otherwise indicated.
- B. Joint Tape: Paper reinforcing tape.
- C. Joint Compound: Ready-mixed vinyl-type for interior use.
 - 1. Grade: A single multi-purpose grade, for entire application.

2.5 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum drywall work of the type and grade recommended by the manufacturer of the gypsum board.

- B. Gypsum Board Screws: Comply with ASTM C 646.
- C. Gypsum Board Nails: Comply with ASTM C 514.
- D. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant for concealed applications per ASTM C 919.
- E. Exposed Acoustical Sealant: Nonoxidizing, skinnable, paintable, gunnable sealant for exposed applications per ASTM C 919.
- F. Water-Resistant Adhesive: Type I organic adhesive for ceramic tile complying with ANSI A136.1.

PART 3 - EXECUTION

3.1 GENERAL GYPSUM BOARD INSTALLATION REQUIREMENTS

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA 216.
- B. Locate exposed end-butt joints as far from center of walls possible, and stagger not less than 1'-0" in alternate courses of board.
- C. Install wall/partition boards vertically to avoid end-butt joints wherever possible.
- D. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16" open space between boards. Do not force into place.
- E. Locate all edge and end joints over supports. Stagger vertical joints over different studs on opposite sides of partitions.
- F. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.
- G. Form control joints and expansion joints with space between edges of boards, prepared to receive trim accessories.
- H. Cover both faces of stud framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls which are braced internally.
 - 1. Except where concealed application is required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area and may be limited to not less than 75% of full coverage.
- I. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4" to 1/2" space and trim edge with J-type semi-finishing edge trim. Seal joints with acoustical sealant.
- J. Space fasteners in gypsum boards in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.

3.2 METHODS OF GYPSUM DRYWALL APPLICATION

- A. Single-Layer Application: Install gypsum wallboard.
- B. On partitions/walls apply gypsum board vertically unless otherwise indicated and provide sheet lengths which will minimize end joints.

3.3 INSTALLATION OF DRYWALL TRIM ACCESSORIES

- A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.
- B. Install metal corner beads at external corners of drywall work.
- C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where semi-finishing type is indicated. Install L-type trim where work is tightly abutted to other work and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or

sealant-filled (including expansion joints).

- D. Install semi-finishing trim where indicated, and where exterior gypsum board edges are not covered by applied moldings or indicated to receive trim with face flanges covered with joint compound.
- E. Provide control joints horizontally and/or vertically at no less than 24'-0" o.c. max. Refer to plans for specific location or installed as directed by Architect.
- F. Install H-molding in exterior gypsum drywall work where control joints are indicated.

3.4 FINISHING OF DRYWALL

- A. General: Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration. Prefill open joints and rounded or beveled edges, if any, using type of compound recommended by manufacturer.
 - 1. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.
 - 2. Apply joint compound in 3 coats (not including prefill of openings in base), and sand between last 2 coats and after last coat.
 - 3. Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216.
 - 4. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.
 - 5. Where gypsum surfaces are to be finished to Level 5 in accordance with GA 214, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.
 - 6. **All Exposed gypsum board surfaces** shall be finished to a minimum **Level 4** in accordance with GA 214.
 - 7. Where gypsum board is to receive eggshell, semi-gloss or gloss paint finish, or where severe, up or down lighting conditions occur, shall be finished to **Level 5** in accordance to GA 214 Level 5, unless indicated otherwise.
 - 8. All gypsum board surfaces at **all Corridors** shall be finished to **Level 5** in accordance to GA 214 Level 5.
 - 9. Plenum areas above ceilings shall be finished to **Level 1** in accordance with GA 214.
 - 10. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to **Level 2** in accordance with GA 214.
 - 11. Walls and ceilings to receive a heavy-grade wall covering or heave textured finish before painting shall be finished to **Level 3** in accordance with GA 214.
- B. Partial Finishing: Omit third coat and sanding on concealed drywall work which is indicated for drywall finishing or which requires finishing to achieve fire-resistance rating, sound rating or to act as air or smoke barrier.
- C. Refer to section on painting in Division 9 for decorative finishes to be applied to drywall work.

3.5 PROTECTION OF WORK

- A. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall work being without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 09301 - PORCELAIN TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Definition: Tile includes ceramic surfacing units made from clay or other ceramic materials.
- B. Extent of tile work is indicated on drawings and schedules.
- C. Types of tile work in this section include the following:
 - 1. Wall Tile.
 - 2. Floor Tile.
 - 3. Wainscot Accent Tile.
 - 4. Wainscot Tile Cap.
 - 5. Base.
 - 6. Stone Thresholds.
- D. Portland cement plaster scratch coat on wall surfaces indicated to receive tile is work of this section.
- E. Sealing expansion and other joints in tile work with elastomeric joint sealers is work of this section.

1.3 QUALITY ASSURANCE

- A. Source of Materials: Provide materials obtained from one source for each type and color of tile, grout, and setting materials.
- B. Mock-Up: Contractor shall provide mock-up panels for evaluation of materials, surface preparation techniques and application workmanship.
 - 1. Mock-up panel shall be no less than 4'-0" x 4'-0" panel as follows:
 - a. One (1) panel per room, per surface. (i.e. 1 panel for wall surface and 1 panel for floor surface for each room of different selection).
 - b. Mock-up panels shall be marked identifying room location and product manufacturer, type, style, size and color information.
 - c. Do not proceed with work until materials, workmanship, color, and sheen are approved by Architect.
 - d. Provide additional mock-up panels as required to produce acceptable work.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information and installation instructions for materials required, except bulk materials.
- B. Samples for Selection Purposes: Submit manufacturer's color charts consisting of actual tiles or sections of tile showing full range of colors, textures and patterns available for each type of tile indicated. Include samples of grout and accessories involving color selection.

1.5 PRODUCT HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

1.6 PROJECT CONDITIONS

- A. Maintain environmental conditions and protect work during and after installation to comply with referenced standards and manufacturer's printed recommendations.
- B. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- C. Maintain temperatures at not less than 50 degrees F in tiled areas during installation and for 7 days after completion, unless higher temperatures required by referenced installation standard or manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
 - 1. Porcelain Tile:
 - a. StonePeak (Basis of Design)
 - b. American Olean Tile Co.
 - c. Marazzi
- B. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 PRODUCTS, GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American National Standard Specifications for Ceramic Tile" for types and grades of tile indicated.
 - 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with installation products and materials indicated.
- C. Colors, Textures and Patterns: For tile and other products requiring selection of colors, surface textures or other appearance characteristics, provide products to match characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standards.
 - 1. Provide tile trim and accessories which match color and finish of adjoining flat tile.
- D. Mounting: Where factory-mounted tile is required provide back- or edge-mounted tile assemblies as standard with manufacturer unless another mounting method is indicated.
 - 1. Where tile is indicated for installation on exteriors or in wet areas, do not use back or edge-mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of use and has been successfully used on other projects.

2.3 TILE PRODUCTS

- A. Provide tile complying with the following requirements:
 - 1. Manufacturer/Series:
 - a. **StonePeak "Simply Modern" Collection.**
 - 2. Type:
 - a. Porcelain
 - 3. Wearing Surface for Floors:
 - a. "stable, firm and slip resistant", (exceeds 0.60 on the ASTM C-1028 test, wet and dry).
 - 4. Nominal Thickness:
 - a. 3/8"

5. Nominal Facial Dimensions as follows:
 - a. Floor Tile
 1. **12" x 24" Floor Tile** - "Simply Modern" Series, Unglazed, with 1/4" grout joints.
 - b. Wall Tile
 1. **12" x 24" Wall Tile** – "Simply Modern" Series, Unglazed, with 1/4" grout joints.
 2. **4" x 12" "Adamas" Series Wall Tile Accent Band – 3 layers high located 6'-0" AFF.** Glazed, with 1/8" grout joints.
 - c. Base:
 1. **6" x 12" Coved Base** – "Schluter Dilex" Series.
 - d. Wainscot Cap:
 1. **3" x 12" Bullnose** – "Simply Modern" Series.
6. Face: Plain with cushion edges.
- B. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with following requirements:
 1. Size:
 - a. As indicated, coordinated with sizes and coursing of adjoining flat tile, where applicable.
 2. Shapes:
 - a. Selected from manufacturer's standard shapes.
 3. External Corners for Portland Cement Mortar Installations:
 - a. Bullnose shape with a radius of not less than 3/4" unless otherwise indicated.
 4. Internal Corners:
 - a. Field-buttet square corners, except use internal cove and cap angle pieces designed to member with stretcher shapes.

2.4 STONE THRESHOLDS

- A. General: Provide stone which is uniform in color and finish, fabricated to sizes and profiles indicated or required to provide transition between tile surfaces and adjoining finished floor surfaces.
- B. Marble Thresholds: Provide marble thresholds complying with ASTM C 503 requirements for exterior use and abrasion resistant for uses subject to heavy foot traffic.
 1. Provide white, bonded marble complying with MIA Group "A" requirements for soundness.

2.5 SETTING MATERIALS

- A. Portland Cement Mortar Installation Materials: Provide materials to comply with ANSI A108.1 as required for installation method designated, unless otherwise indicated.

2.6 GROUTING MATERIALS – FLOOR & WALL

- A. High Performance Epoxy grout that offers color uniformity, durability and stain resistance with extraordinary ease of use.
 1. Laticrete "Spectralock Pro Grout".
 2. Color to be selected by architect after the bid date from manufacturer standards
- B. Epoxy grout is to be installed per manufacturer's instructions.

2.7 MISCELLANEOUS MATERIALS

- A. Single-Component Sealants: ASTM C 920, Type S, Grade NS, use NT (for use in joints in non-traffic areas).

- B. Two-Component Sealants: ASTM C 920, Type M, Grade P, Class 25, use T (for use in joints subject to pedestrian traffic).
- C. Tile Cleaner: Product specifically acceptable to manufacturer of tile and grout manufacturer for application indicated and as recommended by National Tile Promotion Federation, 112 North Alfred St., Alexandria, VA 22134 or Ceramic Tile Institute, 700 N. Virgil Ave., Los Angeles, CA 90029.

2.8 TILE BACKING PANELS

- A. Fiber-Cement Backer Board: ASTM C1288, in maximum lengths available to minimize end-to-end butt joints.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corporation.
 - b. Custom Building Products.
 - c. James Hardie Building Products, Inc.
 - 2. Thickness: 1/2 inch (12.7 mm) unless otherwise indicated on drawings.
- B. Install panels and treat joints in accordance with ANSI A108.11, APA guidelines, and manufacturer's written instructions for type of application indicated

2.9 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch (0.2-mm) nominal thickness.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Schluter Systems L.P.
 - b. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.
- C. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.
 - 1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine surfaces to receive tile work and conditions under which tile will be installed. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard.

3.2 PRE-INSTALLATION CONFERENCE

- A. A pre-installation conference is required before any tiling materials are installed. This conference shall be conducted by a representative of the Architect and attended by the General Contractor and Tile Contractor. Provide at least 72 hours advance notice to participants prior to convening pre-installation conference.
- B. The pre-installation conference is intended to clarify demolition and application requirements for work to be completed before tiling operations can begin. This would include a detailed review of

the specifications, plans, finish schedules and approved shop drawings, submittal data, samples and mock-ups. If this pre-installation conference cannot be satisfactorily concluded without further inspection and investigation by any of the parties present, it shall be reconvened at the earliest possible time to avoid delay of the work. In no case should the work proceed without inspection of all tiling areas and substantial agreement on all requirements.

- C. The following are to be accomplished during the conference:
 - 1. To review all requirements listed in the specifications and resolve any questions or conflicts that may arise.
 - 2. To establish trade-related job schedules.
 - 3. To establish tiling schedule and work methods that will prevent progress of other trades.
 - 4. Require that all surface preparations and conditions be complete prior to installing tile work.
 - 5. To establish those areas on the job site that will be designated as work and storage areas for tiling operations.
 - 6. To establish acceptable methods of protecting the finished tile surfaces if any trades must travel across or work on, above or around any areas of the finished tile work.
- D. The Architect shall prepare a written report indicating actions taken and decisions made at this pre-installation conference. This report shall be made a part of the project record and copies furnished to the General Contractor and the Owner.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standard: Comply with applicable parts of ANSI 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile".
- B. TCA Installation Guidelines: TCA "Handbook for Ceramic Tile Installation"; comply with TCA installation methods indicated or, if not otherwise indicated, as applicable to installation conditions shown.
- C. Setting beds:
 - 1. Floor tile: Thinset.
 - 2. Wall tile: Thinset.
- D. Extend tile work into recesses and under or behind equipment and fixtures, to form a complete covering without interruptions, except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting pattern or joint alignments.
- E. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures and other penetrations so that plates, collars, or covers overlap tile.
- F. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise shown.
 - 1. For tile mounted in sheets make joints between tile sheets same width as joints within tile sheets so that extent of each sheet is not apparent in finished work.
- G. Lay out tile wainscots to next full tile beyond dimensions indicated.
- H. Expansion Joints: Locate expansion joints and other sealant filled joints, including control, contraction and isolation joints, where indicated, or if not indicated, at spacing and locations recommended in TCA "Handbook for Ceramic Tile Installation", and approved by Architect.
 - 1. Prepare joints and apply sealants to comply with requirements of referenced standards and sealant manufacturer.

- I. Grout tile to comply with referenced installation standards, using grout materials indicated.

3.4 FLOOR INSTALLATION METHODS

- A. Porcelain Tile: Install tile to comply with requirements indicated below for setting bed methods, TCA installation methods related to types of subfloor construction, and grout types:
 - 1. Concrete Subfloors, Interior: TCA F113 with isolation membrane equal to Nobleseal CIS.
- B. Grout:
 - 1. High Performance Epoxy grout is to be installed per manufacturer's instructions.
- C. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile unless otherwise indicated.
- D. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood or other flooring which finishes flush with top of tile.

3.5 WALL TILE INSTALLATION METHODS

- A. Install types of tile designated for wall application to comply with requirements indicated below for setting bed methods, TCA installation methods related to subsurface wall conditions, and grout types:
 - 1. Solid Backing, Interior: TCA W221 in wet areas and W213 or W223 25
 - a. applicable in other areas.
- B. Grout:
 - 1. High Performance Epoxy grout is to be installed per manufacturer's instructions.

3.6 CLEANING AND PROTECTION

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Unglazed tile shall be cleaned with non-acid solutions only recommended by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of tile cleaning. Flush surface with clean water after cleaning.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.
- C. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.
- D. Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.7 EXTRA STOCK

- A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
 - 1. Tile Flooring: Furnish not less than one box for each type, color, pattern and size installed.

END OF SECTION

SECTION 09500 – LINEAR METAL CEILING/SOFFIT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Linear Metal Ceiling/Soffit System.
- B. Related Sections:
 - 1. Section 16000, Electrical.

1.3 REFERENCES

- A. Abbreviations and Acronyms:
 - 1. ASTM: American Society for Testing and Materials
 - 2. IBC: International Building Code
 - 3. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
 - 4. ICCES: International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
 - 5. ICCES: International Code Council-Evaluation Services Report - ESR 2631 Rockfon Chicago Metallic Corporation Suspended Ceiling Framing Systems and Suspension Ceiling Systems
- B. Reference Standards:
 - 1. ASTM A1008-Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
 - 2. ASTM A641- Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
 - 3. ASTM A653-Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
 - 4. ASTM C423- Standard Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - 5. ASTM C635/C635M- Standard Specification for Manufacture, performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - 6. ASTM C636/C636M- Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
 - 7. ASTM D3273- Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
 - 8. ASTM E84- Standard Test Method for Surface Burning Characteristics of Building Materials
 - 9. ASTM E580- Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
 - 10. ASTM E1111/E1111M -Standard Test Method for Measuring the Interzone Attenuation of Open Office Components
 - 11. ASTM E1414/E1414M -Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
 - 12. ASTM E1264- Classification for Acoustical Ceiling Products

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Installation Meetings: Conduct meeting at Project site. Agenda includes Project conditions, coordination with work of other trades and layout of items which penetrate ceilings.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's Product data, including suspension system and maintenance data.
- B. Samples: Submit samples of specified ceiling panels.
- C. Show Drawings: Necessary technical drawings and documents that pertain to the layout of the acoustical metal ceiling.
- D. Certifications: Acoustical metal ceiling product's certifications that confirm compliance with applicable tests and standards. Acoustical metal ceiling products must also contain information pertaining to certification for NRC.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Supply additional material (full-size ceiling panels) equal to 5% of ceiling area. Additional material should match products installed and have the appropriate labels and identification.
- B. Supply extra materials that match products installed and are packaged with protective covering for storage and identified with labels describing contents.

1.7 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- B. Fire Performance Details: Suspension ceiling components will feature markings of applicable testing and inspecting organization.
- C. Coordination of Work: Coordination between installers and other related professions in reference to acoustical ceiling work can include electrical fixtures and systems, fire safety systems, gypsum and building construction.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect system components from excessive moisture in shipment, storage, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation.

1.9 WARRANTY

- A. Manufacturer Warranty: Submit a written warranty executed by manufacturer for a period of 1 year from date for metal ceilings, of Substantial Completion, agreeing to repair or replace suspension system components that fail or are compromised within the specified warranty period. Failed or compromised parts can include, but are not limited to:
 - 1. Rusting or defects directly made by the manufacturer.
 - 2. Sagging or warping directly made by the manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. Rockfon, | 4849 South Austin Avenue, Chicago, IL 60638 | 1.800.323.7164 | www.rockfon.com.
- B. Certaineed/Hunter Douglass | 5015 Oakbrook Parkway, Suite 100, Norcross, GA 30093 | Ph: 800.366.4327 | www.certainteed.com.
- C. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS

- A. Metal Panels: Linear Metal Ceiling System, "PLANARPLUS®" LINEAR CEILINGS" by Rockfon with following characteristics:
1. Surface: Smooth
 2. Composition: Metal
 3. Material: 0.024"
 4. Panel Width: 4" wide.
 5. Panel Profile Depth: 5/8" deep.
 6. Reveal: Manufactured to provide a 3/4" reveal when installed on the manufacturer suspension system.
 7. Panel Length: 12 feet Standard length. 2 feet to 16 feet special lengths.
 8. Edges: Square
 9. Finish/Color: Baked Enamel Paint Finish. Color to be selected by Architect from Manufacturer Standard selections. Color shall include "White".
 10. Perforation: To be Non-perforated.
 11. Filler: Matching Integral.
 12. Fire Class: Class A.
- B. Accessories:
1. Filler Strips (Recessed): Manufactured from aluminum 3/4 inch wide by 144 inches long coated to match linear metal panels.
 2. Panel Splices: Manufactured from 0.025 inch thick aluminum, 8-3/4 inches long coated with finish identical to linear metal panels, with profile compatible with linear panels.
 3. End Plugs: Manufactured from 0.025 inch thick aluminum with (round) (square) edges. Coated identical to linear metal panels.
 4. Perimeter Trim
 - a. Wall Channel: Manufactured from 0.025 inch thick aluminum 1 13/16 inch I.D. by 17/8 inch top flange by 1 inch bottom flange by 120 inches long. Coated identical to linear metal panels.
 - b. Wall Angle: Manufactured from 0.025 inch thick aluminum 15/16 inch wide by 3/4 inch high by 144 inches long with hemmed edges.
- C. Suspension System
1. Symmetrical Carrier:
 - a. Manufactured to an inverted "U" shape from 0.040 inch aluminum, 12 feet/144 inches long. Coated with black polyester enamel. Double grip carrier required on all exterior applications.
 - b. Carrier tabs, to which the linear panels are attached, shall be integral to the carrier and shall protrude from each of its legs.
 - c. Holes shall be punched into the spine of the carrier in order to permit direct attachment to overhead structures when appropriate.
 - d. The symmetrical carrier shall be slotted at appropriate intervals in order to receive stabilizing components as described below.
 2. Stabilizer Bars: Manufactured from 0.025 inch thick aluminum (4913/16) (3513/16) (2313/16) inch long. Coated with black polyester enamel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine suspension assemblies, with installer present, for compliance with requirements specified in this and other Sections affecting ceiling/soffit panel installation and with requirements for installation tolerances and other conditions affecting performance of ceiling/soffit assemblies.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install ceiling panels to comply with ASTM C636/C636M, ASTM E580, and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. General:
 - 1. For exterior soffit applications install in accordance with ASTM C636 (see 1.03, A.2.)
- C. Suspension System
 - 1. Symmetrical Carriers: Installed 50 inches on center by direct suspension from existing structure with not less than 12 gauge hanger wires wrapped tightly 3 full turns, spaced 48 inches on center.
 - 2. Stabilizer Bars: Shall be utilized to increase the rigidity of the suspension system layout, as well as to permit easy alignment of the symmetrical carriers. Installed perpendicular to symmetrical carrier 24 to 48 inches on center.
- D. Linear Metal Panels:
 - 1. Attach to main carrier tabs and connect with Panel Splices with joints staggered in adjacent rows.
 - 2. Panel Splices: Where continuous runs of linear metal panels are required, panel splices shall be used to join consecutive panels and shall be of a design which eliminates any noticeable gap between the panels.
 - 3. End Plugs: Installed exposed ends of panels. The end plug shall be of sufficient and appropriate dimensions to fit into the open end of a linear panel. Appropriate styles of end plugs, based upon linear panel width and design, shall be made available.
 - 4. Slip-on Moldings: Install on exposed ends of panels. Where the ends are visible, an end cap, wall angle, or J-molding shall be utilized to trim the exposed ends of the panels.
 - 5. Filler Strips: Installed into open reveal between panels.
 - 6. Wall Angles: Installed on vertical surfaces intersecting system by appropriate method in accordance with industry accepted practice.
 - 7. Access Panels: If Indicated on drawings, installed in accordance with manufacturers recommendations.

3.3 REPAIR

- A. Remove damaged or compromised components; replace with undamaged components.

3.4 REPAIR

- A. Clean exposed surfaces in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 09510 - ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections apply to work of this section.

1.2 SUMMARY

- A. Extent of acoustical ceilings specified in this section include the following:
 - 1. Acoustical lay-in panel ceilings in an exposed suspended metal grid system.

SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
 - 1. Full size sample of each acoustical panel type, pattern and color.
 - 2. Set of 12" long samples of exposed runners and moldings for each color and system type required.
- B. Certificates: Submit certificates from manufacturers of acoustical ceiling units and suspension systems attesting that their products comply with specification requirements.

1.3 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Provide acoustical ceiling components that are identical to those tested for the following fire performance characteristics, according to ASTM test method indicated, by UL or other testing and inspecting agency acceptable to authorities having jurisdiction. Identify acoustical ceiling components with appropriate marking of applicable testing and inspecting agency.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84.
 - 2. Flame Spread: 25 or less.
 - 3. Smoke Developed: 50 or less.
- B. Fire Resistance Ratings: As indicated by reference to design designation in UL "Fire Resistance Directory" for floor, roof or beam assemblies in which acoustical ceilings function as a fire protective membrane; tested per ASTM E 119. Provide protection materials for lighting fixtures and air ducts to comply with requirements indicated for rated assembly.
- C. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by, or penetrating through, ceilings, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition system (if any).
- D. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination or other causes.
- B. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical ceiling units carefully to avoid chipping edges or damaging units in any way.

1.5 PROJECT CONDITIONS

- A. Space Enclosures: Do not install interior acoustical ceilings until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete

and ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

USG Interiors, LLC. (Basis of Design) | www.usg.com | Ph: 1.800.950.3839

1. Certainteed Corporation | www.certainteed.com | Ph: 1.800.233.8990
2. Armstrong World Industries Inc. | www.armstrongceilings.com | Ph: 877.276.7876

- B. Equal products of other manufacturers may be used in the work provide such products have been approved, by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 GENERAL ACOUSTICAL CEILING TILE UNITS

- A. Standard for Acoustical Ceiling Tile Units: Provide manufacturer's standard units of configuration indicated which are prepared for mounting method designated and which comply with FS SS-S-118 requirements, including those indicated by reference to type, form, pattern, grade (NRC or NIC' as applicable), light reflectance coefficient (LR), edge detail, and joint detail (if any).

1. Mounting Method for Measuring NRC: No. 7 (mechanically mounted on special metal support), FS SS-S-118; or Type E-400 mounting as per ASTM E 795.

- B. Sound Attenuation Performance: Provide acoustical ceiling units with ratings for ceiling sound transmission class (STC) of range indicated as determined according to AMA 1-II "Ceiling Sound Transmission Test by Two-Room Method" with ceilings continuous at partitions and supported by a metal suspension system of type appropriate for ceiling unit of configuration indicated (concealed for tile, exposed for panels).

- C. Colors, Textures and Patterns: Provide products to match appearance characteristics indicated or, if not otherwise indicated, as selected by Architect from manufacturer's standard colors, surface textures, and patterns available for acoustical ceiling units and exposed metal suspension system members of quality designated.

2.3 ACOUSTICAL TILES

A. Acoustical Panel Type: Vinyl Covered Ceiling Panels

1. USG "Sheetrock Brand Clean Room Lay-In Gypsum Panels".
2. Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:
 - a. Type XX, mineral based with membrane faced overlay. Vinyl face, back and sides covered gypsum ceiling panels.
 - b. Form: Not Applicable
 - c. Pattern: Smooth
3. Color: Flat White 050.
4. LR: Not less than 0.77
5. NRC: Not less than: N/A
6. CAC: Not less than 35
7. Edge / Joint Detail:
 - a. Square (Typical if not indicated on drawings).
 - b. SLT Beveled Reveal (Only if indicated on drawings).
8. Panel Thickness: 1/2 inch (12.7 mm).

9. Modular Size: 24 by 24 inches (610 by 610 mm).
10. Recycled Content: 80%.
11. Panel Features: Washable, scrubbable, soil and impact resistant finish. Meets USDA/FSIS guidelines for use in food processing areas.
12. Clean room performance: Acceptable in applications up to Class 100 Clean rooms.
13. ClimaPlus™ 30 year limited system warranty. Contains a broad spectrum antimicrobial additive on the face and back of the panel that provides resistance against the growth of mold and mildew. Includes sag resistance performance.
14. Suspension Grid/Width: USG Donn ZXLA; 15/16”.

B. Acoustical Panel Type: Lay-In Acoustical Ceiling Panels

1. USG “Radar” Acoustical Panels
2. Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:
 - a. Type III, mineral base with painted finish
 - b. Form: 2, water felted.
 - c. Pattern: Perforated, small holes and light texture.
3. Color: Flat White 050.
4. LR: Not less than 0.84
5. NRC: Not less than 0.45
6. CAC: Not less than 33
7. Edge / Joint Detail:
 - a. SQ Square (Typical if not indicated on drawings).
 - b. SLT Beveled Reveal (Only if indicated on drawings).
8. Panel Thickness: 5/8 inch (15.8mm).
9. Modular Size: 24 by 24 inches (600 by 600 mm).
10. Recycled Content: Up to 59%.
11. Panel Features:
 - a. Biobased product that is USDA certified.
 - b. Abuse Resistant, high durability and can be cleaned easily with a soft brush & vacuummed.
12. ClimaPlus™ 30 year limited system warranty. Contains a broad spectrum antimicrobial additive on the face and back of the panel that provides resistance against the growth of mold and mildew. Includes sag resistance performance.
13. Suspension Grid/Width: USG Donn DX; 15/16” (24mm).

2.4 GENERAL METAL SUSPENSION SYSTEMS

- A. Standard for Metal Suspension Systems: Provide metal suspension systems of type, structural classification and finish indicated which comply with applicable STM C 635 requirements.
- B. Finishes and Colors: Provide manufacturer's standard factory applied finish for type of system indicated. For exposed suspension members and accessories with painted finish, provide color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's full range of standard colors.
 1. White.

- C. Attachment Devices: Size for 5 times design load indicated in ASTM C 635, Table 1, Direct Hung.
- D. Hanger Wire: Galvanized carbon steel wire, ASTM A 641, soft temper, prestretched, Class 1 coating, sized so that stress at 3- times hanger design load (ASTM C 635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12 gage.
- E. Edge Moldings and Trim: Formed steel section; exposed surfaces prefinished to match suspension system components.
 - 1. Provide shadow molding for edges equal to MS174; 9/16" thick exposed flange; 3/8" x 3/8" reveal; 7/8" vertical flange.
 - 2. At penetrations of ceiling install manufacturer's standard molding which fits with type of edge detail and suspension system indicated.
 - 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- F. Hold-Down/Impact Clips: Where indicated provide manufacturer's standard impact clip system design to absorb impact forces against lay-in panels. Install hold down clips at all ceiling panels within 10'-0" of and exterior door.

2.5 METAL SUSPENSION SYSTEMS

A. USG Donn Brand ZXLA 15/16" Acoustical Suspension System

- 1. Double-web design; Intermediate Duty as defined by ASTM C635. Bottom face with 15/16" (24mm) exposed flange with pre-painted aluminum cap; cross tee holes and hanger wire holes at 6 in oc; integral reversible splices, commercial quality pretreated and painted, exposed surfaces prefinished in manufacturer's enhanced corrosion resistant polyester paint finish. Cross tees; roll-formed into double-web design with rectangular bulb; 15/16 (24mm) in exposed flange with pre-painted aluminum cap; Stainless Steel clips clenched to the web Main tees and cross tees shall be positively locked yet shall be removable without the use of tools.
- 2. Structural Classification: Intermediate Duty.
- 3. Tee Profile: 15/16" (24mm) wide.
- 4. Color: White

B. USG Donn Brand DX/DXL 15/16" Acoustical Suspension System

- 1. Narrow Face, Capped, Double Web, Cold Rolled Steel Suspension System: Main and Cross Tees as defined by ASTM C635, commercial quality pretreated and painted hot-dipped galvanized cold-rolled steel, exposed surfaces prefinished in manufacturer's standard corrosion resistant enamel paint finish
- 2. Structural Classification: Intermediate Duty.
- 3. Tee Profile: Narrow Face 15/16" (22mm) wide.
- 4. Color: White

2.6 SEALANT

- A. Acoustical Sealant: Resilient, non-staining, non-shrinking, non-hardening, non-skinning, non-drying, non-sag sealant intended for interior sealing of concealed construction joints.
- B. Manufacturers: The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
 - 1. BA-98; Pecora Corp.
 - 2. Tremco Acoustical Sealant; Tremco

3. Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than Ten (10) days prior to schedule bid opening.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordination: Furnish layouts for inserts, clips, or other supports required to be installed by other trades for support of acoustical ceilings.
 1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.
- B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Coordinate ceiling layout with lighting layout. Avoid use of less-than-half width units at borders, and comply with reflected ceiling plans.

3.2 INSTALLATION

- A. General: Install materials in accordance with manufacturer's printed instructions, and to comply with governing regulations, fire-resistance rating requirements as indicated, and CISCA standards applicable to work.
- B. Arrange acoustical units and orient directionally-patterned units (if any) in manner shown by reflected ceiling plans.
- C. Install suspension systems to comply with ASTM C 636, with hangers supported only from building structural members.
 1. Locate hangers within 6" inches from each end and spaced 4'-0" along each carrying channel or direct-hung runner, unless otherwise indicated, leveling to tolerance of 1/8" in 12'-0".
 2. Locate hangers on all 4 corners of the ceiling grid where a projector is installed
- D. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperature.
- E. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, counter-splaying or other equally effective means.
- F. Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
- G. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed on back of vertical leg before installing moldings.
- H. Screw-attached moldings to substrate at intervals not over 16" o.c. and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8" in 12'-0". Miter corners accurately and connect securely.
- I. Install acoustical panels in coordination with suspension system with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at borders and at penetrations.
- J. Install hold-down clips on panels, within 10'-0" of exterior door openings, where panels are other than horizontal, and in areas where required by governing regulations or for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

3.3 EXTRA STOCK

- A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
 1. Ceiling Tile: Furnish not less than one box for each type, color, pattern and size installed.

END OF SECTION

SECTION 09640 – STAGE AND DANCE FLOOR SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 SECTION INCLUDES

- A. Plywood Flooring
- B. Plywood Secondary subflooring
- C. Sleepers
- D. Sheet vapor retarder
- E. Vermiculite fill
- F. Surface finishing

1.3 PRECONSTRUCTION CONFERENCE

- A. Conduct preconstruction conference two weeks prior to installation of flooring. Meeting shall be attended by Contractor, flooring installer and Architect.
- B. Review the following:
 - 1. Schedule for delivery, protection, acclimatization, installation and protection of flooring.
 - 2. Existing site conditions and any necessary changes.
 - 3. All architectural detail conditions.

1.4 SUBMITTALS

- A. Product Data: Provide data for flooring and floor finish materials.
- B. Shop Drawings: Indicate floor joint pattern, termination details, and painted floor pattern.
- C. Indicate provisions for expansion and contraction.
- D. Samples: Submit two samples 12 x 12 inch in size of material used.
- E. Installation Instructions: Indicate standard and special installation procedures.
- F. Maintenance Data: Include maintenance procedures.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed stage floors similar in material, design and extent indicated for this project and whose work has resulted in stage floors with a record of successful performance.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not install wood flooring until wet construction work is complete and ambient air at installation space has moisture content stabilized at maximum moisture content of 40 percent.
- B. Provide heat, light, and ventilation prior to installation.
- C. Store materials in area of installation for minimum period of 24 hours prior to installation or as recommended by the flooring manufacturer if different.
- D. Maintain minimum room temperature of 65 degrees F for a period of two days prior to delivery of materials to installation space, during installation, and after installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Vapor Retardner: Black polyethylene sheet, 8 mil thick; 2 inch wide tape for joint sealing.
- B. Sleepers and Shims: softwood lumber, pressure treated for moisture protection, 1 x 4 inch size.
- C. Vermiculite fill: bagged granular vermiculite to fill air space between sleepers and under plywood.
- D. Plywood Subflooring: APA rated, C-D Plugged, exterior glue, tongue and groove, 1/2" thick (1 layers). Use 48:" x 96" sheets.
- E. Plywood Flooring: APA rated, BC Plugged, exterior glue, tongue and groove, 5/8" thick (1 layer). Use 48:" x 96" sheets.

2.2 ACCESSORIES

- A. Fasteners: Type and size recommended by manufacturer, but not less than those recommended by MFMA for application indicated.
- B. Wall Base: Molded, vented, rubber cover base, 4" x 3" x 48" inches, with premolded outside corners.
- C. Floor Finish: Flat black floor paint.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that concrete subfloor surface is smooth and flat to plus or minus ¼ inch in 10 feet.
- C. Verify wood subfloor is properly secured, smooth and flat to plus or minus ¼ inch in 10 feet.
- D. Verify that masonite sheets are painted on bottom before installation.

3.2 SLAB PREPARATION

- A. Based on survey or concrete slab, adjust height or substrate by grinding surfaces or filling with leveling compound as recommended for concrete applications.

3.3 SITE CONDITIONS

- A. Masonite flooring shall not be installed until all masonry, painting and other interior finish work is completed and overhead mechanical and electrical trades have finished.
- B. All permanent heat, light and ventilation shall be installed and operating during and after installation, maintaining a temperature range of 55 degrees F to 78 degrees F and a relative humidity of 35% to 50%.
- C. Initiation of flooring installation shall indicate acceptance of field conditions by the installer.

3.4 SUBFLOOR INSTALLATION

- A. Resilient Pads:
 - 1. Place vapor retarder over subfloor surface, lapping edges and ends minimum 6 inches and tape seal.
- B. Sleepers: Place sleepers at 12 inches on center perpendicular to theater length. Sleepers to attach to resilient cushions and not the concrete slab. Sleepers shall be minimum 96" long except where cutting is necessary for fit at edges.
- C. Vermiculite Fill: Fill the void space between sleepers and below plywood with granular vermiculite. All hollow areas shall be filled.
- D. Plywood Subflooring:
 - 1. Shim between sleepers and plywood to achieve level line of plus or minus ¼" in 10 feet.

2. Place sheathing paper between subflooring layers, lapping edges and ends 2 inches.
3. Lay second layer in the same direction, with edge joints offset 24 inches in both directions.
4. Use full size 48" x 96" sheets except where cutting is necessary at edges.

3.5 FLOORING INSTALLATION

- A. Sheathing paper: Place over plywood subfloor; lap edges and ends 2 inches, staple in place.
- B. Main Flooring:
 1. Screw to plywood subfloor.
 2. Use full size 48" x 96" sheets except where cutting is necessary at edges.
 3. Lay flooring parallel to length of theater space. Verify alignment as work progresses.
 4. Screw attach to plywood with countersunk 1 5/8" #10 screws with Phillips heads. Space screws at 8" on center around edge of each sheet and at 12" each way across the panel.
 5. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar. Provide divider strips and transition strips in accordance with drawings.
 6. Provide a gap for expansion between panels on all sides no less than 1/8". Provide 1/2" expansion space at fixed and other interruptions.
- C. Install base at floor perimeter to cover expansion space.
- D. Finishing: Paint both sides of the plywood. Paint bottom with one coat of primer and one coat of latex paint. Allow to dry before installation. After installation of plywood, paint top with one coat of primer and two coats of flat black latex paint as described in paint section.

3.6 CLEANING

- A. Clean and polish floor surfaces.

3.7 PROTECTION

- A. Place protective coverings over finished floors; do not remove coverings until Substantial Completion.

END OF SECTION

SECTION 09650 – RUBBER BASE, STAIR TREAD, RISER AND STRINGER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Resilient Rubber Base
 - 2. Resilient Rubber Stair Tread with Riser.
 - 3. Resilient Rubber Stair Stringer.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size samples of each resilient product color, texture, and pattern required.
- D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

- A. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by Johnsonite, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

1.6 PROJECT CONDITIONS

- A. Install resilient products after other finishing operations, including painting, have been completed.
- B. Maintain ambient temperatures within range recommended by Johnsonite, but not less than 65 deg F (18 deg C) or more than 85 deg F (29 deg C) in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- C. Maintain the ambient relative humidity between 40% and 60% during installation.
- D. Until Substantial Completion, maintain ambient temperatures within range recommended by Johnsonite, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).

PART 2 - PRODUCTS

2.1 MANUFACTURERES

The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:

- 1. Tarkett USA Inc. (Basis of Design; 30000 Aurora Road, Solon, OH 44139; 800.899.8916; www.tarkettna.com).
- 2. Mannington Commercial, 1844 U.S. Highway 41 S.E. Calhoun, GA 30701; PH: 800.241.2262; www.manningtoncommercial.com.

3. Roppe Corporation, U.S.A.; 1602 North Union Street, Fostoria, Ohio 44830-1158; Ph: 1.800.537.9527 or 419.435.8546; www.roppe.com.
4. Flexco Corporation; 1401 East 6th Street, Tusculumbia, AL 35674; PH: 800.633.315; www.flexcofloors.com.
5. Armstrong Flooring Commercial; 2500 Columbia Avenue, Lancaster, PA 17604; Ph:1.888.276.7876; www.armstrongflooring.com/commercial.

2.2 MATERIALS – RUBBER BASE

- A. Material Physical Characteristics: Provide rubber base complying with FS SS-W-40, Type II, with matching end stops and pre-formed or molded corner units and as follows:
 1. Manufactured from a proprietary thermoplastic rubber formulation.
 2. Meets performance requirements for ASTM F 1861 Standard Specification for Resilient Wall Base, Type TP, Group 1.
 3. ASTM E 648, Standard Test Method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
 4. ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials, Class A, Smoke <450.
 5. Flexibility: Does not crack, break, or show any signs of fatigue when bent around a 1 1/4" diameter cylinder when tested according to ASTM F 137 Standard Test Method for Flexibility of Resilient Flooring Materials protocols.
 6. Color Stability: Meets or exceeds ASTM F 1861 requirements for color stability when tested to ASTM F 1515 Standard Test Method for Measuring Light Stability of Resilient Flooring protocols.
- B. RUBBER WALL BASE:
 1. Height: 4"
 2. Thickness: 1/8"
 3. Style: Standard Top-Set Cove
 4. Finish: Matte
 5. Colors and Patterns: As selected by Architect from manufacturer's standards after the bid.

2.3 MATERIALS - RUBBER INTEGRATED STAIR TREAD WITH RISER:

- A. Material Physical Characteristics:
 1. Manufactured from a homogeneous composition of 100% synthetic rubber.
 2. Complies with requirements for ASTM F 2169 Standard Specification for Resilient Stair Treads, Type TS, Class 1 and 2, Group 1 and 2.
 3. Hardness: ASTM D 2240 – Not less than 85 Shore A.
 4. Abrasion Resistance: ASTM D 3389 – less than 1 gram weight loss.
 5. ASTM D 2047, Standard Test Method for Static Coefficient of Friction of Polish- Coated Flooring of 0.6 or greater.
 6. ASTM E 648, Standard Test Method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
 7. Integrated tread and riser.
 8. Visually Impaired treads meet ADA and are California Title 24 Accessibility requirements.
 9. Visually Impaired treads will have 2" wide co-extruded contrasting color insert or 2" wide contrasting color grit tape insert.

B. RUBBER INTEGRATED STAIR TREAD WITH RISER:

1. Visually Impaired Solid Color Rubber Integrated Stair Tread and Riser with Contrasting Color Insert
 - a. For Raised Round surface, solid color integrated stair tread and riser, 2" height hinged Square Nose, tapering .210" to .113", with 2" contrasting color grit tape insert.
 - b. Color to be selected by Architect after the bid date.
 - c. Round Pattern

2.4 MATERIALS - RESILIENT RUBBER STAIR STRINGER

A. Material Physical Characteristics:

1. ASTM E 648, Standard Test Method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
2. Meets or exceeds the performance requirements for resistance to heat/light aging, chemicals, and dimensional stability when tested to the methods, as described, in ASTM F-1861.
3. Flexibility: Will not crack, break, or show any signs of fatigue when bent around a 1/4" (6.35 mm) diameter cylinder.

B. RUBBER STAIR STRINGER:

1. Rubber Stringers are manufactured from a proprietary thermoplastic rubber formulation designed specifically to meet the performance and dimensional requirements of ASTM F-1861, Type TP, Group 1 (solid) Standard Specification for Resilient Wall Base.
 - a. Thickness of 0.080" (2mm)
 - b. 10" (25.4 cm) height x 6 ft. (1.83 cm) long.
 - c. Color to be selected by Architect after the bid date.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds:** Latex-modified, Portland cement based formulation manufactured and warranted by a reputable manufacturer.
1. Flooring and Tread Adhesives: Premium, Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions.
- B. Stair Tread and Nose Filler:** Two-Part Epoxy Caulking Compound to fill nosing substrates that do not conform to tread contours.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Mechanically remove contamination on the substrate that may cause damage to the resilient flooring material. Permanent and non-permanent markers, pens, crayons, paint, etc., must not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.
 4. Prepare Substrates according to ASTM F 710 including the following:
 - a. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869. Results must not exceed 5 lbs. Moisture Vapor Emission Rate per 1,000 sq. ft. in 24 hours.
 - or –
 - 2) Perform relative humidity test using in situ probes, ASTM F 2170. Must not exceed 80%.
 - b. A pH test for alkalinity must be conducted. Results should range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation must not proceed until the problem has been corrected.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
 5. Wood steps/substrates:
 - a. The substrate must be rigid, free of movement.
 - b. Single wood and tongue and groove substrate should be covered with 1/4" (6.4 mm) or 1/2" (12.7 mm) APA approved underlayment plywood.
 - 1) Use 1/4" (6.4 mm) thick underlayment panels for boards with a face width of 3" (76 mm) or less.
 - 2) Use 1/2" (12.7 mm) thick underlayment panels for boards with a face width wider than 3" (76 mm).
 - c. Do not install over OSB (Oriented Strand Board), particle board, chipboard, lauan or composite type underlayments.
 - B. Fill cracks, holes, depressions and irregularities in the substrate with good quality Portland cement based underlayment leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
 - C. Floor covering shall not be installed over expansion joints.
 - D. Do not install resilient products until they are same temperature as the space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- 3.3** Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.4 INSTALLATION – RUBBER BASE

- A. Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required.
- B. Install base in lengths as long as practicable without stretching base.
- C. Install base at outside corners using preformed corner units. If preformed unit is not available, then fabricate outside corners from base material utilizing a "V" shape top-set or pull-type gouge tool to make a shallow V-shape notch on back-side of wall base. Field-fabricated outside corners

must have a minimum return length around each corner of 3 feet. Adhere to corner of walls so that no "whitening" (discoloration of base material) occurs at the bends.

- D. Install base at inside corners using preformed corner units or fabricated from base materials with mitered or coped inside corners.
- E. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
 - 1. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- F. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.5 INSTALLATION - RESILIENT STAIR TREAD AND RISER

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Tread and Nosing:
 - 1. Use manufacturer Epoxy Caulking Compound to strengthen nosing and fill irregularities in substrates to conform to tread nosing.
 - 2. Tightly adhere to substrates throughout length of each piece.
 - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

3.4 INSTALLATION - RESILIENT RUBBER STAIR STRINGER

- A. Comply with manufacturer's written instructions for installing resilient accessories.

3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION

SECTION 09651 – LUXURY VINYL TILE FLOORING (LVT)

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

- A. Luxury Vinyl Tile flooring and accessories as indicated on drawings and in schedules.

1.2 RELATED REQUIREMENTS

- A. Section 09650 – Rubber Base.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Provide each type of Luxury Vinyl Tile flooring and accessories as produced by a single manufacturer, including recommended primers, adhesives, sealants and leveling compounds.
 - 1. Wherever possible, provide required Luxury Vinyl Tile flooring and accessories produced by a single manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit 2 copies of manufacturer's technical data and installation instructions for each type of Luxury Vinyl Tile flooring and accessory.
- B. Samples: Submit, for verification purposes, samples of each type, color, and pattern of Luxury Vinyl Tile, including accessories, required, indicating full range of color and pattern variation.

1.5 JOB CONDITIONS

- A. Store Luxury Vinyl Tile flooring products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by the manufacture, but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).
- B. Maintain minimum temperature of 65°F in spaces to receive Luxury Vinyl Plank Tile flooring for at least 48 hours prior to installation, during installation, and for not less than 48 hours after installation. Store Luxury Vinyl Tile materials in spaces where they will be installed for at least 48 hours before beginning installation.
- C. Maintain the ambient relative humidity between 40% and 60% during installation.
- D. Until Substantial Completion, maintain ambient temperatures within range recommended by the manufacture but not less than 55 deg F (13 deg C) or more than 85 deg F (29 deg C).
- E. Install Luxury Vinyl Tile flooring and accessories after other finishing operations, including painting, have been completed. Do not install Luxury Vinyl Tile Flooring over concrete slabs until the latter have been cured and are sufficiently dry to achieve bond with adhesive as determined by manufacturer's recommended bond and moisture test.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
 - 1. Mannington Commercial, 1844 U.S. Highway 41 S.E. Calhoun, GA 30701; PH: 800.241.2262; www.manningtoncommercial.com.
 - 2. Patcraft; P.O. Box 2128, Dalton, GA 30722; PH: 334.462.9547; www.patcraft.com.
- B. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS

- A. LVT: "Spacia" Collection; "Abstract" Series

1. Construction High Performance Luxury Vinyl Tile flooring
 2. Class / ASTM F 1700 Class III Printed Film Vinyl Tile, Type B (embossed)
 3. Wear layer Thickness 20 mil or 0.020" (0.5 mm) Quantum Guard Elite
 4. Overall Thickness 4.0 mm or nominal
 5. Nominal Dimensions: 4" wide x 36" long
 6. Backing Class Commercial Grade
 7. Installation Glue Down
 8. Slip Resistance / ASTM D 2047 >0.65 (wet/dry)
 9. Warranty: 15 year limited commercial wear warranty.
 10. Colors as selected by the Owner.
- B. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.
- C. Leveling Compound: ProSpec Feather Edge, premium, polymer modified, rapid setting, trowelable underlayment that results in a very smooth, ultra thin finish or as recommended by the flooring manufacture.
- D. Surfaces must be solid, completely clean, free of oil, gypsum compounds, wax, grease, sealers, curing compounds, asphalt, paint, dirt, loose surface material and any contaminants that act as a bond breaker. Weak concrete surfaces must be cleaned down to solid sound concrete by mechanical means. Acid etching or chemical cleaning is not acceptable. Remove all dirt by vacuuming. All subfloors must be clean, dry and at least 40° F (4° C) prior to applying ProSpec Feather Edge.
- E. Installation: ProSpec Feather Edge will accept standard floor coverings such as VCT, vinyl sheet goods, tile and carpeting in approximately 15-30 minutes after placement.
- F. Materials: Extruded rubber accessories as required (i.e. nosings, reducer strip.)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to manufactures written instructions to ensure adhesion of Luxury Vinyl Tile Flooring.
 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 2. Remove substrate paint, coatings and other substances that are incompatible with adhesives or contain soap, wax, oil, solvents, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
 3. Mechanically remove contamination on the substrate that may cause damage to the resilient flooring material. Permanent and non-permanent markers, pens, crayons, paint, etc., must not be used to write on the back of the flooring material or used to mark the substrate as they could bleed through and stain the flooring material.
 4. Prepare Substrates according to ASTM F 710 including the following:
 - a. Moisture Testing: Perform tests recommended by manufacturer. Proceed with installation

only after substrates pass testing.

- i. Perform anhydrous calcium chloride test, ASTM F 1869. Results must not exceed 5 lbs. Moisture Vapor Emission Rate per 1,000 sq. ft. in 24 hours.
- or**
- ii. Perform relative humidity test using in situ probes, ASTM F 2170. Results must not exceed 80%.
- b. A pH test for alkalinity must be conducted. Results should range between 7 and 9. If the test results are not within the acceptable range of 7 to 9, the installation must not proceed until the problem has been corrected.
 - c. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
- B. Fill cracks, holes, depressions and irregularities in the substrate with good quality Portland cement based underlayment leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
 - C. Floor covering shall not be installed over expansion joints.
 - D. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
 - F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient tile flooring.
 1. Install with manufacturer's adhesive specified for the site conditions and follow adhesive label for proper use.
 2. Follow manufacturer's recommendation and lay tiles so graining follows the same direction.
 3. Roll the flooring in both directions using a 100 pound three-section roller.
- B. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of room area of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, from wall to wall and under all casework or other fixed equipment. Where construction joints in concrete slab occur, lay tile joint with construction joint.
- C. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged if so numbered. Cut tile neatly around all fixtures. Broken, cracked, chipped, or deformed tiles are not acceptable.
 1. Lay each color of tile with grain running in basket weave pattern.
- D. Adhere tile flooring to substrates using full spread of adhesive applied in compliance with flooring manufacturer's directions.
- E. Accessories: Apply wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in lengths as long as practicable, with preformed corner units, or fabricated from base materials with mitered or coped inside corners. Tightly bond base to substrate throughout length of each piece, with continuous contact at horizontal and vertical surfaces.
 1. On masonry surfaces, or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- F. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at edges of flooring which would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. No heavy traffic, rolling loads, or furniture placement for 72 hours after installation.
- E. Cover resilient products until Substantial Completion.
- F. Wait 72 hours after installation before performing initial cleaning.
- G. A regular maintenance program must be started after the initial cleaning.

3.5 EXTRA STOCK

- A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
 - 1. Flooring: Furnish not less than one box for each type, color, pattern and size installed.

END OF SECTION

SECTION 09672 - RESINOUS FLOORING

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Decorative Resinous Flooring System consisting of 100% solids epoxy body coats with decorative quartz broadcasts, finished with a durable urethane topcoat ensuring excellent wear and chemical resistance all producing a seamless floor and integral cove base.
- B. Related Requirements:
 - 1. Section 07900 "Joint Sealants" for sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.
- C. Product Schedule: For resinous flooring. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

- A. LEED Submittals:
 - 1. Laboratory Test Reports for Credit IEQ 4: For flooring systems, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Apply full-thickness mockups on 48-inch- square floor area selected by Architect.
 - a. Include 48-inch length of integral cove base with inside corner.
 - 2. Simulate finished lighting conditions for Architect's review of mockups.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing

manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Dur A Flex: Dur A Quartz (Basis-of-Design Product); 95 Goodwin Street, East Hartford, CT, 06108; Ph.: 877.251.5418: www.dur-a-flex.com.
- B. Subject to compliance with requirements or comparable product by one of the following:
 - 1. American Hi-Tech Flooring Company.
 - 2. BASF Construction Chemicals, Inc.; BASF Building Systems.
 - 3. ChemMasters.
 - 4. Crossfield Products Corp.; Dex-O-Tex.
 - 5. DUDICK Inc.
 - 6. Epoxy Systems, Inc.
 - 7. Key Resin Company.
 - 8. NEOGARD; Division of JONES-BLAIR.
 - 9. Nox-Crete Products Group.
 - 10. Pacific Polymers, Inc.
 - 11. POLY-CARB, Inc.
 - 12. Polymerica, Incorporated.
 - 13. PPG Industries, Inc.
 - 14. Sherwin-Williams Company; General Polymers.
 - 15. Stonhard, Inc.
 - 16. Tamms Industries, Inc.; a division of The Euclid Chemical Company.
 - 17. Tnemec Company, Inc.

2.2 MATERIALS

- A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

2.3 DECORATIVE RESINOUS FLOORING

- A. Resinous Flooring: Abrasion-, impact- and chemical-resistant, decorative- aggregate-filled, epoxy-resin-based, monolithic floor surfacing designed to produce a seamless floor and integral cove base.
- B. System Characteristics:
 - 1. Color and Pattern: As selected by Architect from manufacturer's full range after Bid Date.

2. Wearing Surface: Manufacturer's standard wearing surface.
 3. Overall System Thickness: 1/4 inch.
- C. Body Coats:
1. Resin: Epoxy.
 2. Formulation Description: 100 percent solids.
 3. Application Method: Self-leveling slurry with broadcast aggregates.
 - a. Thickness of Coats: 1/16 inch.
 - b. Number of Coats: Two.
 4. Aggregates: Manufacturer's standard.
- D. Topcoat: Sealing or finish coats.
1. Resin: Epoxy.
 2. Formulation Description: 100 percent solids.
 3. Type: Clear.
 4. Finish: Matte.
 5. Number of Coats: Two.

2.4 ACCESSORIES

- A. Primer: Type recommended by manufacturer for substrate and body coats indicated.
1. Formulation Description: 100 percent solids.
- B. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.
1. Formulation Description: 100 percent solids.
 - a. Provide fiberglass scrim embedded in reinforcing membrane.
- C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

- a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
- b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
- 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
 - 1. Apply waterproofing membrane to integral cove base substrates.
 - 2. Apply waterproofing membrane to flooring substrates
- D. Apply reinforcing membrane to substrate cracks.
- E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 - 1. Integral Cove Base: 6 inches high.
- F. Apply self-leveling slurry body coats in thickness indicated for flooring system.
 - 1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- G. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- H. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- I. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by

resinous flooring manufacturer.

END OF SECTION

SECTION 09680 – CARPETING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification Sections apply to work of this section.

1.2 RELATED SECTIONS

- A. Section 09650 – Rubber Base.

1.3 DESCRIPTION OF WORK

- A. The extent of each type of carpeting is indicated on the drawings, and by specifications, and is defined to include carpet and accessories.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of carpet specified.
- B. Shop Drawings: Submit shop drawings indicating seam layout for approval by Architect.

1.5 QUALITY ASSURANCE

- A. Installer: Firm with not less than 5 years of carpeting experience, similar to work of this section.
- B. Manufacturer: Firm (Carpet Mill) with not less than 5 years of production experience with carpet similar to types specified in this section, and whose published product literature clearly indicates compliance of products with requirements of this section.
- C. General Standard: "Carpet Specifier's Handbook" by the Carpet and Rug Institute; comply with recommendations which can be reasonably applied to types of carpeting work required.
- D. Maintenance Materials: Deliver specified overrun (if any) and usable scraps of carpet to Owner's designated storage space, properly packaged (paper wrapped) and identified. Usable scraps are defined to include roll ends of less than 9'0" length, and pieces of more than 3 sq. ft. area and more than 8" wide. Dispose of smaller pieces.

1.6 PRODUCT DELIVERY AND STORAGE

- A. Deliver carpeting material in protective wrapping, and store inside, protected from weather, moisture and soiling.

1.7 WARRANTY

- A. Provide special project warranty, signed by the Contractor, Installer and Manufacturer (Carpet Mill), agreeing to repair or replace defective materials and workmanship of carpeting work during a 1 year warranty period from date of final acceptance of the project. Attach copies of product warranties.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
 - 1. Mohawk (Basis of Design)
 - 2. Milliken
 - 3. Mannington

2.2 MATERIALS

- A. Series: "Hyper Earth" – 12BY36; 12" x 36" carpet planks.
- B. Color: To be selected by Architect from Series color selections.

2.3 PERFORMANCE

- A. Permanent Static Protection: Dissipates unwanted static electricity and effectively prevents static build-up in excess of 3.0 KV at 70° F, 20% relative humidity when tested under AATC-134-75.
- B. Flammability: DOC-FF-1-70 Pill Test passes. Floor Radiant Panel meets NFPA Class 1 when tested under ASTM E648 Glue Down. NBS Smoke Chamber NFPA-258 (450 or less) Flaming Mode.
- C. Construction Materials: 100% man-made materials for superior stability. Specifications are subject to change without notice when such changes do not alter product performance. Slight color variations may occur from dye lot to dye lot.

2.4 CARPET ACCESSORIES

- A. Wall Base: See Section 09650 – Rubber Base.
- B. Carpet Edge Guard, Metallic: Color as selected by Architect.
- C. Reducer Strip: Install vinyl reducer strip where carpet meets other finishes.
- D. Installation Adhesive: Water-resistant type as recommended by carpet or cushion manufacturer, and which complies with flammability requirements for installed carpet.
- E. Seaming Cement: Hot-melt seaming adhesive or similar product recommended by carpet manufacturer, for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.
- F. Miscellaneous Materials: As recommended by manufacturers of carpet, cushions and other carpeting products; and selected by Installer to meet project circumstances and requirements.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- A. Installer must examine substrates for moisture content and other conditions under which carpeting is to be installed, including the temperature of the area that the carpet is to be installed in, and notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed until satisfactory conditions have been met.
- B. Sequence carpeting with other work so far as to minimize the possibility of damage and soiling of carpet during remainder of construction period.

3.2 INSTALLATION- GENERAL

- A. Comply with manufacturers' instructions and recommendations for seam locations and direction of carpet; maintain uniformity of direction and lay of pile. At doors, center seams under doors; do not place seams in traffic direction at doorways. Provide seam layout to Architect for approval before any work is performed.
- B. Extend carpet under open-bottomed obstructions and under removable flanges and furnishings, and into alcoves and closets of each space.
- C. Provide cut-outs where required, and bind cut edges properly where not concealed by protective edge guards or overlapping flanges.
- D. Install carpet edge guard where edge of carpet is exposed; anchor guard to substrate.

3.3 GLUE-DOWN INSTALLATION

- A. Fit sections of carpets into each space prior to application of adhesive. Trim edges and butter cuts with seaming cement.
- B. Apply adhesive uniformly to substrate in accordance with manufacturers' instructions. Butt carpet edges tightly together to form seams without gaps. Roll lightly to eliminate air pockets and ensure uniform bond. Remove adhesive promptly from face of carpet.
- C. All seams are to be sealed or bonded together with the manufacturer's approved product and method.

CARPET
09680-2

3.4 CLEANING AND PROTECTION

- A. Remove debris, sorting pieces to be saved from scraps to be disposed of.
- B. Vacuum carpet using commercial machine with face-beater element. Remove spots and replace carpet where spots cannot be removed.
- C. Advise Contractor of protection methods and materials needed to ensure that carpeting will be without deterioration or damage at time of substantial completion.

END OF SECTION

CARPET
09680-3

SECTION 09843 SOUND-ABSORBING WALL PANELS [AWP]

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary conditions and Division 1 Specification sections apply to work of this section.

1.2 SECTION INCLUDES

- A. Sound-absorbing wall panels, custom-fabricated and fabric-finished. [AWP].

1.3 REFERENCES

- A. ASTM International:
 - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.4 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Surface Burning Characteristics (ASTM E84):
 - a. Flamespread: 25 maximum.
 - b. Smoke Developed: 450 maximum.
 - c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in-stock fabric, Guilford of Maine, FR 701 Style 2100.

1.5 SUBMITTAL

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit product data sheet, for specified products.
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.
- D. Samples: Submit selection and verification samples of finishes, colors and textures.
- E. Test Reports: Certified test reports showing compliance with specified performance requirements.
 - 1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at

least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

PART 2 - PRODUCTS

2.1 SOUND-ABSORBING WALL PANELS

A. MANUFACTURER

1. Kinetics Noise Control, Inc. (Basis of Design and Quality); PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: intsales@kineticsnoise.com; Web site: www.kineticsnoise.com.
2. Acoustical Solutions; 2420 Genoble Road, Richmond, VA 23294; Phone:800.782.5742; www.acousticalsolutions.com.
3. Acoustics First; 2247 Tomlyn Street, Richmond, VA 23230-3334; 888.765.2900 or 804.342.2900; www.acousticsfirst.com.
4. MBI Products Company, Inc. | 801 Bond Street, Elyria, OH 44035 | Ph.: 440.322.6500 | www.mbiproducts.com.

2.2 MANUFACTURED UNITS

A. HardSide Panels:

1. Thickness: 2 inches (51 mm) and 4 inches (102 mm).
Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm) panel.
2. Core: 2 inches (51 mm) and 4 inches (102 mm) thick fiberglass, 6 - 7 pcf (96 - 112 kg/m³) density.
3. Edge Detail: Square hardened with a Class A hardening solution.
4. Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine.
 - a. Color: As selected by Architect from panel manufacturer's full range of colors.
5. Sound Absorption (ASTM C423): Noise Reduction Coefficient as follows:
 - a. 2 inches (51 mm) panel: 1.00, minimum.
 - b. 4 inches (102 mm) panel: 1.10, minimum, 125 Hz = 0.65 or greater.
6. Mounting Accessories: HS impaling clips or Z-clips.

B. High Impact HardSide Panels:

1. Thickness: 2 1/8 inches (54 mm).
2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm) panel.
3. Core: 2 inches (51 mm) thick fiberglass, 6 - 7 pcf (96 - 112 kg/m³) density, with bonded facing layer of 10 pcf (192 kg/m³), 1/8 inch (3.2 mm) thick impact resistant fiberglass.
4. Edge Detail: Square hardened with non-resin, Class A hardening solution.
5. Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine.
 - a. Color: As selected by architect from panel manufacturer's full range of colors.
6. Sound Absorption (ASTM C423): Noise Reduction Coefficient as follows:
 - a. 2 1/8 inches (54 mm) panel: 1.05, minimum.
7. Mounting Accessories: HS impaling clips or Z-clips.

C. Vinyl Fire Rated Barrier Material:

1. Barrier material shall have a minimum continuous operating temperature range from -40°F to

180°F (-40°C to 82.2°C), be resistant to water, oils, weak acids, alkalies, and fungi, and have weather resistance.

2. Model KNM-100B by Kinetics Noise Control, Inc., Dublin, OH
 - a. KNM-100B 1 PSF (4.9 kg/m²) STC 27, Kinetics limp barrier material, unreinforced and loaded with barium sulphate. Available in black color in 54" x 20 yard (1372 mm x 18.2 m) rolls.

2.3 FABRICATION

- A. General: Treat fabric wrapped panels using heat shrink process to develop fully taut facing.
- B. Wrap panel edges and return facing fabric 1 - 2 inches (25.4 - 51 mm) on back of panel. Secure fabric with adhesive applied to edges and back of panel only.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.2 EXAMINATION

- A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
 1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.
 2. Do not install panels until unsatisfactory conditions are corrected.

3.3 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris.

END OF SECTION

SECTION 09900 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of painting work is indicated on drawings and schedules, and as herein specified including accent painting.
- B. Work includes painting and finishing of interior and exterior exposed items and surfaces throughout project, except as otherwise indicated.
 - 1. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatments specified under other sections of work.
- C. Work includes field painting of exposed bare and covered pipes, conduits and ducts (including color coding), and of hangers, exposed steel and iron work, and conduits and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.
- D. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.
- E. Surfaces to be Painted: Except where natural finish of material is specifically noted as a surface not to be painted, paint exposed surfaces whether or not colors are designated in "schedules". Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.
- F. Following categories of work are not included as part of field-applied finish work.
 - 1. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer finishing is specified for such items as (but not limited to) metal toilet enclosures, prefinished partition systems, acoustic materials, elevator entrance doors and frames, elevator equipment, and finished mechanical and electrical equipment, including light fixtures, switchgear and distribution cabinets.
 - 2. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
 - 3. Finished Metal Surfaces: Unless otherwise indicated, metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting.
 - 4. Operating Parts: Unless otherwise indicated, moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting.
- G. Following categories of work are included under other sections of these specifications.
 - 1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, metal fabrications, hollow metal work and similar items.
 - 2. Unless otherwise specified, shop priming of fabricated components such as shop-fabricated or factory-built mechanical and electrical equipment or accessories is included under other sections of these specifications.
- H. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory

Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer and use only within recommended limits.
- B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information or characteristics of finish materials provided for use, to ensure compatible prime coats are used.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.
- B. Samples: Prior to beginning work, Architect will furnish color chips for surfaces to be painted. Use representative colors when preparing samples for review. Submit samples for Architect's review of color and texture only.
- C. Provide a listing of material and application for each coat of each finish sample. Provide a 4' x 4' sample application of each color paint for Architect's approval prior to final ordering of product. Sample application shall be applied in an inconspicuous place, satisfactory to the Architect.

1.5 DELIVERY AND STORAGE

- A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
 - 1. Name or title of material.
 - 2. Fed. Spec. number, if applicable.
 - 3. Manufacturer's stock number and date of manufacturer.
 - 4. Manufacturer's name.
 - 5. Contents by volume, for major pigment and vehicle constituents.
 - 6. Thinning instructions.
 - 7. Application instructions.
 - 8. Color name and number.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.6 JOB CONDITIONS

- A. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 degree F and 90 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.
- B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45 degree F and 95 degree F, unless otherwise permitted by paint manufacturer's printed instructions.
- C. Do not apply paint in snow, rain, fog or mist, or when relative humidity exceeds 85% or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.
 - 1. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during

application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers are listed as acceptable substitutions to the establish minimum standards. Sherwin Williams Products are listed as the standard of product performance and quality.
 - 1. Sherwin Williams Paint Company (SW)
 - 2. Benjamin Moore and Co. (Moore).
 - 3. Pittsburgh Paints (PPG).
- B. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS

- A. Material Quality: Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.
 - 1. Proprietary names used to designate colors or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.
 - 2. Federal Specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed these minimums.
 - 3. Manufacturer's products which comply with coating qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to Architect. Furnish material data and manufacturer's certificate of performance to Architect for any proposed substitutions.
- B. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

PART 3 – EXECUTION

3.1 INSPECTION

- A. **Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator. If work is begun before satisfactory conditions are met, then it shall be the Applicators' responsibility for the finish surfaces conditions.**
- B. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
- C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

3.2 SURFACE PREPARATION

- A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.
 - 1. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of any anticipated problems in using the specified coating systems with substrates primed by others.
 - 2. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted or provide surface-applied protection prior

to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.
- B. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block, cement plaster and cement-asbestos board to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze.
1. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint. Do not paint over surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
 2. Clean concrete floor surfaces scheduled to be painted with a commercial solution of muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid and allow to dry before painting.
- C. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
1. Prime, stain, or seal wood required to be job-painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling.
 2. When transparent finish is required, use spar varnish for backpriming.
 3. Backprime all exposed exterior wood. Backprime paneling on interior partitions only where masonry, plaster, or other wet wall construction occurs on backside.
 4. Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.
- D. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.
1. Touch-up shop-applied prime coats wherever damaged or bare. Clean and touch-up with same type shop primer.
- E. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.

3.3 MATERIALS PREPARATION

- A. Mix and prepare painting materials in accordance with manufacturer's directions.
- B. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
- C. Stir materials before application to produce a mixture of uniform density and stir as required during application. Do not stir surface film into material. If film exists, remove film and strain paint material.

3.4 APPLICATION

- A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied. Paint colors, surface treatments, and finishes, are indicated in "schedules" of the contract documents.
 1. Provide finish coats which are compatible with prime paints used.

2. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness not less than specified thickness.
 3. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.
 4. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
 5. Paint back sides of access panels, and removable or hinged covers to match exposed surfaces.
 6. Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.
 7. Sand lightly between each succeeding enamel or varnish coat.
 8. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.
- B. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss adhesion of the undercoat.
- C. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.
- D. Prime Coats: Apply prime coat where required to be painted or finished, and which has not been primed coated by others.
1. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- E. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.
- F. Transparent (Clear) Finishes: Use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats, unless otherwise indicated.
- G. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.5 FIELD QUALITY CONTROL

- A. The right is reserved by Owner to invoke the following material testing procedure at any time, and any number of times during period of field painting:
1. Engage services of an independent testing laboratory to sample paint being used. Samples of materials delivered to project site will be taken, identified and sealed, and certified in presence of Contractor.
 2. Testing laboratory will perform appropriate tests for any or all of following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali

resistance and quantitative materials analysis.

- B. If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible.

3.6 CLEAN-UP AND PROTECTION

- A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each day.
- B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.
 - 1. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.
- D. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.7 EXTRA STOCK

- A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
 - 1. Paint: Furnish not less than one gallon for each type and color, applied.

3.8 EXTERIOR PAINT SCHEDULE

- A. Paint all new roof penetrations at roof areas, including roof attic ventilators and exhaust fan housings.
- B. General: Provide the following paint systems for the various substrates, as indicated.
- C. Ferrous Metals: Gloss Alkyd Enamel: 2 Finish coats over primer with total dry film thickness of not less than 6.0 mils.

1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer B66-01310 Series
(5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)

2nd Coat: S-W Industrial Enamel, B54 Series

3rd Coat: S-W Industrial Enamel, B54 Series,
(2-4 mils dry per coat)

Optional System:

1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer B66-01310 Series
(5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)

2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series

3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series,
(1.4 – 1.7 mils dry per coat)

- D. Zinc-Coated Metal: Gloss Alkyd Enamel: 2 Finish coats over primer with total dry film thickness of not less than 2.5 mils.

1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer B66-01310 Series
(5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)

2nd Coat: S-W Industrial Enamel, B54 Series

3rd Coat: S-W Industrial Enamel, B54 Series,
(2-4 mils dry per coat)

Optional System:

1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer B66-01310 Series
(5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)

2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series

3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series,
(2-4 mils dry per coat)

- E. Painted Wood: Gloss Acrylic: 2 finish coats over primer with total dry film thickness of not less than 5.0 mils. Back prime all trim.

1st Coat: S-W Exterior Oil-Based Wood Primer, Y24W08020
(4 mils wet, 2.2 mils dry)

2nd Coat: S-W SuperPaint Exterior Latex Gloss Paint, A84 Series

3rd Coat: S-W SuperPaint Exterior Latex Gloss Paint, A84 Series
(4 mils wet, 1.5 mils dry per coat)

- F. Stained Woodwork: Stained Finish: 2 Coats of stain on open grain wood.

1st Coat: S-W Woodscapes Exterior Acrylic Solid Color Stain,
(200-400 sq ft/gal) @ 4-8 mils wet; 1.3-2.6 mils dry.

2nd Coat: S-W Woodscapes Exterior Acrylic Solid Color Stain,
(200-400 sq ft/gal) @ 4-8 mils wet; 1.3-2.6 mils dry.

- G. Masonry Surfaces (pre-cast, poured in place, EIFS, Stucco, etc)

1st Coat: S-W Loxon Concrete & Masonry Primer / Sealer, LX02W0050
(5.3 – 8.0 mils wet, 2.1 – 3.2 mils dry per coat)

2nd Coat: S-W Loxon Self-Cleaning Acrylic Coating, LX13 Series

3rd Coat: S-W Loxon Self-Cleaning Acrylic Coating, LX13 Series
(5.0 – 7.0 mils wet, 2.1 – 2.9 mils dry per coat)

- H. CMU (Concrete Masonry Units):

1st Coat: S-W Pro Industrial Heavy Duty Block Filler, B42W00150
(16.0 – 21.0 mils wet, 8.0 - 10.5 mils dry per coat)

2nd Coat: S-W Loxon Self-Cleaning Acrylic Coating, LX13 Series

3rd Coat: S-W Loxon Self-Cleaning Acrylic Coating, LX13 Series
(5.0 – 7.0 mils wet, 2.1 – 2.9 mils dry per coat)

3.9 INTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated on drawings, schedules and specifications.

- B. Paint all exposed metals (steel framing, mechanical ducts, conduit, etc.) unless otherwise indicated on drawings.

- C. Painter shall identify all fire and smoke partitions above lay in ceilings as follows: Wording shall be "FIRE AND SMOKE BARRIERS - PROTECT ALL OPENINGS" (4" high), to be applied every 8'- 0" o.c.

- D. Metal/Structural Steel Building Components: Epoxy Eg-Shel Finish: 2 coats over primer with total dry film thickness not less than 6.0 mils. (All Steel/Metal At Interior of Building)

1st Coat: S-W Pro Industrial Pro-Cryl Universal Primer,
B66W01310 (5 – 10 mils wet, 1.9 – 3.8 mils dry per coat)

2nd Coat: S-W Pro Industrial Waterbased Catalyzed Epoxy EgShel Finish,
B73-360 Series (5.0 – 12.0 mils wet, 2.0 – 5.0 mils dry per coat)

- 3rd Coat: S-W Pro Industrial Waterbased Catalyzed Epoxy EgShel Finish, B73-360 Series (5.0 – 12.0 mils wet, 2.0 – 5.0 mils dry per coat)
- E. Concrete Masonry Units: **Latex** Semi-Gloss Enamel Finish: 2 Finish coats over filled surface with total dry film thickness of not less than 11.4 mils.
- 1st Coat: S-W Pro Industrial Heavy Duty Block Filler, B42W00150 (16.0 – 21.0 mils wet, 8.0 - 10.5 mils dry per coat)
- 2nd Coat: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31W12651 Series
- 3rd Coat: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31W12651 Series (4 mils wet, 1.5 mils dry per coat)
- F. Concrete Masonry Units: **Epoxy** Semi-Gloss Finish: 2 Finish coats over filled surface with total dry film thickness of not less than 11.4 mils.
- 1st Coat: S-W Pro Industrial Heavy Duty Block Filler, B42W00150 (16.0 – 21.0 mils wet, 8.0 - 10.5 mils dry per coat)
- 2nd Coat: S-W Pro Industrial® Pre Catalyzed Water-based Epoxy Semi-Gloss, K46-01151 Series (4 mils wet, 1.4 mils dry per coat)
- 3rd Coat: S-W Pro Industrial® Pre Catalyzed Water-based Epoxy Semi-Gloss, K46-01151 Series (4 mils wet, 1.4 mils dry per coat)
- G. Drywall Walls and Ceilings: Interior Semi-Gloss Finish Acrylic Latex, 3 Coat system with dry film thickness not less than 3.8 mils.
- 1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W02600 (4 mils wet, 1.0 mils dry)
- 2nd Coat: S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31W02651 Series
- 3rd Coat: S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31W02651 Series (4 mils wet, 1.5 mils dry per coat)
- H. Zinc-Coated Metal: Alkyd Gloss Finish: 2 Coats over primer, with total dry film thickness not less than 6.0 mils.
- 1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer B66-01310 Series (5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)
- 2nd Coat: S-W Industrial Enamel, B54 Series
- 3rd Coat: S-W Industrial Enamel, B54 Series, (2-4 mils dry per coat)
- Optional System:*
- 1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer B66-01310 Series (5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)
- 2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series
- 3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series, (1.4 – 1.7 mils dry per coat)
- I. Ferrous Metal: Alkyd Gloss Enamel Finish: 2 Finish Coats over primer, with total dry film thickness not less than 6.0 mils.
- 1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer B66-01310 Series (5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)
- 2nd Coat: S-W Industrial Enamel, B54 Series

3rd Coat: S-W Industrial Enamel, B54 Series,
(2-4 mils dry per coat)

Optional System:

1st Coat: S-W Pro Industrial Pro-Cryl® Universal Acrylic Primer
B66-01310 Series (5.0-10.0 mils wet, 1.9-3.8 mils dry per coat)

2nd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series

3rd Coat: S-W Pro Industrial Waterbased Alkyd Urethane Enamel, Gloss, B53 Series,
(1.4 – 1.7 mils dry per coat)

- J. Wood Doors & Trim: Interior Semi-Gloss Acrylic Latex with dry film thickness not less than 3.8 mils.

1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W02600
(4 mils wet, 1.0 mils dry)

2nd Coat: S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss,
B31W02651 Series

3rd Coat: S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss,
B31W02651 Series (4 mils wet, 1.5 mils dry per coat)

- K. Stained Woodwork: Stained Varnish Rubbed Finish: 3 Finish Coats over stain plus filler on open grain wood.

1st Coat: S-W MinWax Performance Series Tintable Interior Stain
550 VOC, (450-550 sq ft/gal) Available in 250 VOC Version

2nd Coat: S-W MinWax Performance Series Fast-Dry Varnish,

3rd Coat: S-W MinWax Performance Series Fast-Dry Varnish
(600-700 sq ft/gal) (available in Gloss, Semi-Gloss, Satin)

- L. Wall Panels: (Acoustical and Wood): Interior Semi-Gloss Finish Acrylic Latex with dry film thickness not less than 3.8 mils.

1st Coat: S-W ProMar 200 Zero VOC Interior Latex Primer, B28W02600
(4 mils wet, 1.0 mils dry)

2nd Coat: S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss,
B31W02651 Series

3rd Coat: S-W ProMar 200 Zero VOC Interior Latex Semi-Gloss,
B31W02651 Series (4 mils wet, 1.5 mils dry per coat)

END OF SECTION

SECTION 10100 - MARKABLE BOARDS AND TACKBOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of markable boards (M.B.) and tackboards (T.B.) is shown on drawings.
- B. Types of markable boards and tackboards specified in this section include the following:
 - 1. Markable Boards
 - 2. Vinyl Fabric-Faced Cork Tackboards

1.3 QUALITY ASSURANCE

- A. Manufacturer: Unless otherwise acceptable to Architect, furnish all markable boards and tackboards by one manufacturer for entire project.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for each material and component part, including data substantiating that materials comply with requirements.
- B. Samples: Submit full range of color samples for each type of markable board, tackboard, trim and accessories required. Provide 12" square samples of sheet materials and 12" lengths of trim members for color verification after selections have been made.
- C. Shop Drawings: Submit for each type of markable board and tackboard. Include sections of typical trim members and dimensioned elevations. Show anchors, grounds, reinforcement, accessories, and installation details.

1.5 SPECIAL PROJECT WARRANTY

- A. Warranty on Porcelain Enamel Markable Boards: Provide written warranty, signed by manufacturer, agreeing to replace, within warranty period, porcelain enamel remarkable boards which do not retain original writing and erasing qualities, defined to include surfaces which become slick and shiny, or exhibit crazing, cracking or flaking; provided manufacturer's instructions for handling, installing, protecting and maintaining markable boards have been adhered to during the warranty period. Replacement is limited to material replacement only and does not include labor for removal and reinstallation.
 - 1. Warranty Period: 50 years from date of substantial completion or lifetime of the building.

PART 2 – PRODUCTS

2.1 MANUFACTURER

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
- B. Manufacturers of Markable Boards and Tackboards:
 - 1. Claridge Products and Equipment, Inc.; www.claridgeproducts.com; 601 Highway 62-65 South, P.O. Box 910, Harrison, AR. 72602-0910; Phone: 800.434.4610 or 870.743.2200.
 - 2. PolyVision, Inc.; www.polyvision.com; 10700 Abbotts Bridge Road, Suite 100, Johns Creek, GA. 30097; Phone: 888.325.6351 or 678.542.3100.
 - 3. Marsh Industries, Inc.; www.marsh-ind.com; 2301 East High Avenue, New Philadelphia, OH, 44663; Phone: 800.426.4244.
- C. Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS

- A. Markable Boards (M.B.) - Markable boards shall be porcelain enamel writing surface as manufactured by PolyVision, Inc. Writing surface shall have magnetic properties and perform as follows:
 - 1. As a Writing Surface: The writing surface shall accept various writing medium including but not limited to chalk, pencil, water base marker, ball point pen, and fiber tip pen. All markings shall be clearly visible and easily cleaned.
 - 2. As a Projection Surface: Projected images shall be clearly visible from any angle.
 - 3. Board Construction shall include the following:
 - a. Facing sheet shall be porcelain enamel (P3 ceramicsteel) fused to 28 gauge steel face at approximately 1500 degrees F. Core shall be 1/2:" particleboard with 0.005" aluminum backing sheet.
 - b. Provide single piece units up to 4' x 16'. Where overall sizes exceed manufacturer's maximum size, provide two or more panels of equal size as acceptable to the Architect.
- B. Tackboards (T.B.): "Fabricork" Vinyl faced fabric (Koroseal) complying with FS CCC-W-408, Type II, mildew resistant, laminated to 1/4" thick cork backing sheet. Furnish materials as required for tack strips.
 - 1. Unless otherwise indicated, make up rigid panels by factory-laminating under pressure to 1/4" thick exterior type plywood or hardboard backing.
 - 2. Color: Color and Pattern to be selected from manufactures standards.
- C. Colors and Textures: Color to be selected from manufactures standards.
- D. Trim and Accessories:
 - 1. General: Fabricate frames and trim of not less than 0.062" thick aluminum alloy, size and shape as indicated, to suit type of installation. Provide straight, single-length units wherever possible and keep joints to minimum. Miter corners to neat, hairline closure.
 - 2. Aluminum Finish: Furnish exposed aluminum trim, accessories and fasteners with the following finish:
 - a. Finish: Manufacturer's standard satin aluminum finish.
 - 3. Chalk-trough: Furnish continuous aluminum chalk-troughs for each markable board, unless otherwise indicated, as follows:
 - a. Solid extrusion, manufacturer's standard ribbed section, enclosed chalk tray with solid end caps, smoothly curved with concealed mounting.
 - 4. Map-rails and Map hooks: Furnish continuous aluminum maprails with cork tackstrip inserts for each markable board. Provide one pair of paper holders and one pair of maphooks for each 4 foot of remarkable board length. Provide flag holder and 1 pair of roller brackets.

2.3 FABRICATION

- A. Assembly: Provide factory-assembled markable board and tackboard units unless field-assembled units indicated.
- B. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
- C. Provide manufacturer's standard vertical joint system between abutting sections of markable board.
 - 1. Provide mullion trim at joints between markable board and tackboard.

PART 3 – EXECUTION

- 3.1 **INSTALLATION:** Verify mounting heights with Owner prior to installation.

- A. Deliver factory-built markable board and tackboard units completely assembled in one piece without joints, whenever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit at factory, disassembled for delivery, and make final joints at site. Use splines at joints to maintain surface alignment.
- B. Install units in locations as shown on drawings and mounted at heights as directed by the Owner, keeping perimeter lines straight, plumb, and level. Provide all grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories for complete installation.

3.2 ADJUST AND CLEAN:

- A. Verify accessories required for each unit properly installed and operating units properly functioning.
- B. Clean units in accordance with manufacturer's instructions, breaking in only as recommended.

END OF SECTION

SECTION 10160 - TOILET PARTITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Extent of toilet partitions is indicated on drawings.
- B. Types of toilet partitions and screens required include the following:
 - 1. Solid phenolic with fused surface laminate, floor-supported, overhead-braced.
- C. Toilet accessories are specified elsewhere in Division 10.

1.3 QUALITY ASSURANCE

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to ensure proper fitting of work. However, allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay work.
- B. Coordination: Furnish inserts and anchorages which must be built into other work for installation of toilet partitions and related work; coordinate delivery with other work to avoid delay.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings, and accessories.
- B. Shop Drawings: Submit shop drawings for fabrication and erection of toilet partition assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.
- C. Samples: Submit full range of color samples for each type of unit required. Submit 6" square samples of each color and finish on same substrate to be used in work, for color selections.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
 - 1. Bobrick Wasroom Equipment
 - 2. General Partitions
 - 3. Global (ASI)
 - 4. Bradley Partitions
 - 5. Columbia Partitions
- B. Equal products of other manufacturers may be used in the work, provided such products have been approved, by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS

- A. General: Provide materials which have been selected for surface flatness and smoothness. Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.
- B. Materials: Doors, panels and pilasters are composed of compressed cellulose fibers impregnated with resins. The surface laminate is fused to the resin-impregnated core. All edges are machined and finished smooth with beveled edge. Material will not delaminate even under extreme conditions. Materials are non-absorbent, impact and graffiti resistant. Materials are impervious to

steam, soaps and detergents and will not mildew.

- C. Panels: Shall be 1/2" thick with eased edges uniformly machined to a 1/16" radius. Panels are 58" high and anchored to walls with 18 gauge stainless steel continuous brackets and continuous stainless steel brackets at panel to pilaster locations.
- D. Doors: Shall be 3/4" thick with eased edges uniformly machined to a 1/16" radius. Doors are 58" high and mounted to pilasters with continuous stainless steel surface mounted hinge. Pre-threaded inserts are to be provided for all door hardware. Each door is furnished with one coat hook/bumper, slide latches, stops and pulls (for outswing doors) to be made of stainless steel. Door hardware shall allow for lift up emergency access.
- E. Pilasters: Shall be 3/4" thick with eased edges uniformly machined to a 1/16" radius. Pilasters are 83" high (or as indicated on the drawings) and anchored to panels and walls with continuous stainless steel brackets. The pilasters contain no less than two level adjusting bolts on the bottom and attach to the floor with two 3/4" expansion bolts and are braced at the top with aluminum headrail.
- F. Stainless Steel Pilaster Shoes: Shall be 3" high, and constructed of 20-gauge stainless steel. Pilaster shoes are bolted onto pilaster with stainless steel, tamper resistant sex bolts and screws.
- G. Latches and Keepers: Shall be fabricated from stainless steel with a satin finish. Latch is mounted onto door with 1/4" stainless steel torx head bolts pre-threaded inserts and acts as the stop for inswing doors. Keepers are mounted on the pilasters with stainless steel toex head screws.
- H. Headrail: Shall be made of heavy-duty extruded aluminum (6463-T5 alloy) with bright-dip anodized finish. Headrail is anti-grip and attaches to the top of the pilasters with stainless steel, tamper resistant torx screws. Headrail is attached to the adjacent wall construction with a stainless steel headrail bracket.
- I. Headrail Bracket: Shall be made of 16 gauge stainless steel and is attached to the adjacent wall construction with #14 x 1 1/2" stainless steel phillips-head screws and plastic anchors.
- J. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel with pinhead, torx screws and bolts.

2.3 FABRICATION

- A. General: Furnish standard doors, panels, screens, and pilasters fabricated for partition system, unless otherwise indicated. Furnish units with cutouts, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories, and grab bars, as indicated.
- B. Door Dimensions: Unless otherwise indicated, furnish 24" wide inswinging doors for ordinary toilet stalls and 32" wide (clear opening) outswinging doors at stalls equipped for use by handicapped.
- C. Overhead-Braced Partitions: Furnish stainless steel supports and leveling bolts at pilasters, as recommended by manufacturer to suit floor conditions. Make provisions for setting and securing continuous aluminum overhead-bracing tube at top of each pilaster. Furnish shoe at each pilaster to conceal supports and leveling mechanism.
- D. Floor-Supported Partitions: furnish galvanized steel anchorage devices, complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters, to permit structural connection at floor. Furnish shoe at each pilaster to conceal anchorage.
- E. Floor-Supported Over-Head Braced Screens: Furnish pilasters not less than 3/4" in thickness, panels and pilasters of same construction and finish as toilet partitions. Furnish galvanized steel anchorage devices, complete with threaded rods, lock washers, and leveling adjusting nuts at pilasters, to permit structural connection to floor. Furnish shoe at pilaster to conceal anchorage.
- F. Accessories: Furnish units with chromium-plated finish, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's recommended procedures and installation sequences. Install partitions rigid, straight, plumb, and level.
- B. Provide clearances of not more than 1/2" between pilasters and panels, and not more than 1" between panels and walls. Secure panels to walls with full length stainless steel brackets. Secure panels to pilasters with not less than two stirrup brackets located to align with stirrup brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.
- C. Overhead-Braced Partitions and Screens: Secure pilasters to floor and level, plumb, and tighten installation with devices furnished. Secure overhead-brace to each pilaster with not less than two fasteners. Hang doors and adjust so that tops of doors are parallel with overhead-brace when doors are in closed position.
- D. Floor-Supported Partitions: Set pilaster units with anchorages having not less than 2" penetration into structural floor, unless otherwise recommended by partition manufacturer. Level, plumb and tighten installation with devices furnished. Hang doors and adjust so that tops of doors are level with tops partition when doors are in closed position.
- E. Screens: Attach with concealed anchoring devices, as recommended by manufacturer to suit supporting structure. Set units to provide support and to resist lateral impact.
- F. Accessories: Mount accessories to partition units in accordance with manufacturer's instructions.

3.2 ADJUST AND CLEAN

- A. Hardware Adjustment: Adjust and lubricate hardware for proper operation. Set hinges on inswinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors (and entrance swing doors) to return to fully closed position.
- B. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION

SECTION 10200 - LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK:

- A. Extent of louvers and vents is indicated on drawings, including indications of sizes and locations.
 - 1. Fixed Wall Louvers.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets for each product and assembly specified.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Cleaning methods.
- C. Shop Drawings: For units and accessories. Include plans; elevations; sections; and details showing profiles, angles, and spacing of elements. Show unit dimensions related to wall openings and adjacent construction; free area for each size indicated for louvers; profiles of frames at jambs, heads, and sills; and anchorage details and locations.
 - 1. Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 2. For installed products indicated to comply with design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Product Certificates:
 - 1. Air Performance: Certificates signed by Air Movement and Control Association International Inc (AMCA) certifying that the manufacturer's stock units are tested in accordance with AMCA Standard 500 and are licensed to bear the AMCA Certified Ratings Seal in accordance with AMCA Standard 511.
 - 2. Water Penetration: Certificates signed by Air Movement and Control Association International Inc (AMCA) certifying that the manufacturer's stock units are tested in accordance with AMCA Standard 500 and are licensed to bear the AMCA Certified Ratings Seal in accordance with AMCA Standard 511.
 - 3. Weather Louver Effectiveness: Certificates signed by Air Movement and Control Association International Inc (AMCA) certifying that the manufacturer's stock units are tested in accordance with AMCA Standard 500-L99, Section 8.3.2 - Wind Driven Rain Water Penetration Test, and are licensed to bear the AMCA Certified Ratings Seal in accordance

with AMCA Standard 511.

4. Provide AMCA Certification - Water, Air for louvers as scheduled.
- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- F. Selection Samples: Two complete color charts showing the full range of colors available for units with factory-applied color finishes.
- G. Samples for Verification: For each finish specified, two samples representing actual finishes specified; prepared on Samples of same thickness and material indicated for final Work. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum 5 years manufacturing similar products. The manufacturer shall have implemented a program for the management of quality objectives, continual improvement, and monitoring of customer satisfaction to assure that customer needs and expectations are met.
- B. Installer Qualifications: Minimum 2 years experience installing similar louvers.
- C. Professional Engineer Qualifications: A professional engineer legally qualified to practice in jurisdiction where Project is located and experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of products that are similar to those indicated for this Project in material, design, and extent.
- D. Source Limitations: Obtain products through one source from a single manufacturer where alike in one or more respects regarding type, design, or factory-applied color finish.
- E. Welding Standards: As follows:
 1. Comply with AWS D1.2, "Structural Welding Code - Aluminum."
 2. Comply with AWS D1.3, "Structural Welding Code - Sheet Steel."
- F. AMCA Standard 500-L: Air performance, water penetration and air leakage ratings shall be determined in accordance with Air Movement and Control Association International Inc (AMCA) Standard 500, "Laboratory Methods of Testing Louvers for Rating."
- G. SMACNA Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" recommendations for fabrication, construction details, and installation procedures.

1.6 SEQUENCING AND SCHEDULING

- A. Field Measurements: Verify openings and adjacent construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual opening dimensions correspond to established dimensions.
 2. Coordinate Setting Drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

1.7 PROJECT CONDITIONS

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

1.8 WARRANTY

- A. Manufacturer shall provide standard limited warranty for louver systems for a period of five years (60 months) from date of installation, no more than 60 months after shipment from manufacturing plant. When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without direct financial cost to the Owner.
- B. Manufacturer shall provide 20 year limited warranty for fluoropolymer-based finish on extruded aluminum substrates.
 - 1. Finish coating shall not peel, blister, chip, crack or check.
 - 2. Chalking, fading or erosion of finish when measured by the following tests:
 - a. Finish coating shall not chalk in excess of 8 numerical ratings when measured in accordance with ASTM D4214.
 - b. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D2244 and ASTM D822.
 - c. Finish coating shall not erode at a rate in excess of 10%/ 5 year as determined by Florida test sample.
- C. Manufacturer shall provide a 5 year limited warranty for Class I and a 3 year limited warranty for Class II anodized finish on extruded aluminum substrates.
 - 1. Seller warrants the Finish under normal atmospheric conditions.
 - a. Will not crack, craze, flake or blister
 - b. Will not change or fade more than (5) Delta-E Hunter units as determined by ASTM method D-2244
 - c. Will not chalk in excess of ASTM D-4214-07 number (8) rating, determined by the procedure outlined in ASTM D-4214-07 specification test.
 - 2. Any forming or welding must be done prior to finishing. Post forming or welding will void the warranty.
 - 3. This Warranty applies only if the anodized aluminum product is installed in strict accordance with Seller's recommended practices and maintained in accordance with AAMA (American Architectural Manufacturers Association) publication number 609 and 610-09 ("Cleaning and Maintenance Guide for Architecturally Finished Aluminum").

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers' products have been used to established minimum standards for materials, workmanship and functions:
 - 1. Reliable Architectural Products (Basis of Design) |1300 Enterprise Road, Geneva, Alabama 36340 | PH: 334.684.3621 or 800.624.3914 | www.reliablelouvers.com.
 - 2. Ruskin Company | 3900 Dr. Greaves Rd. Grandview, MO 64030 | PH: 816.761.7476 | www.ruskin.com.
 - 3. The Airolite Company, LLC. | Ph:715.841.8757 | www.airolite.com.
 - 4. Air Performance Louvers LLC. | 159 Genco Drive, Hartford, AL 36344 | Ph: 334.588.0191 or 588.0070 | www.airperformancellc.com.
 - 5. Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect not less than Ten (10) days prior to scheduled bid opening.

2.2 STATIONARY BLADE LOUVER

- A. Model 4375Z125 as manufactured by Reliable Louver Company
- B. Fabrication:

A New Auditorium for
Straughn School for the
Covington County Board of Education
Andalusia, Alabama

LOUVERS
10200-3

1. Design: Stationary non- drainable louver with drain gutters in head frame with downspouts in the jambs and mullions with all welded construction. Hidden vertical supports to allow unlimited continuous line appearance. Steeply angled integral sill.
2. Frame:
 - a. Frame Depth: 4 inches (102 mm).
 - b. Wall Thickness: .081 inch (2.1 mm) nominal.
 - c. Material: Extruded aluminum, Alloy 6063-T6.
3. Blades:

Style: Non- Drainable: 37.5 degrees at 5-3/32 inches (129 mm)

 - a. Wall Thickness: 0.081 inch (2.1 mm), nominal.
 - b. Material: Extruded aluminum, Alloy 6063 T6.
4. Minimum Assembly Size: 12 inches wide by 12 inches high (305 mm x 305 mm).
5. Maximum Factory Assembly Size: Single sections shall not exceed 120 inches wide by 90 inches high (3048 mm x 2286 mm) or 90 inches wide by 120 inches high (2286 mm x 3048). Louvers larger than the maximum single size shall be require field assembly of smaller sections.
6. Recycled Content: 18% post-consumer. 55% pre-consumer, post-industrial, total 73% by weight.

C. Performance Data:

1. Based on testing 48 inch x 48 inch (1,219 mm x 1,219 mm) size unit in accordance with AMCA 500.
2. Free Area: 54 percent, nominal.
3. Free Area Size: 8.58 square feet (0.79 m²).
4. Maximum Recommended Air Flow through Free Area: 803 feet per minute (4.08 m/s).
5. Air Flow: 6890 cubic feet per minute (3.25 m³/s).
6. Maximum Pressure Drop (Intake): 0.15 inches w.g. (0.035 kPa).
7. Water Penetration: Maximum of 0.01 ounces per square foot (3.1 g/m²) of free area at an air flow of 803 feet per minute (4.08 m/s) free area velocity when tested for 15 minutes.

D. Design Windload: Per Code.

E. Louvers shall be factory engineered to withstand the specified seismic loads.

1. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

2.3 ACCESSORIES

A. Bird Screen: Install insect screens on intake louvers and bird screens on exhaust louvers. Do not install insect screens on HVAC intake louvers.

1. Aluminum: Aluminum, 5/8 inches by 0.040 inch (16 mm by 1 mm), expanded and flattened.
2. Frame: Removable. Re-wireable.

B. Insect Screens: Install insect screens on intake louvers and bird screens on exhaust louvers. Do not install insect screens on HVAC intake louvers.

1. Aluminum: 18-16 mesh, mill finish, .011 inch (0.3 mm) wire.
2. Frame: Aluminum.

C. Extended Sills:

1. Extruded aluminum, Alloy 6063-T6. Minimum nominal thickness 0.060 inch (1.5 mm).

2. Formed aluminum, Alloy 3003. Minimum nominal thickness 0.081 inch (2.1 mm).
- D. Visible Mullions: Manufacturer's standard horizontal or vertical visible mullions for architectural accent as indicated on drawings.

2.4 FINISHES

- A. Finish: 70 percent PVDF: Finish shall be applied at 1.2 mil total dry film thickness.
1. Coating shall conform to AAMA 2605. Apply coating following cleaning and pretreatment. Cleaning: AA-C12C42R1X.
 - a. Standard 2-coat.
 2. 20-year finish warranty.
- B. Color: Color to be selected by Architect.

2.5 MATERIALS, GENERAL

- A. Fastenings: Use same material as items fastened, unless otherwise indicated. Fasteners for exterior applications may be hot-dip galvanized, stainless steel or aluminum. Provide types, gages and lengths to suit unit installation conditions. Use Phillips flat-head machine screws for exposed fasteners, unless otherwise indicated.
- B. Anchors and Inserts: Use metal anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required.
- C. Bituminous Paint: SSPC-Paint 12 (cold-applied asphalt mastic).

2.6 FABRICATION, GENERAL

- A. Provide louvers and accessories of design, materials, sizes, depth, arrangement, and metal thicknesses indicated, or if not indicated, as required for optimum performance with respect to airflow; water penetration; air leakage where applicable (for adjustable units, if any); strength; durability; and uniform appearance.
- B. Fabricate frames including integral sills to suit adjacent construction with tolerances for installation, including application of sealants in joints between louvers and adjoining work.
- C. Include supports, anchorages, and accessories required for complete assembly.
- D. Provide sill extensions and loose sills made of same material as louvers, where indicated, or required for drainage to exterior and to prevent water penetrating to interior.
- E. Maintain equal blade spacing, including separation between blades and frames at head and sill to produce uniform appearance.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Prepare substrates and openings using methods recommended by manufacturer for achieving best result for substrates under project conditions.
- B. Do not proceed with installation until substrates and nailers have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.
- C. If preparation is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
1. Locate and place units level, plumb, and at indicated alignment with adjacent work.
 2. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws

where required to protect metal surfaces and to make a weathertight connection.

3. Form closely fitted joints with exposed connections accurately located and secured.
 4. Provide perimeter reveals and openings of uniform width for sealants and joint fillers as indicated on Drawings.
 5. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
 6. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- B. Install concealed gaskets, flashings, joint fillers, and insulation, as installation progresses, where weathertight joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during installation.

3.3 ADJUSTING, CLEANING AND PROTECTION

- A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.
- B. Protect products from damage until completion of project. Use temporary protective coverings where needed and approved by manufacturer. Remove protective covering at the time of Substantial Completion.
- C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 10200 STATIONARY BLADE WALL LOUVERS (FEMA)

PART 1 – GENERAL

1.1 SECTION INCLUDES

- A. FEMA 361 Approved Stationary Blade Louvers.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of Contract including General and Supplementary conditions and Division 1 Specification sections apply to work of this section.
- B. Section 03300 - Cast-In-Place Concrete.
- C. Section 04200 - Masonry Units.
- D. Section 05100 - Structural Metal Framing.
- E. Section 06100 - Rough Carpentry.
- F. Section 07420 - Metal Wall Panels.
- G. Section 07600 - Flashing and Sheet Metal.
- H. Section 07900 - Joint Sealants.

1.3 REFERENCES

- A. AAMA 2604 – High Performance Organic Coatings on Architectural Extrusions and Panels.
- B. AAMA 2605 - High Performance Organic Coatings on Architectural Extrusions and Panels.
- C. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- D. AMCA 511 - Certified Ratings Program for Air Control Devices.
- E. AMCA 540-13 - Test Methods for Louvers Impacted by Wind Borne Debris with Enhanced Protection Approval.
- F. AMCA 611 - Certified Ratings Program -Product Rating Manual for Airflow Measurement Stations.
- G. AMCA 550 – High Velocity Wind Driven Rain Resistant Louvers.
- H. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.4 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.5 ACTION SUBMITTALS

- A. Submit under provisions of Section 01300.

- B. Product Data: For each product to be used, including:
 1. Manufacturer's product data including performance data.
 2. Preparation instructions and recommendations.
 3. Storage and handling requirements and recommendations.
 4. Installation methods.
- C. Shop Drawings:
 1. Submit shop drawings indicating materials, construction, dimensions, accessories, and installation details.
- D. Product Schedule: For louvers. Use same designations indicated on Drawings.
- E. Samples: Submit sample of louver to show frame, blades, bird screen, gutters, downspouts, vertical supports, sill, accessories, finish, and color.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of louver, for tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 1. The manufacturer shall have implemented the management of quality objectives, continual improvement, and monitoring of customer satisfaction to assure that customer needs and expectations are met.
 2. Manufacturer shall be International Organization for Standardization (ISO) 9001 accredited.
- B. Product Qualifications:
 1. Manufacturer shall design and furnish all supports required to comply with FEMA 361 Design and Construction for Community Shelters, Zone IV criteria, 250 MPH wind, 15 lb. 2x4 impact at 100 mph.
 2. Louvers licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance and water penetration ratings.
 3. Louver shall comply with AMCA 540-13 for enhanced structures and AMCA 550.
 4. Louvers shall be factory engineered to withstand the specified seismic loads.
 - a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store materials in a dry area indoors, protected from damage and in accordance with manufacturer's instructions.
- C. Handling: Protect materials and finishes during handling and installation to prevent damage.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.9 PROJECT CONDITIONS

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

1.10 WARRANTY

- A. Manufacturer shall provide standard limited warranty for louver systems for a period of five years (60 months) from date of installation, no more than 60 months after shipment from manufacturing plant. When notified in writing from the Owner of a manufacturing defect, manufacturer shall promptly correct deficiencies without cost to the Owner.
 - 1. PVDF Finish: Five year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Ruskin Company; 3900 Dr. Greaves Road, Kansas City, Missouri 64030. Tel: (816) 761-7476. www.ruskin.com.
- B. Substitutions: Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect not less than Ten (10) days prior to scheduled bid opening.

2.2 FEMA APPROVED STATIONARY BLADE LOUVER

- A. Model: XP500S as manufactured by Ruskin Company.
- B. Fabrication: Formed Aluminum stationary horizontal chevron louver style.
 - 1. Frame:
 - a. Frame Depth: 8 inches (203 mm).
 - b. Wall Thickness: 0.25 inch (6 mm), nominal.
 - c. Material: Hot Rolled Steel.
 - 2. Blades:
 - a. Style: Horizontal mounted chevron sight proof.
 - b. Wall Thickness: 0.25 inch (6 mm), nominal.
 - c. Material: Hot Rolled Steel.
 - 3. Minimum assembly size: 12 inches wide by 12 inches high (305 mm x 305 mm).
 - 4. Maximum assembly size: Unlimited width by 80 inches high (2032 mm)
 - 5. Maximum shipping width by 80 inches high (2032 mm):
- C. Performance Data:
 - 1. Free Area: 53 percent, nominal.
 - 2. Maximum Recommended Air Flow through Free Area: 900 feet per minute (4.57 m/sec).
 - 3. Air Flow: 7600 cubic feet per minute (3,587 l/s).
 - 4. Maximum Pressure Drop (Intake): 0.30 inches w.g. (0.07 kPa).
- D. Design Windload:
 - 1. Designed Windload:
 - a. 266 PSF: On units up to 80 inches high (2032 mm).
 - 2. Louvers shall be factory engineered to withstand the specified seismic loads.
 - a. Minimum design loads shall be calculated to comply with ASCE – 7, or local requirements of Authority Having Jurisdiction (AHJ).

2.3 ACCESSORIES

- A. Bird Screen:
 - 1. Aluminum: Aluminum, 5/8 inches by 0.040 inch (16 mm by 1 mm), expanded and flattened.
 - 2. Frame: Removable.
- B. Insect Screens:
 - 1. Aluminum: 18-16 mesh, mill finish, .011 inch (0.3 mm) wire.
 - 2. Frame: Aluminum.
- C. Extended Sills:
 - 1. Galvanized steel, 20 gage (1 mm).
- D. Visible Mullions: Manufacturer's standard horizontal or vertical visible mullions for architectural accent as indicated on drawings.

2.4 FINISHES

- A. Finish: 70 percent PVDF: Finish shall be applied at 1.2 mil total dry film thickness.
 - 1. Coating shall conform to AAMA 2605. Apply coating following cleaning and pretreatment. Cleaning: AA-C12C42R1X.
 - a. Standard 2-coat.
 - 2. 20-year finish warranty.
- B. Color: To be selected by Architect from manufactures standard colors.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect areas to receive louvers. Notify the Architect of conditions that would adversely affect the installation or subsequent utilization of the louvers. Do not proceed with installation until unsatisfactory conditions are corrected.
- B. If opening preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean opening thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install louvers at locations indicated on the drawings and in accordance with manufacturer's instructions.
- B. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
- C. Secure louver to structure to comply with FEMA 361 and the following:
 - 1. Substrate: CMU, Grout filled.1500 Min. PSI
 - a. Anchor Type: 3/4 inch (19 mm) diameter Hilti Kwik Bolt III Expansion Anchor.
 - b. Spacing: 8 inches (203 mm) maximum on center and 3 inches (176 mm) from ends.
 - c. Embedment: 4-3/4 inches (121 mm).
 - d. Edge Distance: 4 inches (102 mm).
 - 2. Substrate: Steel or Aluminum Frame.

- a. Anchor Type: 5/8 inch (16 mm) diameter Hilti Kwik Bolt Expansion Anchor.
 - b. Spacing: 8 inches (203 mm) maximum on center and 3 inches (176 mm) from ends.
 - c. Embedment: 4 inches (102 mm).
 - d. Edge Distance: 2 inches (51 mm).
- D. Install joint sealants as specified in Section 07900.
- E. Apply field topcoat within 6 months of application of shop prime coat. Apply field topcoat as specified in Section 09 91 00.

3.4 CLEANING

- A. Clean louver surfaces in accordance with manufacturer's instructions.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 10410 - IDENTIFYING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Types of identifying devices specified in this section include the following:
 - 1. Room Signs (See Door Schedule)
 - 2. Storm Shelter Signs
 - 3. Occupancy Sign
 - 4. Metal Letters
 - 5. Plaque
 - 6. Project Sign
- B. Extent of signs and plaque is indicated on the drawings.

1.3 QUALITY ASSURANCE

- A. Drawings and Specifications are based on one manufacturer's standard products. Another standard system of a similar and equivalent nature may be acceptable when the differences do not materially detract from the design concept or intended performance as judged solely by the Architect.
- B. **General Contractor is responsible for verifying signage requirements and correct wording, names etc. with Owner and Architect before ordering.**

1.4 SUBMITTALS

- A. Shop Drawings: Submit shop drawings for each type of device. Include large scale sections of typical members and other components. Provide dimensioned elevations. Show anchorages, grounds and reinforcement and indicate finishes.

PART 2 - PRODUCTS

2.1 ROOM SIGNS

- A. MANUFACTURER:
 - 1. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function.
 - a. ASI Sign Systems, Inc., 8181 Jetstar Drive, Suite 100, Irving, TX 75063; www.asisignage.com; 1-800-274-7732
 - b. Best Sign Systems, www.bestsigns.com; 1202 N. Park Avenue, Montrose, CO 81401-3171, Phone (970) 249-2378 or 1-800-235-2378; Fax (970) 249-0223
 - c. Leeds Architectural Letters of Alabama Inc, www.leedsletters.com; P.O. Box 40, Leeds, AL 35094; Phone (205) 699-5271; Fax (205) 699-3342
 - d. Bayuk Graphic Systems, Inc., www.bayukgraphics.com; 5005 Old Lincoln Highway Parkesburg, PA 19365; Phone: (717)-442-0274; Fax: (717)-442-1289
 - 2. Substitutions: Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. MATERIALS:

1. Provide 6" x 8" high laminated plastic with raised lettering complying with the Americans with Disabilities Act (ADA).
2. All Signs MUST include 1" Slide In Window Slot.
3. Color to be selected by the Architect after bid date from manufacturer standards.
4. Use International Symbols of accessibility for identifying facilities as accessible.
5. Letters and numerals shall be raised 1/32 in (0.8 mm) minimum, upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille.
6. Raised characters shall be at least 5/8 in (16 mm) high, but no higher than 2 in (50 mm).
7. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 in (152 mm) minimum in height.
8. **See Door Schedule. If not shown provide 20 letter characters per room sign.**
9. **The Supplier will be required to meet with the Owner for exact wording for all room signs before preparation of the shop drawing submittal to the Architect for approval.)**
10. Tactile characters on signs shall be located 48 inches (1220 mm) minimum above the finish floor or ground surface, measured from the baseline of the lowest tactile character and 60 inches (1525 mm) maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.
 - a. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side.
 - b. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf.
 - c. Where a tactile sign is provided at double doors with two active leafs, the sign shall be located to the right of the right hand door.
 - d. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
 - e. Signs containing tactile characters shall be located so that a clear floor space of 18 inches (455 mm) minimum by 18 inches (455 mm) minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position. Mounting devices shall be concealed.

2.2 STORM SHELTER SIGNS

A. MANUFACTURER:

1. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function.
 - a. ASI Sign Systems, Inc., 8181 Jetstar Drive, Suite 100, Irving, TX 75063; www.asisignage.com; 1-800-274-7732
 - b. Best Sign Systems, www.bestsigns.com; 1202 N. Park Avenue, Montrose, CO 81401-3171, Phone (970) 249-2378 or 1-800-235-2378; Fax (970) 249-0223
 - c. Leeds Architectural Letters of Alabama Inc, www.leedsletters.com; P.O. Box 40, Leeds, AL 35094; Phone (205) 699-5271; Fax (205) 699-3342
 - d. Bayuk Graphic Systems, Inc., www.bayukgraphics.com; 5005 Old Lincoln Highway Parkesburg, PA 19365; Phone: (717)-442-0274; Fax: (717)-442-1289
2. Substitutions: Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. MATERIALS

1. Provide 11" x 9" high laminated plastic with raised lettering complying with the Americans with Disabilities Act (ADA),
2. Color to be selected by the Architect.
3. Use International Symbols of accessibility for identifying facilities as accessible.
4. Letters and numerals shall be raised 1/32 in (0.8 mm) minimum, upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille.
5. Raised characters shall be at least 5/8 in (16 mm) high, but no higher than 2 in (50 mm).
6. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram.
7. Supply letter characters per sign as **indicated on the Shelter Plan**.
8. The Supplier will be required to meet with the Architect to verify the exact wording for all storm shelter signs before preparation of the shop drawing submittal to the Architect for approval.
9. Tactile characters on signs shall be located 48 inches (1220 mm) minimum above the finish floor or ground surface, measured from the baseline of the lowest tactile character and 60 inches (1525 mm) maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.
10. **Mount signs at locations indicated on the Shelter Plan.**
11. Mounting devices shall be concealed.

2.3 OCCUPANCY SIGNS

A. MANUFACTURER:

1. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function.
 - a. ASI Sign Systems, Inc., 8181 Jetstar Drive, Suite 100, Irving, TX 75063;
www.asisignage.com; 1-800-274-7732
 - b. Best Sign Systems, www.bestsigs.com; 1202 N. Park Avenue, Montrose, CO 81401-3171, Phone (970) 249-2378 or 1-800-235-2378; Fax (970) 249-0223
 - c. Leeds Architectural Letters of Alabama Inc, www.leedsletters.com; P.O. Box 40, Leeds, AL 35094; Phone (205) 699-5271; Fax (205) 699-3342
 - d. Bayuk Graphic Systems, Inc., www.bayukgraphics.com; 5005 Old Lincoln Highway Parkesburg, PA 19365; Phone: (717)-442-0274; Fax: (717)-442-1289
2. Substitutions: Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. Materials

1. Provide 6" x 8" high laminated plastic with raised lettering complying.
2. Color to be selected by the Architect after bid date from manufacturer standards.
3. Letters and numerals shall be raised 1/32 in (0.8 mm) minimum, upper case, sans serif or simple serif type.
4. Raised characters shall be at least 5/8 in (16 mm) high, but no higher than 2 in (50 mm).

2.4 METAL LETTERS

A. MANUFACTURER:

1. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function.

- a. Impact Architectural Signs, www.impactsigns.com; 26 E. Burlington Avenue, LaGrange, IL 60525; (708) 469-7178; impact@impactsigns.com
 - b. Leeds Architectural Letters of Alabama Inc, www.leedsletters.com; P.O. Box 40, Leeds, AL 35094; Phone (205) 699-5271; Fax (205) 699- 3342
 - c. Matthews Architectural Products, www.matthewsid.com; 2 North Shore Pittsburgh, PA 15212; (412) 571-5500; (800) 950-1317
2. Substitutions: Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. MATERIALS

1. Provide standard cast aluminum letters for exterior architectural signage shown on drawings and as follows:
2. Building Signage: Provide full size sample prior to manufacture of all letters.
 - a. Mounting shall be projected mount without collars set in adhesive.
 - b. Color shall be anodized aluminum.
 - c. Style of letter shall be as follows:
 - I. Height: 15" High - Upper Case.
 - II. Depth: 1 ¼" Deep – Upper Case.
 - III. Font: Arial Bold
 - IV. Letters to read as indicated on drawings.

2.5 PLAQUE

A. MANUFACTURER:

1. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function.
 - a. Impact Architectural Signs, www.impactsigns.com; 26 E. Burlington Avenue, LaGrange, IL 60525; (708) 469-7178; impact@impactsigns.com
 - b. Leeds Architectural Letters of Alabama Inc, www.leedsletters.com; P.O. Box 40, Leeds, AL 35094; Phone (205) 699-5271; Fax (205) 699- 3342
 - c. Matthews Architectural Products, www.matthewsid.com; 2 North Shore Pittsburgh, PA 15212; (412) 571-5500; (800) 950-1317
2. Substitutions: Equal products of other manufacturers may be used in the work, provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

B. MATERIALS

1. **NOTE: This Project has 2 separate Plaques.**
2. Note to the Contractor: PSCA plaques are installed as a permanent part of a building and are required on the following partially or fully PSCA-funded projects: Major renovations, renovations of four (4) or more rooms, and all new construction as follows: buildings, additions, and athletic facilities.
3. Refer to *Detail Of Plaque (ABC Form C-16, August 2001)* [DEDICATORY PLAQUE] at the front end of the project manual.
4. Refer to *Detail Of Plaque (DCM Form 9-M (PSCA), August 2021)* [PSCA PLAQUE] at the front end of the project manual.
5. Size: 24" high x 30" wide.
6. Cast aluminum with bronze finish of standard alloy, hand tooled and chased.

7. Raised letters and border.
 8. Satin finish.
 9. Background pebbled finish and oxidized to a darker finish.
 10. Casting to be free of pits and holes, square and true with no warping.
 11. Border style to be single line.
 12. Letters to be flat face classic design.
 13. Furnish Rubbing to Architect for approval.
- C. Wording on the “**Dedicatory Plaque**” shall read as follows.

A NEW AUDITORIUM
FOR
STRAUGHN SCHOOL
ANDALUSIA, ALABAMA

ERECTED 2022

STATE OF ALABAMA

THE COVINGTON COUNTY BOARD OF EDUCATION
MR. JEFF BAILEY, PRESIDENT
MR. JAMES L. BARTON, VICE PRESIDENT
MR. JOHN P. THOMASSON, BOARD MEMBER
MR. JAMES L. RODGERS, BOARD MEMBER
MR. JAMES T. PRESTWOOD, BOARD MEMBER
MR. SHANNON DRIVER, SUPERINTENDENT

SUPERVISED BY
Alabama Real Property Management, Division of Construction Management

McKEE AND ASSOCIATES ARCHITECTS, INC.

NAME TO BE FURNISHED - CONTRACTOR

- D. Wording on the “**PSCA Plaque**” shall read as follows.

A NEW AUDITORIUM
FOR
STRAUGHN SCHOOL
ANDALUSIA, ALABAMA
ERECTED 2022

STATE OF ALABAMA

PUBLIC SCHOOL AND COLLEGE AUTHORITY
GOVENOR KAY IVEY, PRESIDENT
MR. , VICE PRESIDENT
MR. , SECRETARY

SUPERVISED BY
Alabama Real Property Management, Division of Construction Management

McKEE AND ASSOCIATES ARCHITECTS, INC.

NAME TO BE FURNISHED - CONTRACTOR

2.6 PROJECT SIGN

A. MATERIALS

1. Refer to *Detail of Project Sign (DCM Form C-15, January 2020)* at the front end of the project manual.

B. Wording on the project sign shall read as follow.

<p>STATE OF ALABAMA</p> <p>THE COVINGTON COUNTY BOARD OF EDUCATION MR. JEFF BAILEY, PRESIDENT MR. JAMES L. BARTON, VICE PRESIDENT MR. JOHN P. THOMASSON, BOARD MEMBER MR. JAMES L. RODGERS, BOARD MEMBER MR. JAMES T. PRESTWOOD, BOARD MEMBER MR. SHANNON DRIVER, SUPERINTENDENT</p> <p><i>“Investing in Alabama’s Future”</i></p> <p>A NEW AUDITORIUM FOR STRAUGHN SCHOOL ANDALUSIA, ALABAMA</p> <p>Alabama Real Property Management, Division of Construction Management</p> <p>McKEE AND ASSOCIATES ARCHITECTS, INC</p> <p>NAME TO BE FURNISHED – CONTRACTOR</p>

2.7 FABRICATION

- A. General: Fabricate signs to comply with requirements indicated including, dimensions, design details, quality, thickness and finish of materials. Use materials and shapes of sufficient thickness, with reinforcing, if needed, to produce sufficient flatness, free of “oil canning”, and to impart sufficient strength for size, design and application indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units plumb and level, in locations and with mounting shown. Securely attach to the supporting structure with concealed fasteners, in accordance with the manufacturer's installation instructions.

3.2 CLEANING AND PROTECTION

- A. At completion of the installation, clean surfaces in accordance with the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION

SECTION 10440 - FIRE EXTINGUISHERS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fire Extinguishers.
 - 2. Extinguisher cabinets.
 - 3. Accessories.
- B. Related Requirements:
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 REFERENCES

- A. Reference Standards:
 - 1. ASTM International (ASTM):
 - a. ASTM E814-11a, Standard Test Method for Fire Tests of Penetration Firestop Systems.
 - 2. International Code Council (ICC):
 - a. International Building Code (IBC) - Current Edition.
 - 3. Intertek Testing Services/Warnock-Hersey International (ITS/WHI)
 - 4. National Fire Protection Association (NFPA):
 - a. NFPA 10-2010, Standard for Portable Fire Extinguishers: For criteria covering installations for Class A, B, C, D, and K hazards as well as the selection, inspection, maintenance, recharging, and testing of portable fire extinguishing equipment.
 - b. NFPA 70-2011, National Electrical Code.
 - 5. Underwriters Laboratories, Inc. (UL)
 - 6. United States Code (USC):
 - a. Americans with Disabilities Act of 1990, as amended by the ADA Amendments Act of 2008: For restrictions relating to cabinet projections in corridors.

1.3 ACTION SUBMITTALS

- A. Submit in accordance with Section 01600:
 - 1. Product Data:
 - a. Cabinets: Materials description for fire extinguisher cabinets include roughing-in dimensions, details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, door style and materials.
 - b. Extinguishers: Materials description for fire extinguishers; include ratings and classifications.
 - c. Installation instructions for each product specified.
 - 2. Shop Drawings:
 - a. Small-scale plans showing locations of fire extinguisher cabinets and individual fire extinguishers.
 - b. Schedules showing each type of cabinet and extinguisher to ensure proper fit and function.

- c. Indicate installation procedures and accessories required for a complete installation.
- 3. Samples:
 - a. Extinguisher Cabinet Door and Trim Finishes: For each type of exposed finish required, prepared on samples of size indicated below:
 - i. Size: 6 inches (150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Comply with standards referenced in Article 1.02 - REFERENCES.
- B. Provide fire extinguishers, cabinets and accessories produced by a single manufacturer.
- C. Provide fire extinguishers of type approved by UL, State Fire Marshal's Office, and local regulatory agencies, if any.
- D. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle fire protection specialties and related materials using means and methods that will prevent damage, deterioration, or loss.
 - 1. Deliver components in manufacturer's original packaging, properly labeled for identification.

1.7 WARRANTY

- A. All Fire Protection Products (except fire extinguishers) carry a one year warranty after date of shipment against defects in materials or workmanship. Fire extinguishers carry a longer warranty. We will replace or repair any product found defective within this period. No other warranty expressed or implied is valid. Manufacturer's warranty, terms and conditions apply in all cases. Please see complete warranty on our website for more details.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION SPECIALTIES MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. J. L. Industries, Inc., a division of Activar Construction Products Group; 9702 Newton Av S Bloomington, MN 55431; (800) 554-6077, (952) 835-6850, (952) 835-2218 (FAX); SALES@ACTIVARCPG.COM; www.activarcpg.com
 - 2. Larsen's Manufacturing Company
 - 3. Modern Metal Products
- B. Substitutions: Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 FIRE EXTINGUISHERS

- A. Multi-Purpose Chemical Type: Extinguisher unit containing a fluidized and siliconized mono ammonium phosphate powder; nonconductive and nontoxic.
 - 1. Construction: Heavy duty steel cylinder with metal valve and siphon tube, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin and upright squeeze grip.
 - 2. Finish: Factory powder-coated; Red.
 - 3. Effectiveness (Rating): Class A, B, and C fires.

4. Model Identification and UL Rating: Cosmic **10E; 4A-80BC**.
 5. "Start Up Tags" for each fire extinguisher must be provided and approved by Local Fire Department before Final Inspection.
- B. Class K Wet Chemical Type: Extinguisher unit containing a low "pH" potassium acetate solution.
1. Construction: Stainless steel cylinder with protective nozzle tip orifice seal and nonmetallic nozzle tip finger guard, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin, and upright squeeze grip.
 2. Effectiveness (Rating): Class K fires.
 3. Model Identification and and UL Rating: **25; Class K**. Capacity: 2.5 gal.

2.3 EXTINGUISHER CABINETS

- A. Cabinet with Steel Trim and Door:
1. **Ambassador Series, Model 1017F10** at Non-Fire Rated Walls.
 2. **Ambassador Series, Model 1017F10FX2** at Fire Rated Walls.
- B. Cabinet Style: **Semi-recessed**.
1. Tub: Cold-rolled steel.
 - a. Finish: Factory-applied powder coat paint finish.
 - i. To be selected by Architect after bid date from manufacturer Standard Colors.
 2. Door and Trim Construction: Cold-rolled steel; flush doors with 5/8 inch (15.88 mm) door stop attached by continuous hinge and equipped with zinc-plated handle with roller catch.
 - a. Finish: Factory-applied powder coat paint finish.
 - i. To be selected by Architect after bid date from manufacturer Standard Colors.
 3. Trim Style and Depth: Cabinets located in corridors shall not protrude into the hall way more than 2 1/2".
 - a. Semi-Recessed Cabinet:
 - i. Rolled Edge: 2-1/2 inch (63.50 mm).
 - b. Trim Dimensions: 1-3/4 inch (44.45 mm) face trim on frame and 1-1/4 inch (31.75 mm) face trim on door.
- C. Fire-Rating: Provide Fire-Rated cabinets for 1-hour and 2-hour combustible and noncombustible wall systems as required.

2.4 CABINET DOOR STYLES, GLAZING TYPES, AND ADDITIONAL OPTIONS

- A. Door Style:
1. Style F: Full glazing; with pull handle.
- B. Door Glazing:
1. Type 10: Clear acrylic.
- C. Additional Options:
1. Cabinet Lettering:
 - a. Text: FIRE EXTINGUISHER.
 - b. Color(s): [Red] [Black] [White]. To be selected by Architect after bid date.

2.5 SOURCE QUALITY CONTROL

- A. Ship extinguishers to the Project site fully charged, EXCEPT those which contain water as an extinguishing agent, if any.

- B. Obtain Fire Extinguishers and Fire Extinguisher Brackets from same manufacturer to ensure compatibility.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets will be installed and blocking where surface mounted cabinets will be installed.
 - 1. Notify the Contractor in writing of conditions detrimental to proper and timely completion of the installation.
 - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install cabinets in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
 - 1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
 - 2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
 - 3. Maintain fire ratings where cabinets are recessed into fire-rated wall systems.
- B. Cabinet Lettering:
 - 1. Identify fire extinguisher in cabinet with lettering spelling "FIRE EXTINGUISHER" painted on door by silk screen process. Provide lettering on door as indicated, or if not indicated, as selected by Architect from manufacturer's standard letter sizes, styles, colors and layouts.

3.3 FIELD QUALITY CONTROL

- A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag, just prior to turnover.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 10530 - FIRST AID CABINETS AND SAFETY KITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. "First Aid Cabinets" refer to units which are wall surface mounted with first aid/burn kits enclosed
- B. Type of products in this section include:
 - 1. First aid cabinets
 - 2. Safety kits

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions. Include roughing-in dimensions, and details showing mounting methods, relationships to surrounding construction, door hardware, cabinet type and materials, trim style and door construction, style and materials. Include color charts showing full range of manufacturer's standard colors and designs available.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
 - 1. American First Aid Kits, 200+ Person / Industrial First Aid Station with pocket liner / Wall Mountable, Product code: 249-O/P-200
- B. Substitutions: Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 FIRST AID CABINETS AND KITS

- A. General: Provide first aid cabinets of suitable size for housing safety kits of types and capacities as follows:
- B. Quantity Required: **[Total of 2]** First Aid Cabinets and Kits.
- C. Description: 5 Shelf Industrial First Aid Station with a pocket liner. This 5-shelf, 1720pc industrial first aid station serves 200 + people. Meets all of the OSHA and ANSI recommendations with refill requirements.

- D. Contents:

QTY: ITEM:

- 1 I-435: Antacid tablets, (125) 2-pks
- 1 I-415: Non-aspirin tablets, (125) 2-pks
- 1 I-427: Extra-strength pain reliever, (125) 2-pks
- 1 H-410: Aspirin tablets, (50) 2-pks
- 1 G-155: 3/4"x3" Adhesive plastic bandages, 100/bx
- 1 G-122: 1"x3" Fabric bandages, 100/bx
- 1 G-124: Knuckle fabric bandages, 40/bx
- 1 G-126: Fingertip fabric bandages, 40/bx

- 1 G-128: Fingertip fabric bandages, large, 25/bx
- 2 B-204: 2"x4.1 yd. Conforming gauze roll bandages, 2/bx
- 1 B-207: 4"x4" Gauze dressing pads, 4/bx
- 1 3"x5 yd. Cohesive elastic bandage wrap
- 1 M-270: Super Stop™ bandage
- 1 B-518: Triangular sling/bandage, 1/bx
- 1 G-532: Exam quality gloves, 5 pr/bx
- 1 H-305: Alcohol cleansing pads, 100/bx
- 1 B-503: 4"x5" Instant cold compress, 1/bx
- 1 M-564-E: 6"x9" Instant cold compress, 1/bx
- 1 SL-109: 2"x4" Elbow & knee plastic bandages, 25/bx
- 1 M-5064: 3" Cotton tipped applicators, 100/vial
- 1 I-228: 24 - 2"x2", 24 - 3"x3" Gauze dressing pads, 48/bx
- 1 M-701-NIA: Eye wash, 4 oz.
- 1 M-704-NIA: Eye wash solution, 8 oz.
- 1 M-707: Redness reliever eye drops, 1/2 oz.
- 1 M-528: Antiseptic spray, 3 oz.
- 1 M-531: Burn spray, 3 oz.
- 1 M-527: Spray on bandage, 3 oz.
- 1 M-583: 5-3/4" Deluxe scissors - stainless steel
- 1 M-584: 4" Tweezers, plastic
- 1 M-660: 2"x5 yd. 3-Cut first aid tape
- 1 H-307: Antiseptic cleansing wipes (sting free), 50/bx
- 1 G-310: Povidone-iodine infection control wipes, 50/bx
- 1 B-718: 4 Sterile, oval, gauze eye pads, 1/2"x5 yd. first aid tape, 1/bx
- 1 G-231: 2"x3" Non-stick pads with adhesive edges, 50/bx
- 1 B-504: CPR Pack: 1 Rescue Breather™ CPR one-way valve faceshield, 2 large latex gloves and 3 antiseptic wipes (sting free)
- 1 A-5009: Ammonia inhalants, 10/bx
- 1 A-151: Medium butterfly wound closures, 10/bx
- 2 AN-205: 32 sq. in. Absorbent gauze compress, 1/bx
- 1 G-486: Hydrocortisone cream, 1.0%, 1.5 gm pack, 25/bx
- 1 G-469: Burn relief packs, 3.5 gm pack, 25/bx
- 1 M-5068: 22-pocket, vinyl liner

E. Cabinet Construction: Manufacturer's standard enameled steel box, with trim, frame, door and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.

F. Cabinet Type: Suitable for surface mounting conditions.

G. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types with label emboss.

- H. Door Hardware: Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch, or door pull, exposed or concealed, and friction latch. Provide concealed or continuous type hinge permitting door to open 180°.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install items included in this section in locations and at mounting heights indicated, or if not
- B. indicated, at locations and heights to comply with applicable regulations of governing authorities and ADA.
 - 1. Securely fasten mounting brackets to structure, square and plumb, to comply with manufacturer's instructions.
 - 2. Where exact location of surface-mounted cabinets with other trades and as directed by Architect.

3.2 IDENTIFICATION

- A. Identify first aid kit in cabinet with lettering spelling "FIRST AID" painted on door.

END OF SECTION

SECTION 10531 - ALUMINUM HANGER ROD CANOPY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The work covered by this section shall include furnishing and installing aluminum hanger rod canopy, with decking and fascia material. The canopy shall consist of structural aluminum panels bound by a framework of fascia which also acts as a water collecting gutter. All components shall be as required to support design loads in accordance with engineering prints and calculations provided by the manufacturer.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings, and accessories.
- B. Shop Drawings: Submit shop drawings for fabrication and erection of assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.
- C. Samples: Submit full range of color samples for each type of unit required.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of the following except as otherwise indicated.
 - 1. International Building Code, latest addition with amendments, if any. AWS (American Welding Society) standards for structural aluminum welding.
- B. Manufacturer: Obtain aluminum covered walkway system from only one (1) manufacturer, although several may be indicated as offering products complying with requirements.
- C. Installer Qualification: Firm with not less than three (3) years experience in installation of aluminum walkway covers of type, quantity and installation methods similar to work of this section.
- D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to insure proper fitting of work. However, allow for adjustments within specified tolerations wherever taking of field measurements before fabrication might delay work.
- E. Shop Assembly: Pre-assemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- F. Coordination: Furnish inserts and anchorages which must be built into other work for installation of rod canopy's and related work; coordinate delivery with other work to avoid delay.

1.5 PERFORMANCE REQUIREMENTS

- A. System Performance: Provide aluminum covered walkway system that has been designed, produced, fabricated and installed to withstand normal temperature changes as well as live loading, dead loading and wind loading in compliance with Standard Building Code requirements for geographic area in which work is located and as follows:
- B. The system shall be designed by a registered Engineer in the State of Alabama, certifying the system meets all wind, foundation and all other applicable loads and requirements set forth by local or state building requirements.
 - 1. Live Load:
 - a. 30 p.s.f. minimum
 - 2. Structural design for wind forces:

- a. Comply with ANSI A58.1-1982
- 3. Design Wind Velocity:
 - a. 130 m.p.h.
- 4. Importance Factor:
 - a. 1.1.
- 5. Stability Criteria:
 - a. 2015 International Building Code
- C. Sizes shown on drawings are to be considered minimum.
- D. Structure shall be capable of sustaining severe icing, hail, hurricane force winds and supporting a concentrated load such as being walked upon.

PART 2 - PRODUCT

2.1 MANUFACTURERS

- A. The following manufacturers products have been used to establish minimum requirements for materials, workmanship, and function:
 - 1. Tennessee Valley Metals, Inc. **(Basis of Design and Standard or Quality)** | 190 Industrial Park Road, Oneonta, Alabama 35121 | (205) 274-9500 | www.tvmetals.com.
 - 2. Dittmer Architectural Aluminum | 1006 Shepherd Road, Winter Springs, Florida 32708 |(800) 822-1755; (407) 699-1755 | www.dittdeck.com; info@dittdeck.com.
 - 3. Superior Mason Products LLC. | 116 Citation Court, Birmingham, Alabama 35209 |(877) 445-1200 | www.superiormetalproducts.com; canopysales@superior-mason.com.
 - 4. Mitchell Metals | 1761 McCoba Dr. SE Suite B, Smyrna, Georgia 30080 | (770) 285-5875 | www.mitchellmetals.net; sales@mitchellmetals.net.
 - 5. Gulf South Metals | 17869 Samantha Drive, Foley, Alabama 36535 | (251) 943-6443; www.gulfsouthmetals.com; info@gulfsouthmetals.com.
 - 6. Equal products of other manufacturers may be used in the work, provided such products have been approved, by the Architect, not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS

- A. All aluminum extrusions shall be alloy 6063 heat treated to a T-6 temper.
- B. Standard finish for all components shall be satin anodize 204-R1 meeting Aluminum Association Specification AA-M-10C-22A-21.
- C. Fasteners:
 - 1. Deck Screws (rivets not permitted): Type 18-8 non-magnetic stainless steel sealed with a neoprene "O" ring beneath 5/8" outside dimension, conical washer.
 - 2. Fascia Rivets: Size 3/16" by 1/2" grip range aluminum rivets with aluminum mandrel.
 - 3. Bolts: All bolts, nuts and washers to be 18-8 non-magnetic stainless steel.
 - 4. Tek Screws: not permitted

2.3 WARRANTY

- A. Manufacturer shall warrant the entire system against defects in labor and materials for a period of one (1) year commencing on the date of substantial completion as established in Division One of these specifications.
- B. Intention of this warranty is the manufacturer will come onto the jobsite and do all necessary to effect corrections of any deficiencies.

- C. Prima Facie Evidence of defects in labor and material may include but is not limited to, one or more of the following:
 - 1. Moisture leaks
 - 2. Metal failure including excessive deflection
 - 3. Fastener failure
 - 4. Finish failure

2.4 FABRICATION

- A. Comply with indicated profiles, dimensioned requirements and structural requirements.
- B. Use sections true to details with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture, free from defects impairing strength and durability.
- C. All welding do be done by heli-arc process.
- D. Bents shall consist of shop welded one piece units. When size of bents do not permit shipment as a welded unit, concealed mechanical joints may be used.
- E. Mechanical joints shall consist of stainless steel bolts with a minimum of two (2) bolts per fastening. Bolts and nuts shall be installed in a concealed manner utilizing 1/2" thick by 1 1/2" aluminum bolt bars welded to structural members. All such mechanical joints must be detailed on shop drawings showing all locations.
- F. Roof Deck: Flush deck extruded aluminum shapes, interlocking self-flashing sections. Shop fabricate to lengths and panels widths required for field assembly. Depth of sections to comply with structural requirements. Provide shop induced camber in deck units with spans greater than 16'- 0" to offset dead load deflections. Welded dams are to be used at non-draining ends of deck.
- G. Expansion joints, design structure for thermal expansion and contraction. Provide expansion joints as required.
- H. Exposed rivets used to fasten bottom of fascia to deck to have finish to match fascia.
- I. Apply a shop applied dip-coat of clear acrylic enamel to each column end terminating in concrete to insulate from electrolytic reaction. Column ends shall be pierced to "key" grout to bent for maximum uplift protection.
- J. Finish: Provide enameled finish on all components from manufacturers standards selected by Architect, fascia and related components designed for optimum performance in exterior installations under all environmental conditions. The finish shall be applied in accordance with and conform to, or exceed the Painted Sheet "Quality Standards" and recommended ASTM, Military and/or Federal Test Methods specified by the Aluminum Association in their publication "Aluminum Standards & Data" 1972-1973. Finishes shall be updated as necessary to conform to future editions of this publication.
- K. Component Accessories: Roof Brackets, Flashing, etc., shall be of similar materials and finishes as specified for prime components. Each part and its use is described in the engineering prints and calculations provided by the manufacturer. Each part shall be used as specified in the aforementioned prints. Posts shall be used as specified.
- L. Hanger rod shall be galvanized steel pipe with finish to match other components.
- M. Hardware: All bolts, nuts, washers, and screws used in joining the members of the canopy together shall be stainless steel up to 1/4" diameter nominal size. Any hardware 1/4" diameter and larger shall be hot dip galvanized to withstand 200 hours salt spray test of maximum resistance to rust and corrosion.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle covered walkway system components as recommended by manufacturer. Handle and store in a manner to avoid deforming members and to avoid

excessive stresses.

3.2 EXAMINATION

- A. Examine adjacent work for conditions that would prevent quality installation of system.
- B. Do not proceed until defects are corrected.
- C. Installations:
 - 1. Installed units shall have the following minimum pitch for water drainage of the roof.
 - 2. Minimum pitch for all panels and fascia - Up to 10' - 1/8th/ft.
 - 3. Installed unit shall be properly caulked with a suitable, high quality material where needed and where specified.
 - 4. Installed unit shall meet local building code requirements and conform to the engineering prints provided by manufacturer.

3.3 FIELD DIMENSIONS

- A. General contractor shall field confirm bent locations, dimensions and elevations shown on shop drawings prior to fabrication.

3.4 CLEANING AND PROTECTION

- A. Damaged Units: Replace roof deck panels and other components of the work which have been damaged or have deteriorated beyond successful minor repair.
- B. Cleaning: Remove protective coverings at time in project construction sequence which will afford greatest protection of work. Clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.

END OF SECTION

SECTION 10800 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL

- A. Drawings and general provisions of contract including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

1.2 RELATED DOCUMENTS

- A. Section 06100, Rough Framing for Blocking

1.3 DESCRIPTION OF WORK

- B. Extent of each type of toilet accessory is indicated on drawings and schedules.
- C. **NOTE: Prior to placing any orders for items within this section, the General Contractor is responsible for verifying all toilet accessories with the Owner. Should the owner choose to provide/supply any of these toilet accessories, the General Contractor shall issue a deductive Change Order for material only. The General Contractor will maintain responsibility for installation.**
- D. Toilet Accessories **Furnished and Installed by the Contractor** as follows:
 - 1. Soap Dispensers
 - 2. Toilet Tissue Dispensers
 - 3. Paper Towel Dispensers
 - 4. Grab Bars
 - 5. Mirror Units
 - 6. Utility Shelf/Mop Rack

1.4 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish inserts and anchoring devices which must be set in concrete or built into masonry; coordinate delivery with other work to avoid delay.
- B. Accessory Locations: Coordinate accessory locations with other work to avoid interference and to assure proper operation and servicing of accessory units.
- C. Products: Provide products of same manufacturer for each type of accessory unit and for units exposed in same areas, unless other- wise acceptable to Architect.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data and installation instructions for each toilet accessory.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. The following manufacturer's products have been used to establish minimum standards for materials, workmanship and function.
 - 1. Soap Dispensers:
 - Wall Mounted over each sink
 - a. Approved Products:
 - i. Bobrick #B-2112
 - ii. ASI #0345
 - iii. Bradley #6562

2. Toilet Tissue Dispensers:
 - a. Roll Type: (One each water closet)
 - b. Approved Products:
 - i. Bradley #5425
 - ii. ASI #0040
 3. Paper Towel Dispensers:
 - a. Roll Type
 - b. Surface Mounted
 - c. Approved Products:
 - i. Bobrick #B52860
 4. Grab Bars:
 - a. Where shown on Plans with Safety-Grip Finish.
 - b. Approved Products:
 - i. Bradley Corporation #8122
 - ii. Series ASI #3200P
 - iii. Bobrick #B6806.99
 5. Mirror Units:
 - a. 18" x 38" One over each lavatory
 - b. 24" x 48" One at each Gang Toilet
 - c. Approved Products:
 - i. Bradley #780
 - ii. Bobrick #B290
 - iii. ASI #0600
 6. Utility Shelf/Mop Rack:
 - a. At locations indicated on drawings. If not indicated, provide One (1) at each Janitor Closet containing water closet. If location is not indicated, contractor is to coordinated location(s) with architect.
 - b. Approved Products:
 - i. ASI #1308-4 (44")
 - ii. Bradley #9934 (44')
 - iii. Bobrick #B239 x 44
- B. Equal products of other manufacturers may be used in the work provided such products have been approved by the Architect not less than Ten (10) days prior to scheduled bid opening.

2.2 MATERIALS, GENERAL

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 22 gage minimum, unless otherwise indicated.
- B. Mirror Units: Mirror glass shall be FS DD-G-451, Type I, Class I, Quality q2, 1/4" thick, with silver coating, copper protective coating, and non-metallic paint coating complying with FS DD-M-411. Mirror shall be provided in stainless steel frames.
- C. Fasteners: Screws, bolts, and other devices of same material as accessory unit or of galvanized steel where concealed.

2.3 FABRICATION

- A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated; in obtrusive labels on surfaces not exposed to view are acceptable. Where locks are required for a particular type of toilet accessory, provide same keying throughout project.
- B. Furnish two keys for each lock.
- C. Surface Mounted Toilet Accessories General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
- D. Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all welded construction, without mitered corners. Hang doors or access panels with full-length stainless steel piano hinge. Provide anchorage which is fully concealed when unit is closed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install toilet accessory units in accordance with manufacturer's instructions, using fasteners which are appropriate to substrate and recommended by manufacturer of unit. Install units plumb and level, firmly anchored in locations and at heights indicated.

3.2 ADJUSTING AND CLEANING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function smoothly. Replace damaged or defective items.
- B. Clean and polish all exposed surfaces after removing labels and protective coatings.

END OF SECTION

SECTION 12304 - LAMINATE CLAD CASEWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract including General and Special Conditions and Division 1 Specification sections apply to work of this section.
- B. Section Includes:
 - 1. Furnish and install plastic laminate casework and accessories, instrument storage casework, cubbies and specialty casework as shown and listed on drawings and specified herein. Includes all countertops, sink cutouts, splashes, supports, shelving, and filler panels necessary for a complete casework installation.
- C. Related Requirements to be Performed by Others:
 - 1. Division 06 Section: "Rough Carpentry" for blocking within walls to adequately support casework.
 - 2. Division 06 Section: "Finish Carpentry"
 - 3. Division 09 Section: "Resilient Base and Accessories" for resilient base applied to manufactured casework.
 - 4. Division 15 Section: "Plumbing" for furnishing, installation, and hook-up of sinks, fixtures, outlets, strainers, tailpieces, traps, vacuum breakers, and stops shall be performed by the plumbing contractor to state and local codes. In all cases, sink cutouts shall be by the casework contractor.
 - 5. Division 16 Section: "Electrical" for the electrical contractor to state and local codes shall perform electrical furnishing, installation, and final connections of wiring, conduit, and/or electrical items within casework.

1.1 REFERENCES

- A. ANSI-A135: for all hardboard.
- B. ANSI-A161.2-1998: for performance of fabricated high-pressure decorative laminate countertops.
- C. ANSI-A208.1-2009: for grade M-3 mat-formed wood particleboard.
- D. BHMA A156.9: for grade-1 hinge requirements.
- E. NEMA 3 LD-2005: for performance requirements of high pressure laminates.
- F. SEFA 8PL Recommended Practices: for cabinet construction.

1.2 DEFINITIONS

- A. Exposed: In casework, surfaces visible when drawers and opaque doors (if any) are closed; behind clear glass doors; bottoms of cabinets 42" or more above finished floor; and tops of cabinets less than 78" above finished floor.
- B. Semi-Exposed: In casework, surfaces that become visible when opaque doors are open or drawers are extended; bottoms of cabinets more than 30" or tops of cabinets less than 42" above finished floor.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Comply with Division 1.
 - 2. Submit three sets of laser quality, 11 x 17 shop drawings consisting of:
 - a. Finish, hardware, construction options selection sheet.
 - b. Small scale floor plan showing casework in relation to the building.

- c. Large scale elevations and plan views.
 - d. Cross-sections; service runs; locations of blocking within walls (blocking is done by others); rough-in requirements and, sink centerlines
3. Approved shop drawings to be returned to manufacturer at least 60 days before production.
 4. Project Architect and Construction Manager must approve all items prior to fabrication and delivery of casework.
 5. Manufacturer and/or Manufacturer's rep verifies all critical building dimensions prior to fabrication.
- B. Samples:
1. Submit one set of laminate color brochures from standard laminate manufacturers Wilsonart, Formica, Pionite, and Nevamar.
 2. Submit one edge color sample chain and one set of interior colors samples.
 3. Submit catalog showing construction details, material specifications and hardware specifications of all items used.
- C. Warranty: Provide sample warranty document stating specified terms as referenced herein.

1.4 QUALITY ASSURANCE

- A. Unless otherwise indicated, comply with AWI, for grades of interior architectural woodwork, construction, finishes and other requirements:

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
1. Deliver casework once painting, and similar requirements have been completed that will not damage casework. This includes ensuring spaces are enclosed and weather tight.
 2. All casework shall be blanket wrapped for protection during shipping.
- B. Storage and Handling: Casework must be protected from dust, dirt and/or other trades.

1.6 SITE CONDITIONS

- A. Ambient Conditions:
1. Do not deliver or install the casework until concrete, masonry, and drywall/plaster work is dry; ambient relative humidity is maintained between 25 – 55% prior to delivery and throughout the life of installation; and the temperature is controlled above 55°F.
 2. Casework shall not be stored or installed in non-climate controlled conditions.
 3. If ambient conditions are not met at the time of requested delivery, the general contractor or owner must provide the manufacture a letter releasing manufacturer from any liability and responsibility from any warranty or damage resulting from not complying with required ambient conditions.

1.7 WARRANTY

- A. Manufacture shall offer a one year warranty to the original owner against defective material and workmanship.
- B. The warranty specifically does not cover any product or hardware, which has been incorrectly installed, including poor climate conditions, exposed to excessive loads or abuse.
- C. All non-casework items supplied, but not manufactured at the manufacture shall be covered under the original manufacturers' warranty.

PART 2– PRODUCTS

2.1 MANUFACTURER

- A. The following manufacturers' products have been used to establish minimum standards for materials, workmanship and function:
1. Case Systems- Midland, MI. (Basis of Design)
 2. TMI Systems - Dickson, N.D.
 3. L.S.I.
 4. Stevens Industries - Teutopolis, IL.
 5. Cabinets by Design, LLC; 770.418.1200
 6. PR Bean Company, LLC; 812.254.3761
 7. Advanced Cabinet Systems (ACS); 765.677.8000
 8. Varner Woodworks, Montgomery, AL.

2.2 MATERIALS

- A. Provide Plastic Laminate Faced Cabinets Manufactured with:
1. Particleboard Core: All particleboard shall be Grade M-3 and shall meet or exceed all requirements as set by ANSI A208.1-2009.
 2. Mechanical Joinery: All cabinet body components shall be secured utilizing concealed interlocking mechanical fasteners as approved by the AWI Quality Standards 8th Edition -2003 Sections 400A-T-12, 400B-T10 and 1600-T-11.
 3. Surface Material: Acceptable laminate color, pattern, and finish as either scheduled or otherwise indicated on drawings or as selected by Architect from manufacturer's standards types and nominal thickness including:
 - a. Vertical surface decorative grade VGS: .028" thick
 - b. General purpose decorative grade HGS: .048" thick
 - c. Cabinet decorative liner grade CLS: .020" thick
 - d. Non-decorative backer grade BKH: .028" thick
 - e. Thermally fused melamine laminate
 4. Edge banding: PVC
 - a. Shall be applied utilizing hot melt adhesive and radiused by automatic trimmers. Edging shall be available in a variety of color options.
 5. Adhesives:
 - a. PVA: Adhesive shall be mechanically applied. NAUF, no VOC
 - b. EVA: Adhesive shall be mechanically applied.

2.3 FABRICATION

- A. General Cabinet Body Construction:
1. Cabinet Box Style shall be Reveal Overlay
 2. Cabinet Box Core shall be Particleboard.
 3. Bottoms and ends of cabinets, and tops of wall and tall cabinets (all structural components) shall be 3/4" thick.
 4. All panels shall be manufactured with balanced construction.

5. Fixed interior components such as fixed shelves, dividers, and cubicle compartments shall be full 3/4" thick and attached with concealed interlocking mechanical fasteners.
 6. Cabinet body exterior surfaces shall be: VGS
 7. Cabinet body interior surfaces shall be: Thermally Fused
 8. Cabinet body front edge shall be: .020 PVC.
 9. Mounting stretchers are 3/4" thick structural components fastened to end panels and back by mechanical fasteners, and are concealed by the cabinet back.
 10. When the rear of a cabinet is exposed, a separate finished 3/4" thick decorative laminate back panel may be specified.
 11. Backs of cabinets are 1/2" thick surfaced both sides for balanced construction and fully captured on both sides and bottom.
 12. A 5mm diameter row hole pattern 32mm (1-1/4") on center shall be bored in cabinet ends for adjustable shelves. This row hole pattern shall also serve for hardware mounting and replacement and/or relocation of cabinet components.
 13. An upper 3/4" thick stretcher shall be located behind the back panel and attached between the end panels with mechanical fasteners. This stretcher is also fastened to the full sub-top thus capturing the back panel.
- B. Base Cabinet Construction:
1. All base cabinets, except sink cabinets, shall have a solid 3/4" thick sub-top of core (as specified above), fastened between the ends with interlocking mechanical fasteners.
 2. Sink cabinets with a split removable back panel shall have a formed metal front brace, and steel corner gussets shall be utilized to support and securely fasten top in all four corners. Front brace shall be powder coated black.
- C. Tall Cabinet Construction:
1. All tall cabinets shall be provided with an intermediate fixed shelf to maintain internal dimensional stability under heavy loading conditions as well as an intermediate 3/4" thick stretcher located behind the back panel and be secured between the cabinet ends with mechanical fasteners. The stretcher shall be secured to the shelf through the back with #8 x 2" plated flat head screws.
- D. Wall Cabinet Construction:
1. All wall cabinet bottoms shall be 1" thick core particleboard, mechanically fastened between end panels and secured to the bottom back stretcher.
 2. A lower 3/4" thick stretcher shall be located behind the back panel and attached between the end panels with mechanical fasteners. The stretcher is also secured through the back and into the cabinet bottom.
 3. All wall cabinet exterior bottoms shall be: Match Standard Interior.
 4. All wall cabinet tops shall be: 3/4" thick.
- E. Tall and Wall Cabinet Top Edges shall be Raw.
- F. Tall, Wall and Hutch Tops shall be CLS to Match Standard Interior.
- G. Tall, Wall and Hutch Upper Door Reveal shall be standard - 15mm Reveal.
- H. Toe Base of Cabinet:
1. Individual finished bases shall be constructed of 3/4" thick marine grade plywood, factory applied to base and tall cabinets and shall support and carry the load of the end panels, and the cabinet bottom, directly to the floor. The base shall be let in from the sides and back of the cabinet to allow cabinets to be installed tightly together and tight against a wall. All bases shall have finished facings unless rubber vinyl base covering is being furnished and applied by others. There shall be a front to back center support for all bases over 30" wide.

2. Toe Base Height: 96mm.
 3. Toe Base: Attached. **Cabinet sides to floor will NOT be allowed.**
- I. Drawer Fronts and Solid Doors:
1. All drawer fronts and solid door components shall be particleboard surfaced both sides for balanced construction.
 2. Options shall be HPL Door and Drawer Front Exterior and Grade CLS on Interior. Surfaces shall be HPL Grade VGS.
 - a. **Thermofused Laminate (Melamine) Will NOT Be Allowed.**
 3. Door and drawer front edge shall be 3mm PVC
- J. Drawer Boxes:
1. Drawer box constructed with a full 1/2" thick core shall be particleboard non-racking, non-deflecting platform bottom that is carried directly by "L" shaped, bottom mount drawer glides.
 2. Drawer box at finished interiors shall be Surface to Match Standard Interior
- K. Doors:
1. Solid Doors shall be 3/4" thick core.
 2. Glazed Doors, Framed shall be:
 - a. Hinged or sliding 3/4" thick, framed doors shall be Clear Acrylic Panels. Panels must be a minimum of 1/4" thick. Glazing panel shall be set into the doorframe without the use of a separate molding. Glazing shall be held in place with removable stops.
- L. Shelves:
1. Adjustable:
 - a. Adjustable shelves shall be particleboard.
 - b. Adjustable shelves in closed cabinets shall be 3/4" Shelves, 1" for Shelves Over 36" Wide and Open Cabinets.
 - c. All adjustable shelves in open cabinets shall be 1" thick, except for special use cabinets such as mail, cubical, instrument or locker type units.
 - d. Adjustable shelf edge on open & closed cabinets shall be .020" Match Edge at Front.
 2. Fixed:
 - a. Fixed shelves shall be particleboard.
 - b. Fixed shelves shall be 3/4" Shelves, 1" at Opens.
 - c. Fixed shelf surfaces on open & closed cabinets shall match Interior Selections.
- M. Countertops:
1. High-pressure decorative laminate, nominal 1-1/8" thick solid core conforming to NEMA Standard LD3-2005 and ANSI A161.2-1998.
 - a. General Purpose: HGS on horizontal surface.
 - b. Laminate bonded to M-2 Particleboard core with PVA rigid adhesives. Core shall be balanced with backing Grade BKL.
 - c. All joints shall be secured with biscuits for alignment and tight joint fasteners.
 - d. Provide 4" high back splashes with thickness matching countertop thickness where shown and at all ends abutting walls and adjacent cabinets.
 - e. Provide edges as 3mm PVC.

N. Specialty Products:

1. Instrument Storage Cabinets:

a. Shelves:

- I. Core shall be particleboard
- II. Surface shall be heavy-duty continuous thermoplastic, permanently bonded to core and tight fitting to cabinet back and end panels. Front edge of shelves and cabinet end panels shall be high impact radiused 3mm PVC

b. Doors:

- I. Grille doors shall be powder coated with a platinum finish and shall be attached to cabinet end panels by means of thru bolting.

c. Instrument Cabinet Interior Surface shall match Standard Interior

2.4 FINISHES

A. Plastic Laminate Casework Colors:

1. High Pressure Laminate is available in non-premium, non-specialty and manufacturers' standard suede finishes from our select laminate manufacturers, including:

- a. Wilsonart® in a "60" or "38" matte finish and Nevamar® in a "T" textured finish and Formica in a "58" finish and Pionite in an "N" finish.

- b. Color: Selected from manufactures standards.

2. Thermally Fused Melamine Laminate that meets performance requirements of ANSI/NEMA 3 LD – 2005 for GP-28.

- a. Natural Almond (Wilsonart D30) or Fashion Grey (Wilsonart D381) or Frosty White (Wilsonart 1573).

3. Cabinet Liner .020" thick, high-pressure cabinet liner conforming to ANSI/NEMA 3 LD – 2005, Grade CLS. Surface texture shall be similar to exterior finish.

- a. Color shall match interior.
- b. Almond or Grey or White.

B. Plastic Laminate Countertop Colors:

1. Same as listed for Plastic Laminate Casework colors

C. Accessories:

1. Hinges: 5-Knuckle Hinge: Three finishes are available as standard in epoxy powder coat: black, almond or platinum

2. Pulls: Aluminum Wire Countertop Supports shall be in one of our standard colors - light grey, light neutral, black or White

3. Round Grommet shall be in one of our standard colors - black, almond, grey or white.

2.5 ACCESSORIES

A. Hardware:

1. Hinges:

- a. 5-Knuckle Hinges: Hinges shall be .095" thick steel five-knuckle hospital-tip, institutional Grade (Grade 1 per ANSI/BHMA A156.9) quality with .187" diameter tight pin. Each hinge shall be secured with a minimum of nine No. 8 screws. Hinge shall permit door to swing 270 degrees without binding. Doors less than 48" in height shall have two hinges. Doors over 48" in height shall have three hinges

2. Pulls:
 - a. One pull shall be located at the centerline of the drawer, regardless of width, to ensure ease of operation and maximize drawer slide life.
 - b. Anodized aluminum wire pull, 8mm diameter with 96mm O.C. mounting holes
3. Drawer Slides:
 - a. Self-closing, bottom mount epoxy coated with captive roller and positive in stop. Slide shall have 100 lb. load rating, must be self-closing and must prevent drawer fronts from contacting the cabinet body. Drawer slides must meet or exceed Grade 1 requirements per ANSI A156.9/BHMA with full extension slides on file and paper storage.
 - b. File drawer: Full extension, bottom mount epoxy coated with captive roller and positive in stop. Slide shall have 100lb. load rating, must be full extension, and prevent drawer fronts from contacting the cabinet body. Drawer slides must meet or exceed Grade 1 requirements per ANSI/BHMA.
4. Shelf Clips:
 - a. Plastic: Shelf clips shall be injected molded clear plastic, with a double pin engagement 32mm on center and shall have 3/4" and 1" anti-tip locking tabs as approved in AWI 400B-T-9 for premium Grade.
5. Coat Hooks shall be Zinc plated, single prong and double prong.
6. Closet Rods shall be Zinc plated rod, 1" diameter with captive sockets.
7. Mirrors:
 - a. Teacher wardrobe mirrors to be 8" x 10".
8. Locks:
 - a. For **all** doors, drawers, cabinets and any other.
 - b. Lock Type: National: Five disc tumbler cam locks, chrome plated steel faceplate. All locks keyed alike or keyed differently by room and master keyed. Shall permit a minimum of 50 keying options. Lock core is removable permitting owner to easily change lock arrangements. Inactive door of base and wall cabinets shall be secured by using an elbow catch, or a chain pull for tall cabinets
9. Catches:
 - a. Catches shall be magnetic at Base and Wall, 1 Roller at Tall
10. Countertop Supports:
 - a. Powder coated, formed metal supports. Must provide attachment points between countertop and wall.
11. Computer Grommets: Shall be 2 ½ inch dia. plastic insert and cover to be located at each computer station.

PART 3 – EXECUTION

3.1 INSTALLERS

- A. Installation shall be by the casework manufacturer's authorized representative.

3.2 INSTALLATION

- A. Casework shall not be installed until concrete, masonry, and drywall/plaster work is dry.
 1. If ambient conditions are not met at the time of requested delivery, the general contractor or owner must provide Case Systems a letter that releases manufacturer from any liability and responsibility from any warranty or damage resulting from not complying with required ambient conditions.

- B. Casework shall be installed plumb and true and is to be securely anchored in place.
- C. The casework contractor shall verify all critical building dimensions prior to fabrication of casework.
- D. Provide all labor for unloading, distribution, and installation of casework and related items as specified.
- E. All casework shall be securely anchored to horizontal wall blocking, not to plaster lathe or wall board.
- F. The casework manufacturer shall re-configure the casework arrangements to dimensions requiring 2-1/2" or less of filler at each end of wall-to-wall elevations, and to ensure a complete and satisfactory installation.
- G. The casework installer shall remove all debris, sawdust, scraps, and leave casework spaces clean.
- H. All casework must be installed by casework installer plumb and level, adjust all doors, drawers and hardware to comply with manufacturers specifications and operate properly.

END OF SECTION

DIVISION 13 SPECIFICATIONS



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SECTION 13930

WET-PIPE FIRE-SUPPRESSION SPRINKLERS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connection.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.
7. Backflow preventer

1.2 DEFINITIONS

- Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig (1200 kPa) maximum.

1.3 SYSTEM DESCRIPTIONS

- ###### A. Wet-Pipe Sprinkler System:
- Automatic sprinklers are attached to piping, containing water, that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS

- ###### A. Standard-Pressure Piping System Components:
- Listed for 175-psig (1200-kPa) minimum working pressure.
- ###### B. Design:
- Design sprinkler system, including comprehensive analysis, using performance requirements and design criteria indicated.
- ###### C. Sprinkler system design must be approved by all authorities having jurisdiction.
1. Sprinkler Occupancy Hazard Classifications: Comply with NFPA 13 (2016)
 2. Minimum Density for Automatic-Sprinkler Piping Design: Comply with NFPA 13 (2016). Exceptions may be applied as allowed by NFPA 13 (2016).
 3. Maximum Protection Area per Sprinkler: Per UL listing and per NFPA 13 (2016).
 4. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 (2016) unless otherwise indicated:

1.5 SUBMITTALS

- A. Product Data: Fire sprinkler contractor shall submit factory generated data for each type of product proposed to be used. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Choice of options shall be clearly indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, wiring diagrams, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Domestic water piping.
 - 2. HVAC ductwork and piping.
 - 3. Items penetrating finished ceiling including, but not limited to, the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Alarm Components
- D. Qualification Data: For qualified Installer.
- E. Approved Sprinkler Piping Drawings: Working plans, (ACAD 2010 Edition or higher), prepared according to NFPA 13 (2016) Chapter 23, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- F. Welding certificates.
- G. Fire-hydrant flow test report. Submitted hydraulic calculations must be based on results of test conducted within 12 months previous to submittal.
- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 (2016). Include "Contractor's Material and Test Certificate for Aboveground Piping."
- I. Field quality-control reports shall be regularly generated and delivered to the General Contractor, Architect, and Owner's representative.
- J. Operation and Maintenance Data: For sprinkler system specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire sprinkler systems, in compliance with specified code standards, and requirements of all authorities having jurisdiction.
- B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Code Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13 (2016 Edition) "Installation of Sprinkler Systems."
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 and marked for intended location and application.
3. International Fire Code (2015 Edition).
4. International Building Code (2015 Edition).

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings including, but not limited to, light fixtures, electrical equipment, HVAC equipment, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Comply with NFPA 13 (2016).
1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 (2016) and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" section, in this specification, for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Schedule 40 Black-Steel Pipe: ASTM A 135; ASTM A 795/A 795M, Type E; or ASME B36.10M, wrought steel; with wall thickness not less than Schedule 40. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller.
- C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Uncoated, Steel Couplings: ASTM A 865, threaded.
- E. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. National Fittings, Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
2. Pressure Rating: 250 psig (1725 kPa) minimum.
3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).

B. Ball Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Anvil International, Inc.
 - b. Victaulic Company.
 - c. Nibco Inc.
 - d. Milwaukee Valve Company
2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Fivalco Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Bronze.
5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Global Safety Products, Inc.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.
6. End Connections: Grooved.

E. Check Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. Potter Roemer.
 - e. Reliable Automatic Sprinkler Co., Inc.
 - f. Tyco Fire & Building Products LP.
 - g. Watts Water Technologies, Inc.
2. Standard: UL 312.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Milwaukee Valve Company.
 - c. NIBCO INC.
 - d. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig (1200 kPa).
4. Body Material: Bronze.
5. End Connections: Threaded.

G. Indicating-Type Butterfly Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Anvil International, Inc.
 - b. Global Safety Products, Inc.
 - c. Milwaukee Valve Company.
 - d. NIBCO INC.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Valves NPS 2 (DN 50) and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
5. Valves NPS 2-1/2 (DN 65) and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

H. NRS Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Mueller Co.; Water Products Division.
 - c. NIBCO INC.
 - d. Tyco Fire & Building Products LP.
2. Standard: UL 262.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Body Material: Cast iron with indicator post flange.
5. Stem: Non-rising.
6. End Connections: Flanged or grooved.

2.4 TRIM AND DRAIN VALVES

A. General Requirements: Angle, Ball, and Globe valves:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig (1200 kPa) minimum.
3. Body material: Bronze

4. End Connections: Threaded

B. Angle Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

C. Ball Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Milwaukee Valve Company.
 - b. NIBCO INC.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Watts Water Technologies, Inc.

D. Globe Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Fire Protection Products, Inc.
 - b. United Brass Works, Inc.

2.5 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Globe Fire Sprinkler Corporation.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.

C. Automatic (Ball Drip) Drain Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. AFAC Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4 (DN 20).
6. End Connections: Threaded.

D. Dual Check Backflow Preventer: BFP shall meet the requirements of the water authority having jurisdiction and shall be UL and FM approved. BFP assembly shall include inlet and outlet OS&Y gate valves with waterproof tamper alarm switches. Coordinate with electrical contractor for connections to fire alarm system.

2.6 SPRINKLER SPECIALTY PIPE FITTINGS

A. Sprinkler System Inspector's Test Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Triple R Specialty.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - e. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig (1200 kPa) minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

B. Adjustable Drop Nipples:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. CECA, LLC.
 - b. Corcoran Piping System Co.
 - c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig (1725 kPa) minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

C. Flexible, Sprinkler Hose Fittings:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Fivalco Inc.
 - b. FlexHead Industries, Inc.
 - c. Gateway Tubing, Inc.
 - d. Easyflex
2. Standard: UL 1474.
3. Type: Flexible tube or braided flexible hose for connection to sprinkler, with factory furnished bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Size: Same as connected piping, for sprinkler.

2.7 SPRINKLERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Quick-Response, (Unless noted otherwise).
2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch (12.7-mm) orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Guards:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

- a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
- 2. Standard: UL 199.
 - 3. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators (Flow Switches):

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. McDonnell & Miller; ITT Industries.
 - b. Potter Electric Signal Company.
 - c. Viking Corporation.
 - d. Watts Industries.
- 2. Standard: UL 346.
- 3. Water-Flow Detector: Electrically supervised.
- 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
- 5. Type: Paddle operated.
- 6. Pressure Rating: 250 psig (1725 kPa).
- 7. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches: (Tamper Switches)

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
- 2. Standard: UL 346.
- 3. Type: Electrically supervised.
- 4. Components: Single-pole, double-throw switch with normally closed contacts.
- 5. Design: Signals that controlled valve is in other than fully open position.
- 6. Tamper switches installed on backflow preventer control valves, in concrete vault on site, shall be waterproof.

2.9 PRESSURE GAGES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on drawings or comparable product by one of the following:

1. Ashcroft, Inc.
2. Brecco Corporation.
3. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch (90- to 115-mm) diameter.

D. Pressure Gage Range: 0 to 250 psig (0 to 1725 kPa) minimum.

E. Water System Piping Gage: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations.

B. Report fire hydrant flow test results promptly and in writing, to owner, architect, system design engineer, and all authorities having jurisdiction.

3.2 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to underground water-service for service entrance to the protected building. Underground water service shall be provided and installed, to within 5'-0" of the fire sprinkler riser room, by the civil utility's contractor. Coordinate with the utilities contractor to verify required flushing and testing of underground service has been performed and recorded, prior to making final connection.

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping. See sprinkler control riser detail on drawings.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from the design engineer, architect, and authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13 (2016).

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13 (2016).
- G. Install sprinkler piping with main and auxiliary drains for complete system drainage.
- H. Install alarm devices in piping systems.
- I. Install hangers and supports for sprinkler system piping according to NFPA 13 (2016). Comply with requirements for hanger materials in NFPA 13 (2016).
- J. Install pressure gages on riser or feed main, at each sprinkler test connection, and where otherwise indicated on design drawings. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing. See sprinkler system control riser assembly details on design drawings.
- K. Fill sprinkler system piping with water.
- L. Install escutcheons for exposed piping penetrations of walls, ceilings, and floors.
- M. Install fire stopping at all penetrations of fire rated structure in order to maintain the rating of that structure. Coordinate with architect and general contractor for the location and ratings of fire and smoke barriers.

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems. Provide dielectric adapters where required to protect adjacent piping.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 (2016), approved design drawings, and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control all sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve. Signs must comply with the requirements of approved design documents, authorities having jurisdiction, the owner's representative, the owner's insurance underwriters, and NFPA 13 (2016).
- C. Install check valve in each water-supply connection.
- D. Dual check backflow preventer shall be installed, by the site utilities contractor, on the fire water service in a concrete vault. Coordinate with site utilities contractor and all authorities having jurisdiction.
- E. Fire Department Connection shall be pedestal type, installed by the site utilities contractor, downstream of the backflow preventer. Coordinate with site utilities contractor and all authorities having jurisdiction.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.
- B. Install dry barrel sprinklers, with water supply from heated space, for protection of areas subject to freezing. Dry barrel lengths and installation shall comply with NFPA 13 (2016) requirements. Do not install wet-type sprinklers in areas subject to freezing.
- C. Flexible drop assembly (arm-over/sprinkler head connections), fabricated of flexible metal tube or flexible braided hose, are acceptable.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals, in compliance with NFPA 13 (2016), International Fire Code (2015), International Building Code (2015), authorities having jurisdiction, owner' requirements, and the requirements of the owner's insurance underwriters.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections. Comply with NFPA 25 (most current edition).

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13 (2016), "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports and deliver copies to Architect, Owner, and authorities having jurisdiction.

3.9 **DEMONSTRATION**

- A. Train Owner's maintenance personnel to adjust, operate, and maintain system. Create a list of personnel receiving training and provide a copy to the owner's representative.
- B. Provide a copy of NFPA-25 "Standard for the Inspection, Testing, and Maintenance of Water-based Fire Protection Systems," to the Owner's representative.

3.10 **CLEANING**

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.11 **PIPING SCHEDULE**

- A. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller, shall be one of the following:
 1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- B. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 6, shall be one of the following:
 3. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 4. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.9 **SPRINKLER SCHEDULE**

A. Use sprinkler types below for the following applications:

1. Rooms without ceilings (open to structure): Upright sprinklers. Rough brass.
2. Rooms with hard ceilings: Pendent; Concealed; Rough Brass; Factory painted off-white cover plate. Sprinklers shall be centered in relation to lights and HVAC grilles. Provide extra sprinklers in order to meet this requirement. Consult architectural reflected ceiling plan. Coordinate with all disciplines. The Design Engineer shall make the final decision for number and location of sprinklers.
3. Rooms with suspended ceilings: Pendent; Recessed; Factory painted off-white. Sprinklers shall be centered in ceiling tiles. Provide extra sprinklers in order to meet this requirement. Consult architectural reflected ceiling plan. Coordinate with all disciplines. The Design Engineer shall make the final decision for number and location of sprinklers.
4. Wall Mounting: Sidewall; Pendent; Factory off-white finish (unless noted otherwise).
5. Porch areas subject to freezing: Dry barrel sidewall sprinklers connected to wet system piping located in heated space. Dry barrel lengths shall comply with NFPA 13 (2016).
6. Provide factory escutcheons to match sprinklers.

3.13 PROJECT CLOSE-OUT

- A. Prior to issuance of certificate for final payment, submit to Architect and obtain his approval of the following:
 1. A letter signed by the subcontractors for fire sprinkler and electrical work stating that they have jointly checked each power circuit, alarm circuit, and control circuit, and mutually agree that each item is properly wired, and that power, alarm, and control circuits function properly.
 2. Record Drawings (As-Built Drawings) – Fire sprinkler piping (ACAD 2010 or higher).
 3. Record Drawings (As-Built Drawings) – Fire sprinkler head locations (ACAD 2010 or higher).
 4. Water and Air Pressure tests for fire sprinkler systems.
 5. Equipment Submittal Data (3 copies).
 6. Equipment Operating and Maintenance Manuals (3 copies).
 7. Maintenance Schedule (3 copies).
 8. Equipment Warranty dates and Guarantee (3 copies).
 9. List of Owner's Personnel who have received maintenance training.

END OF SECTION

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DIVISION 15 SPECIFICATIONS



A New Auditorium for
Straughn High School for the
Covington County Board of Education

MCKEE PROJECT NO. 20-168

DIVISION 15 SEAL PAGE
1 of 1

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SECTION 15050 - GENERAL HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for the HVAC systems.

1.2 QUALIFICATIONS OF SUB-CONTRACTORS

- A. Must be properly licensed and established as a Heating and Air Conditioning Contractor at the location of the work and shall maintain locally adequate service facilities. He shall have had previous experience in the satisfactory installation of at least three systems of this type and size.

1.3 SCOPE

- A. Include all equipment, material and labor required for complete operation of heating, air conditioning and ventilation systems, even though every item involved is not indicated. Included in the scope but not limited by the scope are the following complete new operating systems.

1.4 CODES

- A. Comply with applicable 2015 International Building Code, 2015 International Mechanical Code and 2013 ASHRAE 90.1 requirements and conform to ordinances and codes of the locality. Where conflicts occur between code and construction drawings or specifications, most stringent requirements shall apply. Any work provided contrary to these requirements shall be removed and replaced at contractor's expense.

1.5 PERMITS

- A. Provide all permits and arrange for inspections as required by local, city, county and state authorities. Furnish certificate of final inspection from local building inspector indicating that installation complies with all regulations governing the same. Provide additional materials, parts, labor, etc. and modify the work as required by city and state inspections and regulations.

1.6 DRAWINGS

- A. In the interest of clearness, the work is not always shown to scale or exact location. Check all measurements, location of pipe, ducts, and equipment with the detail architectural, structural, and electrical drawings, and lay out work so as to fit with ceiling grids, lighting, and other parts. Where doubt arises as to the meaning of the plans and specifications, obtain the Architect's decision before proceeding with parts affected; otherwise assume liability for damage to other work and for making necessary corrections to work in question.
- B. The Plans are not intended to show all ductwork, pipes valves, fittings, connections, and details of the work to be done. The piping, duct and equipment locations shall be adhered to as closely as possible; however, any changes necessary to avoid columns, beams, lighting fixtures, ductwork, sprinkler piping, etc., shall be made at no additional cost to the owner. Do not scale plumbing or HVAC drawing. Refer to Architectural drawings for dimensions.

1.7 CHANGES AND CONFLICTS

- A. If during construction desirable or necessary changes become apparent, advise the Architect, and secure his decision in writing. Otherwise make no deviation from the system as detailed.

1.8 WARRANTY

- A. Contractor shall provide a one-year full parts and labor warranty for materials and workmanship for all items starting at substantial completion of entire project. The following items, but not

limited to the following, shall have extended warranties remain in effect past the one-year warranty. All warranty shall start at substantial completion of entire project.

1. AC Equipment:

Provide one-year parts and labor warranty for entire system.

Provide five-year parts and labor warranty for compressors.

2. Control System - Provide two-year parts and labor warranty for entire system.

3. Filters - Contractor shall change all filters every two months for first year.

1.9 MISCELLANEOUS REQUIREMENTS

A. Materials and Equipment: New and of best quality in every respect. All pipes and fittings shall conform to the ASTM Standard designated for pipe of each material.

Equipment shall be essentially the standard product of the manufacturer and shall be UL approved where required by Code. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be.

B. Listed Equipment: Being listed as "A supplier of comparable products" means the listed manufacturer will receive consideration if in accordance with all documents, delivery, and space requirements. Being listed does not indicate nor imply the manufacturer's equipment is acceptable for the project. Only the "Base" manufacturer's equipment has been verified for compliance with the documents. The burden of approval of the equipment rests solely with the contractor.

C. Equipment Protection: Protect during construction, duct openings against the entrance of foreign materials and protect all equipment from damage by mortar, paint, weather, etc. Damaged equipment shall be replaced at no expense to project. Make provisions to protect equipment.

D. Finishes: Manufacturer's standard unless otherwise stated. Submit color cards for selection where such choice is specified or available.

E. Charges, Grease, Filters, Etc.: Furnish first charges of refrigerant grease, oils, etc., and be responsible for such full charges for the guarantee period, except when loss is due to negligence of Owner. Where disposable type filters are specified, furnish two sets for each air conditioning unit; one set to be used during test period, other set to be installed just prior to occupancy. Contractor shall change all disposable filters every two months for first year. Sets of filters to be installed during one-year guarantee period. Where permanent type is specified, provide disposable type for testing and operating prior to occupancy. Provide Owner a typed list (O & M Manual) of all filter sizes and required quantity.

F. Cleaning and Adjusting: Upon completion of work, clear drains, traps, ducts, and pipelines. Adjust all valves, remove rubbish, and leave work in clean and operating condition. Install final permanent type filters only after cleaning of building is completed.

G. Cutting and Patching: Openings are to be laid out and built in; furnish detailed layout drawings to other trades in advance of their work. Piping within or behind walls must be installed before wall is erected.

Otherwise, walls, etc. affected must be reworked by trade which erected same at expense of HVAC Contractor; chasing and cutting of new work will not be accepted. HVAC Contractor shall prepare shop drawings of required opening to General Contractor and Architect for review.

H. Foundations: Provide foundations, supports, etc., not specified under other Sections, and as required to mount equipment in a workman like and structurally sound manner. Consult drawings pertaining to other trades to determine extent of their work.

- I. Roof Flashing: Roofing work is specified under Roofing Section. Roofer shall be advised of all requirements and all furnished items to be installed before roofing is installed. Roofer shall install all mechanical roof penetration and provide full roof warranty.
- J. Vibration and Noise Control: All items of mechanical equipment including air handling units, and fans shall be properly isolated from the structure by means of approved vibration absorbing accessories, foundations or supports.
Elimination of objectionable vibration and noise is the responsibility of the Contractor, who must provide all foundations, isolators, flexible connections, etc., required thereby. Pay special attention to vibration problems at year end inspection and correct all deficiencies noted.
- K. Operating and Maintenance Instructions: Provide the services of a competent person to thoroughly instruct representatives appointed by the owner in the proper operation and care of all equipment and control systems. Furnish a complete set of Operating and Maintenance (O & M Manuals) instructions in 3 copies (including equipment data, spare parts lists, operating instructions, filter sizes, valves services, control, and wiring diagrams) in bound folder form prior to final acceptance. O & M Manuals, Test and Balance report to be submitted 2 weeks prior to final inspection.
- L. Painting and Finishing: Clean and paint with two coats of asphalt varnish all exposed ferrous metal parts of mechanical equipment located above ceilings, etc.). Surfaces in finished areas are to be painted by Painting Contractor. Where factory finished items are marred or scratched item must be replaced, or upon approval, may be refinished or touched-up as required to bring to a like-new condition.
- M. Where device occurs above a lift-out acoustical ceiling panel, identify the panel with a 3/8" #8 round head self-threading sheet metal screw, screwed into panel with only the head showing. Before inserting, paint head of screw with appropriate color as specified under Pipe Identification and Color Coding. Furnish sample for approval.
- N. Dis-similar Metal: Separate all dis-similar metals as required for services. Dis-similar metal shall not touch.
- O. Coordination:
 - 1. Mechanical contractor shall submit written verification that he has coordinated all electrical requirements for HVAC with electrical subcontractor. Written document shall indicate any difference between design requirements and actual verified requirements and shall recommend solutions to any conflicts found. Refer to "EXAMPLE" form at end of this section.

NOTE: Mechanical submittals will not be reviewed without this document included.

PART 2 – PRODUCTS (not applicable)

PART 3 – EXECUTION (not applicable)

END OF SECTION

See Attachment A

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SECTION 15050 - ATTACHMENT "A"

A New Auditorium for
Straughn High School for the
Covington County Board of Education

MCKEE PROJECT NO. 20-168

ATTACHMENT "A"

1 of 1

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Morris Engineering LLC

James H. Morris, P.E. - Mechanical

903 South Perry Street
 Montgomery, AL 36104
 TEL. 334-269-0329 FAX 334-269-1559

COORDINATION OF ELECTRICAL REQUIREMENTS FOR HVAC AND PLUMBING EQUIPMENT

PROJECT: XYZ High School - Montgomery, AL DATE: 1-10-11

EQUIP. MARK	DESIGN CHARACTERISTICS				SUBMITTED REQUIREMENTS				CHANGE REQ'D (Y/N)	RECOMMENDED SOLUTION		
	V/PH	HP/A/KW	CKT BKR	DISC SW	FEEDER SIZE	V/PH	HP/A/KW	CKT BKR			DISC SW	FEEDER SIZE
AH-1	208/3	2 HP	15/3P	30A3P	3#12 & 1#12(G)-1/2" c	208/3	3 HP	20/3P	30A3P	3#12 & 1#12(G)-1/2" c	Y	Change 15/3 CB to 20/3 CB
AH-2	208/3	5 HP	40/3P	60A3P	3#8 & 1#10(G)-3/4" c	208/3	5 HP	40/3P	60A3P	3#8 & 1#10(G)-3/4" c	N	
ACCU-7	208/3	45.3A	60/3P	60A3P	3#6 & 1#10(G)-3/4" c	208/3	43.7A	60/3P	60A3P	3#6 & 1#10(G)-3/4" c	N	
ACCU-9	208/3	15.2A	20/3P	30A3P	3#12 & 1#12(G)-1/2" c	208/3	18.1A	30/3P	30A3P	3#10 & 1#10(G)-3/4" c	Y	See Note 1 below.
CH-1	480/3	155A	200/3P	N/A	3#3/0 & 1 #6(G)-2" c	480/3	183A	250/3P	N/A	3#250M&1#4(G)-2 1/2" c	Y	See Note 2 below.

- NOTES:**
- ACCU-9 - Change 20/3P CB to 30/3P CB and change circuit to 3#10&1#10G-1/2" c.
 - CH-1 - Change 200/3P CB to 250/3P CB and change circuit to 3#250 MCM&1#4G-2 1/2" c.

The above referenced contractors have coordinated all electrical requirements for the HVAC and plumbing equipment and agree to all changes. The mechanical and plumbing contractors acknowledge that they are responsible for any cost difference for the electrical contractor's changes.

James Doe
 Electrical Contractor

Henry Smith
 Mechanical Contractor

Joe Thomas
 Plumbing Contractor

ABC Electric, Inc.
 Company

Smith Heating & Air
 Company

Joe's Plumbing Company
 Company

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SECTION 15052

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Equipment installation requirements common to equipment sections.
 - 8. Concrete bases.
 - 9. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 15 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
- C. Pressure Plates: Carbon steel. Include two for each sealing element.
- D. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink, and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- N. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 4. PVC Non-pressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel, and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.8 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout on concrete bases and provide smooth bearing surface for equipment.
- F. Place grout around anchors.
- G. Cure placed grout.

3.9 GENERAL

- A. General and Special Conditions: Refer thereto for all applicable provisions.
- B. Scope: Include all equipment, material and labor required for complete operating plumbing, and gas, even though every item involved is not indicated.
- C. Codes: Comply with 2015 International Plumbing Code, 2015 International Building Code, ADA, LEED specifications sections 18A through 18D, and OSHA of the locality. Where conflicts occur between code and contract drawings or specifications, most stringent requirements shall apply.
- D. Qualifications: Sub-contractor shall be licensed plumber and gas pipe fitter in the locality.
- E. Permits: Provide all permits and arrange for inspections as required by city, county, and state authorities.

- F. Drawings: In the interest of clearness, the work is not always shown to scale or exact location. Check all measurements, location of pipe, fittings, and equipment with the detail architectural, structural, and electrical drawings and layout work so as to fit in with other parts. Where doubts arise as to the leaning of the plans and specifications, obtain the Architect's decision before proceeding with parts as may be affected; otherwise, the Contractor shall be liable for damage to work and for removing and repairing his own work in proper manner.
- G. Changes: If during construction, desirable or necessary changes become apparent, advise the architect, and secure his decision in writing. Otherwise make no deviation from the system as detailed.
- H. Existing Conditions: Bidders shall visit site and become acquainted with all job conditions. No consideration will be given after bid opening for alleged misunderstanding regarding utility connections, permits, fees, etc.
- I. Prior Approval: Bidders shall submit equipment for prior approval 10 days before bid date.
- J. Warranty: Guarantee in writing to make good without cost any defects in materials and workmanship within one year from the date of acceptance of project.
- K. Low – Emitting Materials – Adhesives and Sealants: All adhesives and sealants shall comply with LEED 2015 for New Construction Reference Guide. See credits IEQ4.1 and IEQ4.2.
- L. Low – Emitting Materials – Paints and Coatings: All paints and coatings shall comply with LEED 2015 for New Construction Reference Guide. See credits IEQ4.1 and IEQ4.2.
- M. Submittals:
 - 1. Within 25 days the award of the contract and before any orders are planned, the contractor shall submit to the Architect for approval seven (7) copies of a complete list of all proposed materials and all equipment, include catalog data, capacities, model numbers, any accessories, and any pertinent information to indicate full compliance with specification and drawings. Partial list will not be accepted. Rejected items shall be resubmitted until approval has been obtained.
 - 2. The contractor shall submit shop drawings on the following items but not limited to the following items.
 - a. List of proposed materials and equipment.
 - b. Letter stating coordination of plumbing, mechanical and electrical work, signed by plumbing, mechanical, electrical, and general contractors. Submittals and shop drawings will not be reviewed without receipt of this item.
 - c. Shop drawing showing coordination of Plumbing and Electrical.
 - d. Showing drawing of Plumbing of a scale of not less than 1/8-inch equals one foot. The drawing shall show coordination with all HVAC, lighting, conduit, equipment, & etc.
 - e. Pipe hanger shop drawings including methods of attachment to structure anchors.
 - f. Schedule of insulation to be used including thickness. Submittal literature on all insulation, mastics, and materials. Include flame spread and smoke developed ratings.
 - g. Access panels.
 - h. Notify Architect of all pressure tests to be preformed.
 - i. Water closets and accessories.
 - j. Lavatories and accessories.

- k. Urinals and accessories.
- l. Type water piping and accessories (interior and exterior)
- m. Type sanitary drain and vent piping and accessories
- n. Water heaters and accessories.
- o. Cleanouts (wall, floor, etc.)
- p. Floor drains
- q. Valves
- r. Water hammer arrestor
- s. Hydrants
- t. Trap Guard & Trap Primer
- u. Mop basin and accessories.
- v. Sinks and accessories.

3.10 PROJECT CLOSE-OUT:

- A. Prior to issuance of certificate for final payment, submit to Architect and obtain his approval of the following:
 - 1. A letter signed by the subcontractors for plumbing and electrical work stating that they have jointly checked each power circuit and control circuit and mutually agree that each item is properly wired, and that controls and power circuits will function properly.
 - 2. Record drawings – waste and vent piping (ACAD 2015 or higher).
 - 3. Record drawings – water piping (ACAD 2015 or higher).
 - 4. Record drawings – gas, and miscellaneous systems (ACAD 2015 or higher).
 - 5. Loose tee keys for wall hydrants shall be turned over to owner.
 - 6. Water/Air pressure test for waste and water systems.
 - 7. Equipment submittal data (3). Furnish in searchable .pdf format.
 - 8. Equipment Operating and Maintenance Manuals (3).
 - 9. Maintenance schedule (3).
 - 10. Equipment warranty dates and guarantee (3).
 - 11. List of Owner's Personnel who have received maintenance training.

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SECTION 15057

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small, and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.

- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.

3. Capacitors start, inductor run.
 4. Capacitors start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
 - C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 - D. Motors 1/20 HP and Smaller: Shaded-pole type.
 - E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

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SECTION 15061

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Equipment supports.
- B. See Division 5 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.3 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
 - 3. Powder-actuated fastener systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze pipe hangers. Include Product Data for components.
 - 2. Metal framing systems. Include Product Data for components.

3. Equipment supports.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

- B. Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- (690-kPa-) minimum, compressive-strength insulation inserts encased in sheet metal shield.

- B. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head.
 - c. MasterSet Fastening Systems, Inc.
 - d. MKT Fastening, LLC.
 - e. Powers Fasteners.
- B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Non-staining noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F (49 to 232 deg C) pipes, NPS 4 to NPS 16 (DN 100 to DN 400), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24 (DN 20 to DN 600), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36 (DN 100 to DN 900), with steel pipe base stanchion support and cast-iron floor flange.
 - 7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30 (DN 25 to DN 750), from 2 rods if longitudinal movement caused by expansion and contraction might occur.
 - 8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42 (DN 50 to DN 1050), if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20 (DN 20 to DN 500), if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).
 - c. Heavy (MSS Type 33): 3000 lb (1360 kg).
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 1. Install powder-actuated fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood inserts.
 - 6. Insert Material: Length at least as long as protective shield.
 - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedure for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

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SECTION 15076

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.

1.2 SUBMITTAL

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Pre-coiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.3 VALVE TAGS

- A. All valves except equipment service valves shall be equipped with engraved laminated plastic valve tags secured with chains to valve yoke or stem (not handles). Tags shall be 2" x 3" with 1/2" high red numbers on white background. Locate numbers at one end of tag leaving room for future engraving by others. Number tags in sequence from lowest to highest point in building starting with number 1. In each equipment room provide framed valve chart showing number and location of each valve and type of service. Identify location of equipment, valves, etc. above ceilings as specified under 1510 B.6.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 9 Section "Interior Painting." Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Domestic Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
2. Storm Drainage Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
3. Domestic Hot Water Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.
4. Gas Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

- C. All valves except equipment service valves shall be equipped with engraved laminated plastic valve tags secured with chains to valve yoke or stem (not handles). Tags shall be 2" x 3" with 1/2" high red numbers on white background. Locate numbers at one end of tag leaving room for future engraving by others. Number tags in sequence from lowest to highest point in building starting with number 1. In each equipment room provide framed valve chart showing number and location of each valve and type of service. Identify location of equipment, valves, etc. above ceilings.

END OF SECTION

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SECTION 15077 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances.
 - 7. Fasteners: Stainless-steel self-tapping screws.
 - 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulates.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item (indoor and outdoor heat pump and mini-split units, and fans) of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 15082

PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Mineral fiber.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Field-applied jackets

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
 - 8. Detail field application for each equipment type.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 - 2. Type I, 850 deg F (454 deg C) Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.

- e. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - C.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto PVC Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- C. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.

2. Factory cut and rolled to size.
3. Finish and thickness are indicated in field-applied jacket schedules.
4. Moisture Barrier for Indoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
5. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.
6. Factory-Fabricated Fitting Covers:
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - c. Tee covers.
 - d. Flange and union cover.
 - e. End caps.
 - f. Beveled collars.
 - g. Valve covers.
 - h. Field fabricates fitting covers only if factory-fabricated fitting covers are not available.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Handholes.

6. Cleanouts.

3.3 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 1. Comply with requirements in Division 7 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 7 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.6 FINISHES

- A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by the Contracting Officer. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect field-insulated equipment, randomly selected by the Contracting Officer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by the Contracting Officer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- B. Domestic Chilled Water (Potable): Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- C. Stormwater and Overflow: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.
- D. Roof Drain and Overflow Drain Bodies: Insulation shall be the following:
 - 1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

END OF SECTION

SECTION 15086 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 1. Supply air.
 - 2. Return air.
 - 3. Outdoor air.
- B. Related Sections:
 - 1. Division 15 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties, and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.
- C. Qualification Data: Independent insulation contractor.

1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

2.3 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 3. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 4. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 - 2. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 - 3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 4. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
 - 2. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
 - 3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 4. Color: White.

2.4 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
4. Color: Aluminum.

2.5 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches (75 mm).
 2. Thickness: 6.5 mils (0.16 mm).
 3. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.6 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm) wide with wing seal.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces, free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

- install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
- D. Insulation Installation at Floor Penetrations:
1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 2. Seal penetrations through fire-rated assemblies.

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not over compress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1-inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic

applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies.

3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 1. Supply air.
 2. Return air.
 3. Outdoor air.
- B. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Vibration-control devices.
 5. Factory-insulated access panels and doors.

3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Supply-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density. First 15' from AHU shall be internally lined with flexible elastomeric, 1" thick.
- B. Return-air duct insulation and outdoor air insulation shall be the following:
 1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft (12-kg/cu m) nominal density. First 15' from AHU shall be internally lined with flexible elastomeric, 1" thick.

END OF SECTION

SECTION 15088 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Refrigerant suction and hot-gas piping, indoors and outdoors.
 - 2. Condensates drain piping, indoors.
- B. Related Sections:
 - 1. Division 15 Section "Duct Insulation."

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application at linkages of control devices.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 / NFPA 255, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 FLEXIBLE ELASTOMERIC AND POLYOLEFIN ADHESIVES

- A. Basis-of Design Product: Subject to compliance with requirements, provide Armacell LLC; ArmaFlex 520 Adhesive or comparable product.
- B. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- C. Adhesive formulated for Flexible Elastomeric Insulation: Synthetic rubber base with synthetic resins, black air -drying contact adhesive, Comply with ASTM G21/C1338.

2.3 PIPE SUPPORTS

- A. Material: PET-foam load bearing core, flexible closed cell preformed insulation on the outer part for connection. Outside cladding made of PVC foil.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Mechanical systems shall be turned off before insulating piping. Wait 36 hours after insulating for the adhesive to cure before restarting mechanical system.
- B. Surface Preparation: Clean all dust, dirt, oil and water from pipework using denatured alcohol and dry surfaces prior to insulation. Remove materials that will adversely affect insulation application.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation shall comply with ASTM C1710 "Standard Guide for Installation of Flexible Closed Cell Preformed Insulation in Tube and Sheet Form"
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs. All joints shall be sealed with adhesive recommended by insulation material manufacturer. Do Not Tape
- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.

- J. Where pipe supports are required. Provide as specified and install per manufacturer's recommendations. Maintain a complete vapor barrier.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Insulation Installation on Pipe Fittings and Elbows:
 - 1. Install mitered sections of pipe insulation.
 - 2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- O. Insulation Installation on Valves and Pipe Specialties:
 - 1. Install preformed valve covers manufactured of same material as pipe insulation when available.
 - 2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 - 3. Install insulation to flanges as specified for flange insulation application.
 - 4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.

3.3 PIPING PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
- C. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.

3.4 PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping: Flexible elastomeric, black, 3/4-inch wall thickness.
- B. Condensate Drain Piping: Flexible elastomeric, 1/2 inch (13 mm) thick.

END OF SECTION

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SECTION 15093 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Concrete Slabs above Grade:
 - a. Galvanized-steel-pipe sleeves.
 - 2. Interior Partitions:
 - a. Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 15098 - ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.
- C. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- D. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type, or split-plate.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass, or split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass, or split-casting brass type with polished, chrome-plated finish.

- g. Bare Piping in Equipment Rooms: One-piece, cast-brass [or split-casting brass] type with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 15111

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Brass ball valves.
 - 2. Bronze ball valves.
 - 3. Bronze swing check valves.
 - 4. Bronze globe valves.
- B. Related Sections:
 - 1. Division 15 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 15 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
 - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

E. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Kitz Corporation.
 - d. Milwaukee Valve Company.
 - e. NIBCO INC.
 - f. Red-White Valve Corporation.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

2.3 BRONZE BALL VALVES

A. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Kitz Corporation.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.

- h. NIBCO INC.
2. Description:
- a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.4 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Red-White Valve Corporation.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
- a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly, gate, and globe valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.
 - 1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball valves.
 - 2. Throttling Service: Globe valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two-piece, full port, brass, or bronze with brass trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Globe Valves: Class 125, bronze disc.

3.5 SANITARY-WASTE AND STORM-DRAINAGE VALVE SCHEDULE

A. Pipe:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two-piece, regular port, brass, or bronze with brass trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Globe Valves: Class 125, bronze disc.

END OF SECTION

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SECTION 15126

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bimetallic-actuated thermometers.
 - 2. Liquid-in-glass thermometers.
 - 3. Thermowells.
 - 4. Dial-type pressure gages.
 - 5. Gage attachments.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product certificates.
- C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Ashcroft Inc.
 - 2. Miljoco Corporation.
 - 3. Terice, H. O. Co.
 - 4. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - 5. Weiss Instruments, Inc.
- C. Standard: ASME B40.200.
- D. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch (127-mm) nominal diameter.
- E. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F (deg C).
- F. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

- G. Connector Size: 1/2 inch (13 mm), with ASME B1.1 screw threads.
- H. Stem: 0.25 or 0.375 inch (6.4 or 9.4 mm) in diameter; stainless steel.
- I. Window: Plain glass.
- J. Ring: Stainless steel.
- K. Element: Bimetal coil.
- L. Pointer: Dark-colored metal.
- M. Accuracy: Plus, or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Miljoco Corporation.
 - b. Terice, H. O. Co.
 - c. Weiss Instruments, Inc.
 - 3. Standard: ASME B40.200.
 - 4. Case: Cast aluminum; 7-inch (178-mm) nominal size unless otherwise indicated.
 - 5. Case Form: Adjustable angle unless otherwise indicated.
 - 6. Tube: Glass with magnifying lens and blue organic liquid.
 - 7. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F (deg C).
 - 8. Window: Glass.
 - 9. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
 - 10. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.
 - 11. Accuracy: Plus, or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

- A. Thermowells:
 - 1. Standard: ASME B40.200.
 - 2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
 - 3. Material for Use with Copper Tubing: CNR.

4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Ashcroft Inc.
 - b. Miljoco Corporation.
 - c. Terice, H. O. Co.
 - d. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - e. Weiss Instruments, Inc.
3. Standard: ASME B40.100.
4. Case: Sealed type(s); cast aluminum or drawn steel; 6-inch (152-mm) nominal diameter.
5. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
6. Pressure Connection: Brass, with NPS 1/4 (DN 8), ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
7. Movement: Mechanical, with link to pressure element and connection to pointer.
8. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi (kPa).
9. Pointer: Dark-colored metal.
10. Window: Glass.
11. Ring: Metal.
12. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.
- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
- K. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.
- L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- M. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.

2. Industrial-style, liquid-in-glass type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F (Minus 20 to plus 50 deg C).

3.4 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:

1. Sealed, direct-mounted, metal case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:

1. Sealed, direct-mounted, metal case.

C. Pressure gages at suction and discharge of each domestic water pump shall be the following:

1. Sealed, direct-mounted, metal case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi (0 to 600 kPa).

END OF SECTION

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SECTION 15140

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Water meters.
4. Escutcheons.
5. Sleeves and sleeve seals.

B. Related:

1. New water service piping where water service piping enters the building.
2. Scope: Connect to new 2" water meter serving building and extend to all plumbing fixtures, etc. Provide gate valve in box, backflow preventer and PRV set at 60 PSI. Pay the water works for any and all cost for meter and connections.
3. Arrange with city for service connection to main, etc. pay city cost of service. Provide full size gate valve.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components.

C. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) and ASTM B 88, Type L (ASTM B 88M, Type B) water tube, annealed temper.
 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 SPECIALTY VALVES

- A. Comply with requirements in Division 15 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.5 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa) at 180 deg F (82 deg C).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

2.6 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- E. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge.
- F. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- G. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.7 SLEEVES

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

2.8 SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.9 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Non-shrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 15 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- G. Install domestic water piping level and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install thermostats in hot-water circulation piping.
- S. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 15 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.2 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 15 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 15 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for balancing valves.

3.4 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

3.5 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 "Plumbing Fixtures" for connection sizes.
 - 3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.

- B. Escutcheons for New Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split casting, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One-piece, cast brass with polished chrome-plated finish.
 5. Bare Piping in Equipment Rooms: One-piece, stamped steel with set screw or stamped steel with spring clips.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches (50 mm) above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Comply with requirements in Division 7 Section "Sheet Metal Flashing and Trim" for flashing.

3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
 - b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 (DN 150) and larger.
 - c. Install sleeves that are large enough to provide 1-inch (25-mm) annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Penetration Firestopping" for firestop materials and installations.

3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections, and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.13 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.14 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Under-building-slab, domestic water, building service piping, NPS 3 (DN 80) and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper solder-joint fittings; and brazed joints.
- C. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 6 (DN 100 to DN 150), shall be the following:
1. Push-on-joint, ductile-iron pipe; standard-pattern push-on-joint fittings; and gasketed joints.
- D. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
1. Soft copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); wrought-copper solder-joint fittings; and brazed joints.
- E. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought- copper solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought- copper solder-joint fittings; and brazed joints.

3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball valves for piping NPS 2 (DN 50) and smaller. Use ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION

SECTION 15165

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
1. Vacuum breakers.
 2. Backflow preventers.
 3. Water pressure-reducing valves.
 4. Balancing valves.
 5. Temperature-actuated water mixing valves.
 6. Hose bibbs.
 7. Wall hydrants.
 8. Water hammer arresters.
 9. Trap-seal primer valves.
 10. Aluminum jacket.

- B. See Division 15 Section "Domestic Water Piping" for water meters.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. NSF Compliance:
1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Ames Co.
- b. Conbraco Industries, Inc.
- c. FEBCO; SPX Valves & Controls.
- d. Watts Industries, Inc.; Water Products Div.
- e. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Woodford Manufacturing Company.
 - d. Zurn Plumbing Products Group.
3. Standard: ASSE 1001.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Double-Check Backflow-Prevention Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
4. Standard: ASSE 1015.
5. Operation: Continuous-pressure applications, unless otherwise indicated.
6. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
7. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
8. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
9. Configuration: Designed for horizontal flow.
10. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
Cash Acme.
 - a. Conbraco Industries, Inc.
 - b. Honeywell Water Controls.
 - c. Watts Industries, Inc.; Water Products Div.
 - d. Zurn Plumbing Products Group; Wilkins Div.
3. Standard: ASSE 1003.
4. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
5. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 for NPS 2-1/2 and larger.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and larger.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Lawler Manufacturing Company, Inc.
 - b. Leonard Valve Company.
 - c. Powers; a Watts Industries Co.
 - d. Symmons Industries, Inc.
4. Standard: ASSE 1017.
5. Pressure Rating: 125 psig (860 kPa).
6. Type: Exposed-mounting, thermostatically controlled water mixing valve.
7. Material: Bronze body with corrosion-resistant interior components.
8. Connections: Threaded or union inlets and outlet.
9. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
10. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
11. Valve Finish: Rough bronze.
12. Piping Finish: Copper.

2.5 LIMITING VALVES

- A. Temperature Limiting Valve: Acorn ST70 and Leonard 170D-LF for all lavatories, sinks, etc., or equivalent by Watts, Zurn, Powers, Symmons or T&S.

2.6 HOSE BIBBS

- A. Hose Bibbs:
 - 1. Standard: ASME A112.18.1 for sediment faucets.
 - 2. Body Material: Bronze.
 - 3. Seat: Bronze, replaceable.
 - 4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
 - 5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
 - 6. Pressure Rating: 125 psig (860 kPa).
 - 7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
 - 8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
 - 9. Finish for Service Areas: Rough bronze.
 - 10. Finish for Finished Rooms: Chrome or nickel plated.
 - 11. Operation for Equipment Rooms: Operating key.
 - 12. Operation for Service Areas: Operating key.
 - 13. Operation for Finished Rooms: Operating key.
 - 14. Include operating key with each operating-key hose bibb.
 - 15. Include integral wall flange with each chrome- or nickel-plated hose bibb.
- B. Hose Bibb (interior) encased narrow wall hydrant in wall box with loose tee key, Zurn Model Z-1350 (narrow wall hydrant) or equal by J. R. Smith, Wade or Josam.

2.7 WALL HYDRANTS

- A. Wall Hydrants (Typical): Freeze proof box type (stainless steel finish) 1/2" nickel plated bronze hose bibb with loose key, J.R. Smith 5509 QT. Install approximately 18" above finished grade.
 - A. Non-freeze Wall Hydrants:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Watts Drainage Products Inc.
 - e. Woodford Manufacturing Company.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 - 3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
 - 4. Pressure Rating: 125 psig (860 kPa).
 - 5. Operation: Loose key.
 - 6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
 - 7. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).

8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: Polished nickel bronze.
11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
12. Nozzle and Wall-Plate Finish: Polished nickel bronze.
13. Operating Keys(s): One with each wall hydrant.

2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products Inc.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
3. Standard: ASSE 1010 or PDI-WH 201.
4. Type: Copper tube with piston.
5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.9 TRAP-SEAL PRIMER VALVES

- ### **A. TP: Trap Primer: Watts No. A-200, P.P.P. Inc., JR Smith, Wade or Josam; Mount high up under one lavatory in each toilet that has a floor drain. Install cold water supply with 1/2" piping into wall and below slab to floor drain. Provide 12" x 12" access panels for each trap primer. Comparable products of access panels: Williams Bros., Accudor, and Milcor.**
- ### **B. Supply-Type, Trap-Seal Primer Valves:**
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 3. Standard: ASSE 1018.
 4. Pressure Rating: 125 psig (860 kPa) minimum.

5. Body: Bronze.
6. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
7. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
9. TrapGuard or equal by J.R. Smith Trap Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with airgap fitting, fixed airgap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.
- C. Install balancing valves in locations where they can easily be adjusted.
- D. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install water hammer arresters in water piping according to PDI-WH 201.
- F. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- G. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.
- H. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 1. Double-check backflow-prevention assemblies.
 2. Water pressure-reducing valves.
 3. Primary, thermostatic, water mixing valves.
 4. Supply-type, trap-seal primer valves.
- I. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Sections.

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

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SECTION 15150

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.3 SUBMITTALS

- A. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.
- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Solvent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 - 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

- 1.
 2. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.
- D. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground, soil, waste, and vent piping shall be the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Copper DWV tube, copper drainage fittings, and soldered joints.
 4. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Underground, soil, waste, and vent piping shall be the following:
 1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3.2 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified.
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

- C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- D. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch, and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drainpipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- E. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- F. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- G. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- H. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- I. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

- A. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- C. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 15 Section "General-Duty Valves for Plumbing Piping."
- B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Install backwater valves in accessible locations.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports for Plumbing Piping." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 15 Section "Hangers and Supports for Plumbing Piping."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 48 inches with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches with 5/8-inch (16-mm) rod.
 - 4. NPS 6 (DN 150): 48 inches with 3/4-inch (19-mm) rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- G. Install supports for vertical PVC piping every 48 inches (1200 mm).
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:

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1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection.

3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction.
 1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 2. Prepare reports for tests and required corrective action.

3.8 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.9 PROTECTION

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

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SECTION 15155

SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
1. Backwater valves.
 2. Cleanouts.
 3. Floor drains.
 4. Roof flashing assemblies.
 5. Miscellaneous sanitary drainage piping specialties.
 6. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
 4. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
 5. Size: Same as connected drainage piping
 6. Body Material: As required to match connected piping.
 7. Closure: Brass plug.
 8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.36.2M for adjustable housing cleanout.
5. Size: Same as connected branch.
6. Type: Adjustable housing.
7. Body or Ferrule: Cast iron.
8. Clamping Device: Required.
9. Outlet Connection: Threaded.
10. Closure: Brass plug with straight threads and gasket.
11. Adjustable Housing Material: Cast iron with threads.
12. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
13. Frame and Cover Shape: Round.
14. Top Loading Classification: Extra Heavy Duty.
15. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.36.2M. Include wall access.
5. Size: Same as connected drainage piping.
6. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
7. Closure: Countersunk plug.

8. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
9. Wall Access: Round, flat, chrome-plated brass, or stainless-steel cover plate with screw.
10. Wall Access: Round stainless-steel wall-installation frame and cover.

- D. Cleanouts: Provide in PVC sanitary piping at all changes in direction, at ends of branches, at intervals not exceeding 50 feet on 3" and smaller and 75' on 4" and larger on straight runs, and elsewhere as shown. Cleanouts shall be full opening type, completely accessible. Size same as lines in which they occur, but not larger than 4 inch. Tees and extensions shall be of same weight as soil pipe. Plugs countersunk or raised head type with gasket. Catalog numbers from J.R. Smith. Cleanout head shall not extend out past finish wall, except in unfinished spaces.

In tile floors: 4051, adjustable, cast-iron body with ABS plug and satin finished square adjustable scoriated secured Nickel Bronze top, where soft tile occurs provide 4171 recessed square adjustable secured Nickel Bronze Top.

In concrete floors: 4237, cast iron with round adjustable scoriated cast iron top with non-tilt tractor cover ferrule with ABS plug.

In outside lines: 4292, terminate at grade or pavement in 18" x 18" x 6" concrete pad with tooled edges.

In accessible unfinished spaces: 4511 castiron with bronze plug as appropriate.

In finished walls: 4531 cast iron cleanout tee with countersunk bronze plug and stainless steel wall plate cover. Where distance from plug to finish wall will exceed 4 inches provide 4402 extended over from sanitary tee to bring plug within 4 inches.

In terrazzo floors: 4191, adjustable cast iron head and ferrule, ABS plug and round adjustable secured nickel bronze top with 1/2" recess.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
4. Standard: ASME A112.6.3.
5. Pattern: Area drain.
6. Body Material: Gray iron.

7. Seepage Flange: Required.
8. Anchor Flange: Required.
9. Clamping Device: Required.
10. Outlet: Bottom.
11. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
12. Sediment Bucket: As required.
13. Top or Strainer Material: Bronze.
14. Top of Body and Strainer Finish: Rough bronze.
15. Top Shape: Round.
16. Top Loading Classification: Extra Heavy-Duty.
17. Funnel: Not required.
18. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
19. Trap Material: Bronze.
20. Trap Pattern: Deep-seal P-trap.
21. Trap Features: Cleanout and trap-seal primer valve drain connection.

- B. Floor Drains: Size outlets same as pipe to which they connect. Install temporary closures during construction. Each drain to have cast iron P-trap. Provide types as scheduled below.

Where drains occur above finished spaces, furnish with clamping collar to secure waterproof membrane.

Typical Floor Drains: Smith 2005L-BNB two-piece cast iron drains with speedi-set type outlet and adjustable Nickel Bronze strainer and rim. Strainer tops for 2" drains 5" x 5", for 3" drains 6" x 6". Floor drains shall have tap for trap primer where shown or required by code and deep seal 'P' traps.

Mechanical Room Drains: Smith 2230L two-piece cast iron drain with speedi-set outlet, sediment bucket and cast-iron grate.

2.3 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

- B. Description: Manufactured assembly made of 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thick, lead flashing collar and skirt extending at least 8 inches (200 mm) from pipe, with galvanized-steel boot reinforcement and counter-flashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

- A. Open Drains:
 - 1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
 - 2. Size: Same as connected waste piping with increaser fitting of size indicated.
- B. Deep-Seal Traps:
 - 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
 - 2. Size: Same as connected waste piping.
 - a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.
 - b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.
- C. Floor-Drain, Trap-Seal Primer Fittings:
 - 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
 - 2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.
- D. Air-Gap Fittings:
 - 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
 - 2. Body: Bronze or cast iron.
 - 3. Inlet: Opening in top of body.
 - 4. Outlet: Larger than inlet.
 - 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping
- E. Sleeve Flashing Device:
 - 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch (25 mm) above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 - 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings:
 - 1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps:
 - 1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 - 2. Size: Same as connected stack vent or vent stack.

2.5 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 - 1. General Use: 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness.
 - 2. Vent Pipe Flashing: 3.0-lb/sq. ft. (15-kg/sq. m), 0.0469-inch (1.2-mm) thickness.
 - 3. Burning: 6-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness.
- B. Fasteners: Metal compatible with material and substrate being fastened.
- C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- D. Solder: ASTM B 32, lead-free alloy.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 15 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
 - G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
 - H. Assemble open drain fittings and install with top of hub 1 inch (25 mm) above floor.
 - I. Install deep-seal traps on floor drains and condensate waste outlets.
 - J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
 - K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
 - L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
 - M. Install vent caps on each vent pipe passing through roof.
 - N. Install traps on plumbing specialty drain outlets.
 - O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
 - D. Secure flashing into sleeve and specialty clamping ring or device.
 - E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings.
 - F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 15183 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.2 PERFORMANCE REQUIREMENTS

1. Suction Lines for Heat-Pump Applications: 450 psi.
2. Hot-Gas and Liquid Lines: 450 psig.

1.3 SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop based on manufacturer's test data.
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 1. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.5 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ACR - ASTM B 280, Type K or L.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 2. End Connections: Socket ends.
 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 VALVES AND SPECIALTIES

- A. Diaphragm Packless Valves:
 1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
 2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
 3. Operator: Rising stem and hand wheel.
 4. Seat: Nylon.
 5. End Connections: Socket, union, or flanged.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 275 deg F (135 deg C).
- B. Check Valves:
 1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
 2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
 3. Piston: Removable polytetrafluoroethylene seat.
 4. Closing Spring: Stainless steel.
 5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
 6. End Connections: Socket, union, threaded, or flanged.
 7. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 275 deg F (135 deg C).
- C. Service Valves:
 1. Body: Forged brass with brass cap including key end to remove core.
 2. Core: Removable ball-type check valve with stainless-steel spring.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Copper spring.
 5. Working Pressure Rating: 500 psig (3450 kPa).
- D. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
 1. Body and Bonnet: Plated steel.
 2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
 3. Seat: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and 24-V ac coil.
 6. Working Pressure Rating: 500 psig.
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
 8. Manual operator.
- E. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 2. Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Seat Disc: Polytetrafluoroethylene.
 4. End Connections: Threaded.
 5. Working Pressure Rating: 500 psig.
 6. Maximum Operating Temperature: 240 deg F (116 deg C).
- F. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
 2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
 3. Packing and Gaskets: Non-asbestos.
 4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
 5. Suction Temperature: 40 deg F (4.4 deg C).
 6. Superheat: Adjustable.
 7. Reverse-flow option (for heat-pump applications).
 8. End Connections: Socket, flare, or threaded union.
 9. Working Pressure Rating: 700 psig (4820 kPa).
- G. Ball Valve: Mitsubishi Diamondback BV-Series or approved equal.
1. Full port design.
 2. 700 PSIG rated.
 3. R-410A compatible.
 4. Flare connections.
 5. Temperature range: -40°F to +325°F.
 6. Ball valve insulation:
 - a. Insulation: Inner and outer layer polyethylene foam (PEF).
 - b. Covering: Adhesive tape of polyvinyl chloride (PVC).
 - c. Separator: Soft film of polyvinyl chloride (PVC).
- H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
 2. Screen: 100-mesh stainless steel.
 3. End Connections: Socket or flare.
 4. Working Pressure Rating: 500 psig (3450 kPa).
 5. Maximum Operating Temperature: 275 deg F (135 deg C).
- I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
 2. Drain Plug: Brass hex plug.
 3. Screen: 100-mesh monel.
 4. End Connections: Socket or flare.
 5. Working Pressure Rating: 500 psig (3450 kPa).
 6. Maximum Operating Temperature: 275 deg F (135 deg C).
- J. Moisture/Liquid Indicators:
1. Body: Forged brass.
 2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
 3. Indicator: Color coded to show moisture content in ppm.
 4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
 5. End Connections: Socket or flare.
 6. Working Pressure Rating: 500 psig (3450 kPa).
 7. Maximum Operating Temperature: 240 deg F (116 deg C).
- K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
 2. Filter Media: 10 microns, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina or charcoal.
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig (14 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 240 deg F (116 deg C).
- L. Permanent Filter Dryers: Comply with ARI 730.
1. Body and Cover: Painted-steel shell.
 2. Filter Media: 10 microns, pleated with integral end rings; stainless-steel support.
 3. Desiccant Media: Activated alumina or charcoal.
 4. Designed for reverse flow (for heat-pump applications).
 5. End Connections: Socket.
 6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
 7. Maximum Pressure Loss: 2 psig (14 kPa).
 8. Working Pressure Rating: 500 psig (3450 kPa).
 9. Maximum Operating Temperature: 240 deg F (116 deg C).
- M. Liquid Accumulators: Comply with ARI 495.
1. Body: Welded steel with corrosion-resistant coating.
 2. End Connections: Socket or threaded.
 3. Working Pressure Rating: 500 psig (3450 kPa).
 4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.3 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Atofina Chemicals, Inc.
 2. DuPont Company; Fluorochemicals Div.
 3. Honeywell, Inc.; Genetron Refrigerants.
 4. INEOS Fluor Americas LLC.
- C. ASHRAE 34, R-410A.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications from Outdoor Unit Indoor Unit: Nitrogenized ACR hard drawn copper tube – ASTM B280.
- B. Option: Mitsubishi factory pre-insulated soft copper Type L line sets from Outdoor Heat Pump Unit to Indoor Air Handlers.
- C. Safety-Relief-Valve Discharge Piping: Copper, Type L, drawn-temper tubing, and wrought-

copper fittings with soldered joints.

D. Safety-Relief-Valve Discharge Piping:

1. NPS 1-1/2 and Smaller: Copper, Type L, drawn-temper tubing, and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

- A. Install packed-angle valves in suction and discharge lines of compressor.
- B. Install service valves for gage taps at strainers if they are not an integral part of strainers.
- C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.
- D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.
- E. Install a full-sized, three-valve bypass around filter dryers.
- F. Install solenoid valves upstream from each expansion valve. Install solenoid valves in horizontal lines with coil at top.
- G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
 1. Install valve so diaphragm case is warmer than bulb.
 2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
 3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.
- H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.
- I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.
- J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
 1. Solenoid valves.
 2. Thermostatic expansion valves.
 3. Compressor.
- K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.
- L. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 8 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in protective conduit where installed belowground.
- N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
- O. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.
- R. Seal penetrations through fire and smoke barriers.
- S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.
- U. Seal pipe penetrations through exterior walls.
- V. Identify refrigerant piping and valves according to Division 15 Section "Mechanical Identification."

3.4 PIPE JOINT CONSTRUCTION

- A. Soldered Joints (Soft Copper Type L Refrigeration Coils – ASTM B280: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

- B. Brazed Joints (Nitrogenized ACR Hard Drawn Copper – ASTM B280: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."
- B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
- C. Support multi-floor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping and specialties. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

- A. Charge system using the following procedures:
 - 1. Install core in filter dryers after leak test but before evacuation.
 - 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
 - 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
 - 4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

- A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
- B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

- D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Open shutoff valves in condenser water circuit.
 2. Verify that compressor oil level is correct.
 3. Open compressor suction and discharge valves.
 4. Open refrigerant valves except bypass valves that are used for other purposes.
 5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 15195

FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig (690 kPa) minimum unless otherwise indicated.
 - 2. Service Regulators: 65 psig (450 kPa) minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is 2 psig (13.8 kPa) and is reduced to secondary pressure to be 14" W.C. or less.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding certificates.
- D. Field quality-control reports.
- E. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.

3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 7. Operating-Pressure Rating: 5 psig (34.5 kPa).
- C. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 3. Anodeless Service-Line Risers: Factory fabricated, and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
 4. Transition Service-Line Risers: Factory fabricated, and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.

- b. Outlet shall be threaded or suitable for welded connection.
- c. Bridging sleeve over mechanical coupling.
- d. Factory-connected anode.
- e. Tracer wire connection.
- f. Ultraviolet shield.
- g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

2.2 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
 - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 - 4. Corrugated stainless-steel tubing with polymer coating.
 - 5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
 - 6. End Fittings: Zinc-coated steel.
 - 7. Threaded Ends: Comply with ASME B1.20.1.
 - 8. Maximum Length: 72 inches (1830 mm).
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 - 1. Copper-alloy convenience outlet and matching plug connector.
 - 2. Nitrile seals.
 - 3. Hand operated with automatic shutoff when disconnected.
 - 4. For indoor or outdoor applications.
 - 5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
 - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 - 2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller.
 - 3. Strainer Screen: 40-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
 - 4. CWP Rating: 125 psig (862 kPa).
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
- E. Lab Table Gas Valves:
 - 1. Lab Turret with 2-90° hose, cocks – T& S brass model BL-4203-0 (Gas) or equal.
 - 2. Lab Turret with 4 hose cocks. T&S brass model BL-4203-04 or equal.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.4 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig (862 kPa).
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.

2.5 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico Inc.
 - c. Metraflex Company (The).
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
 3. Pressure Plates: Carbon steel.
 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.7 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 - EXECUTION

3.1 OUTDOOR PIPING INSTALLATION

- A. Comply with 2015 International Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches (900 mm) below finished grade. Comply with requirements in Division 2 Section "Earthwork" for excavating, trenching, and backfilling.
 1. If natural-gas piping is installed less than 36 inches (900 mm) below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.

- D. Install fittings for changes in direction and branch connections.
- E. Exterior-Wall Pipe Penetrations: Seal penetrations using steel or cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- F. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- G. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 22 Section "Meters and Gages."

3.2 INDOOR PIPING INSTALLATION

- A. Comply with 2015 International Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
- L. Verify final equipment locations for roughing-in.
- M. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- N. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm)

long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

- O. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- P. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

3.3 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install anode for metallic valves in underground PE piping.

3.4 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
 - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 - 2. Bevel plain ends of steel pipe.
 - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Division 22 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).

3.6 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.7 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 15 Section "Mechanical Identification" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.8 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to 2015 International Gas Code and authorities having jurisdiction.

- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.9 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be the following:
 - 1. PE pipe and fittings joined by heat fusion; service-line risers with tracer wire terminated in an accessible location.
- B. Aboveground natural-gas piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

3.10 INDOOR PIPING SCHEDULE

- A. Aboveground, piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- B. Underground, below building, piping shall be the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.11 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe shall be the following:
 - 1. Bronze plug valve.

END OF SECTION

(See Attachment "A")

SECTION 15195 - ATTACHMENT "A"

A New Auditorium for
Straughn High School for the
Covington County Board of Education

MCKEE PROJECT NO. 20-168

ATTACHMENT "A"

1 of 1

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TracPipe® CounterStrike® Flexible Gas Piping Specification Sheet

SPECIFICATION DATE:
PROJECT NAME:
MODEL NUMBERS: FGP-CS-375 - FGP-CS-500 - FGP-CS-750 - FGP-CS-1000 - FGP-CS-1250 - FGP-CS-1500 - FGP-CS-2000
A. Standards & Certifications: All flexible gas piping system components must be:
<p>A.1 CSA International Certified Corrugated Stainless Steel Tubing (CSST) Flexible Gas Piping with Mechanical Attachment AutoFlare® Fittings that conform to the latest ANSI standards for safe performance ANSI LC-1 /CSA 6.26.</p> <p>A.2 Underwriters Laboratories Classification Listed for Thru Penetration Fire Stop Requirements Ratings to include one, two, three and four hour tests.</p> <p>A.3 Listed with FM (Factory Mutual) requirements for Flammable Gas Piping Systems. For seismic resistance.</p> <p>A.4 Tubing shall be tested and listed in accordance with ICC LC-1024. For resistance to arcing from transient energy.</p>
B. Stainless Steel Tubing:
<p>B.1 Tubing shall be made from 300 series Stainless Steel Strip conforming to ASTM A240.</p> <p>B.2 Tubing shall not be subjected to heat treating or annealing after the corrugation forming operation.</p> <p>B.3 Tubing shall be suitable for operation with fuel gases.</p> <p>B.4 Tubing is rated for 25-PSI.</p> <p>B.5 Tubing must have elevated pressure ratings of 125G for sizes up to 1-1/4 inches for high-pressure applications permitted by the Local Distribution Utility. These elevated pressure ratings shall be demonstrated by test reports from the certification agency.</p>
C. Plastic Jacket:
<p>C.1 The jacket shall be extruded from fire-retarded Polyethylene.</p> <p>C.2 Chlorinated plastics such as PVC are not permitted.</p> <p>C.3 ASTM E-84 flame spread rating shall not exceed 25.</p> <p>C.4 ASTM E-84 smoke density rating shall not exceed 50.</p> <p>C.5 Polyethylene is to be resistant to UV.</p> <p>C.6 Jacket shall be a single layer black and electrically conductive.</p>
D. AutoFlare® Mechanical Attachment Fittings:
<p>D.1 Fittings shall be made from yellow brass.</p> <p>D.2 Fittings shall be equipped with a stainless steel insert to pilot on the tubing ID and provide a reliable flaring operation.</p> <p>D.3 Fittings are tested and listed by CSA International for concealed use where required.</p> <p>D.4 Fittings are available in straight, straight reducer, tee, reducer tee and coupling configurations.</p> <p>D.5 Fittings shall provide a metal-to-metal seal (no gaskets).</p>
E. Protective Devices:
<p>E.1 Striker Plates:</p> <p>E.1 A Striker plates shall be listed as part of the OMEGAFLEX, INC. TracPipe® system and shall be marked with the symbol of the Manufacturer (OMEGAFLEX, INC.) and the listing Agency (CSA International).</p> <p>E. 1 B Striker plates shall be made from carbon steel, heat-treated to RB75.</p> <p>E. 1 C Striker Plates are available in Quarter, Half, Three Quarter, Full and 6 X 17 Configurations.</p> <p>E.2 Floppy Conduit:</p> <p>E.2 A Floppy conduit used for additional protection with striker plates (type RW electrical conduit) is to be made from galvanized steel.</p>
F. Accessories:
<p>F.1 Termination Mount Fittings are to be used to provide a secure termination for the tubing at moveable appliance locations and other "stub-out" points depending on building construction. Termination mount accessories consist of a plated carbon steel plate or brass mounting flange and an AutoFlare® fitting. Fittings at termination mounts must be accessible and provide a fitting joint exterior to the building floor or wall.</p>

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TracPipe® CounterStrike® Flexible Gas Piping Specification Sheet

Continued

F. Accessories: Continued

F.2 Meter Termination Fittings may be used for exterior wall penetrations at meter locations and other penetrations such as roof top units. Meter terminations consist of a plated carbon steel mounting plate and sleeve and an **AutoFlare** fitting. Fittings at meter termination outlets must be accessible and provide a fitting joint exterior to the building.

F.3 Manifolds are made from malleable iron either poly coated or uncoated. Manifolds may be mounted using available manifold brackets or Gas Load Centers; they may alternatively be mounted using conventional pipe mounting methods.

F.4 Pounds-to-inches line pressure regulators shall be listed per ANSI Z21.80 or a recognized national standard for pressure regulators. Regulators must be mounted in an accessible location.

F.4.1 Regulators with included approved vent-limiting device do not require venting to outdoors provided they are mounted in a ventilated location (e.g. near a gas appliance which also requires placement in a ventilated area). Ventilated locations include (but are not limited to) mechanical rooms, attics, garages, and basements.

F.4.2 Approved vent limiters limit the fuel gas leakage to 2.5 cfh in the event of a diaphragm failure.

F.5 Shut-off valves must be approved for fuel gas service and must be rated for the pressure of the gas piping system installed. For elevated pressure sections an approved valve must be located upstream from the pounds-to-inches regulator.

F.6 Overpressure protection devices must be installed for elevated systems higher than 2-PSI to prevent downstream pressure from exceeding 2-PSI in the event of regulator failure.

G. Bonding:

G.1 Primary protection from nearby lightning strikes for all metallic systems within a building is recommended to be provided by proper grounding of the electrical system and equipotential bonding of all metallic systems including the gas piping system. Grounding and bonding shall be in accordance with the National Electrical Code NFPA 70.

G.2 The installation of a lightning protection system per NFPA 780 is recommended in areas prone to a high level of lightning strikes to protect the building in the event of a direct strike.

G.3. There are no additional bonding requirements for **CounterStrike®** imposed by the manufacturer's installation instructions. The piping system is to be bonded in accordance with the National Electrical Code NFPA 70 Article 250.104, and any local requirements which may be in excess of the manufacturers requirements.

G.4. Wherever possible, tubing runs should be installed with a bend radius of 8 inches or more.

G.5 Where required by the AHD the bonding clamp must be attached to the brass **AutoFlare®** fitting adapter (adjacent to the pipe thread area –see illustration below) or to a black pipe component (pipe or fitting) located in the same electrically continuous gas piping system. The corrugated stainless steel portion of the gas piping system **SHALL NOT** be used as the bonding attachment point under any circumstances.

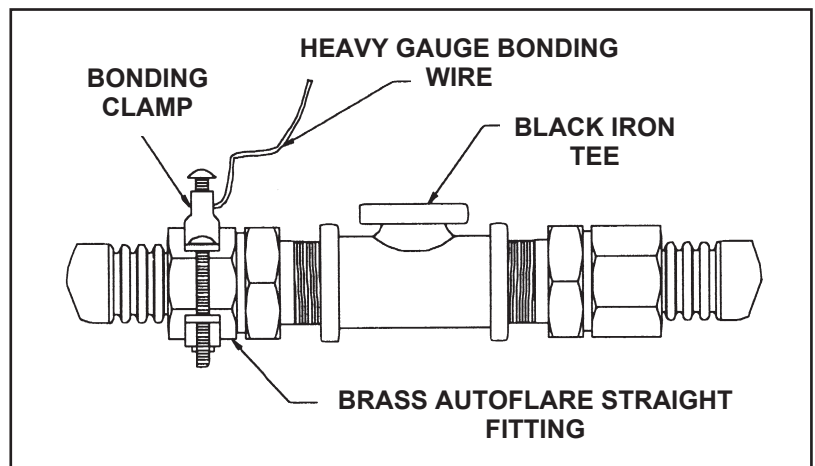


Diagram is for illustration purposes only.
Bonding wire attachment when required by local code.

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TracPipe[®] PS-II Underground Specification Sheet

SPECIFICATION DATE:							
PROJECT NAME:							
MODEL NUMBERS: FGP-UGP-375 - FGP-UGP-500 - FGP-UGP-750 - FGP-UGP-1000 - FGP-UGP-1250 - FGP-UGP-1500 - FGP-UGP-2000							
<p>A.1 CSST underground and under building slab installations shall be made using the pre-sleeved TracPipe PS-II system or other sleeve configurations meeting code requirements and acceptable to the local administrative authority.</p> <p>A.2 Underground piping shall consist of CSST sleeved with a black integral polyethylene sleeve. The external polyethylene sleeve shall be designed to withstand the superimposed loads. The external protective sleeve shall have internal vent channels lengthwise to direct any leakage along the pipe to the end fittings.</p> <p>A.3 For gas piping under building slabs, Plumbing, Mechanical and Fuel Gas Code requirements shall be followed for encasement within a conduit and venting to the atmosphere. The construction of the pre-sleeved system shall provide the encasement and venting capabilities required by the codes.</p> <p>A.4 Underground fittings may be used within the system. All metallic parts of the buried fittings shall be wrapped in a code-approved manner (e.g. mastic used for wrapping metallic pipe). Underground fittings are not permitted under the slab of a building.</p> <p>A.5 The underground piping system shall be listed by either ICC or IAPMO for use in underground or underground beneath building applications.</p>							
Superimposed Loading Chart							
TracPipe PS-II Size	3/8 inch	1/2 inch	3/4 inch	1 inch	1- 1/4 inch	1-1/2 inch	2 inch
Max. Superimposed Loading <i>psf</i>	9640	7254	5409	4203	3390	2901	2124
NOTES: 1. Super-imposed loading includes all dead load and live load combinations. 2. Maximum buried depth of 36 inches. 3. Soil Density: 120 PCF. 4. Factor of safety used: 4.							
B. Stainless Steel Tubing:							
<p>B.1 Tubing shall be made from 300 series Stainless Steel Strip conforming to ASTM A240.</p> <p>B.2 Tubing shall not be subjected to heat treating or annealing after the corrugation forming operation.</p> <p>B.3 Tubing shall be suitable for operation with fuel gases.</p> <p>B.4 Tubing is rated for 25-PSI.</p> <p>B.5 Tubing must have elevated pressure ratings of 125G for sizes up to 1-1/4 inches for high-pressure applications permitted by the Local Distribution Utility. These elevated pressure ratings shall be demonstrated by test reports from the certification agency.</p>							
C. AutoFlare[®] Mechanical Attachment Fittings:							
<p>C.1 Fittings shall be made from yellow brass.</p> <p>C.2 Fittings shall be equipped with a stainless steel insert to pilot on the tubing ID and provide a reliable flaring operation.</p> <p>C.3 Fittings are tested and listed by CSA International for concealed use.</p> <p>C.4 Fittings are available in straight, straight reducer, tee, reducer tee and coupling configurations.</p> <p>C.5 Fittings shall provide a metal-to-metal seal (no gaskets).</p> <p>C.6 Fittings shall be supplied with a plastic containment coupling and 1/4 inch NPT vent port, to provide venting as required.</p>							
D. Bonding:							
<p>D.1 There are no additional bonding requirements for TracPipe[®] Ps-II imposed by the manufacturer's installation instructions. The piping system is to be bonded in accordance with the National Electrical Code NFPA 70 Article 250.104, and any local requirements which may be in excess of the manufacturers requirements.</p> <p>D.2 Tubing runs shall be installed with a bend radius not exceeding those established by the manufacturer.</p> <p>D.3 Where required by the AHD the bonding clamp must be attached to the brass AutoFlare[®] fitting adapter (adjacent to the pipe thread area –see illustration below) or to a black pipe component (pipe or fitting) located in the same electrically continuous gas piping system. The corrugated stainless steel portion of the gas piping system SHALL NOT be used as the bonding attachment point under any circumstances.</p>							

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TracPipe® PS-II Underground Specification Sheet

Continued

D. Bonding: (cont)

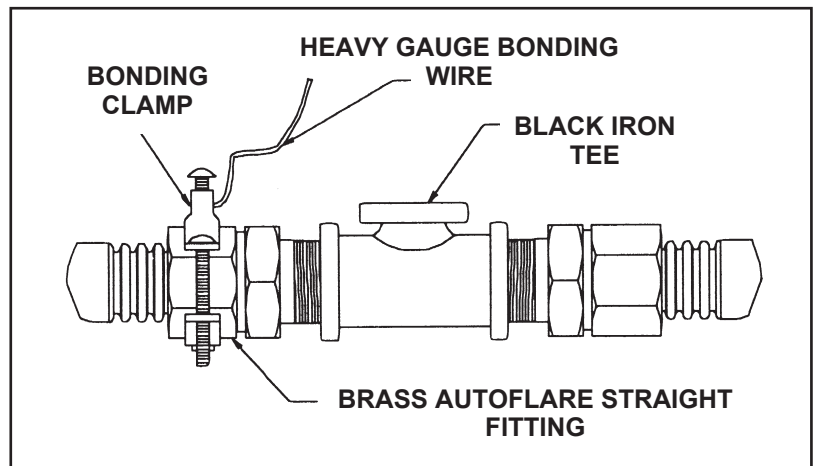


Diagram is for illustration purposes only.
Bonding wire attachment when required by local code.

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SECTION 15410

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Plumbing fixtures.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities "Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
4. Stainless-Steel Residential Sinks: ASME A112.19.3.
5. Vitreous-China Fixtures: ASME A112.19.2M.
6. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.

6. Hose-Coupling Threads: ASME B1.20.7.
 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 8. NSF Potable-Water Materials: NSF 61.
 9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 3. Faucets: ASME A112.18.1.
 4. Hand-Held Showers: ASSE 1014.
 5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Off-Floor Fixture Supports: ASME A112.6.1M.
 7. Pipe Threads: ASME B1.20.1.
 8. Plastic Toilet Seats: ANSI Z124.5.
 9. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 FIXTURES AND MISCELLANEOUS ITEMS

- A. Fixture Trim: Exposed metal parts to be of heavy weight polished brass, heavily chromium plates, of best quality as regularly furnished by the plumbing fixture manufacturer. Supplies to all fixtures and equipment shall be provided with stop valves.

B. Scheduled Items:

WC-1: ZURN: Z5660.18.11.03.00. 1.6 gpf ADA height floor mount Topspud flush valve toilet; Metroflush piston-operated flush valve; elongated, standard white, open front toilet seat, less cover, with self-sustaining stainless-steel check hinge; Z5972 closet bolt/wax ring kit. No carrier required. Provide YB, YC and YK suffix for flush valve. Equal by Kohler, American Standard or Crane. Flush valve equal to Sloan.

WC-2: ZURN: Z5650.185.11.03.00. 1.6 gpf floor mount Topspud flushvalve toilet, Metroflush piston-operated flush valve; elongated, standard white, open front toilet seat, less cover, with self-sustaining stainless-steel check hinge; Z5972 closet bolt, wax ring kit. No carrier required. Provide YB, YC and YK suffix for flush valve. Equal by Kohler, American Standard or Crane. Flush valve equal to Sloan.

UR-1: ZURN: Z5730.168.02. 1.0 gpf Topspud Siphon Jet Urinal; Metroflush Piston-Operated Exposed Flush Valve; Z5978 Urinal Strainer (flat urinal strainer) Mount 17" lip to finished floor. Suggested Carriers: Z1221, Z1222 Provide YB, YC and YK suffix for flush valve. Equal By: American Standard, Kohler, and Crane. Flush valve equal to Sloan.

UR-2: ZURN: Z5730.168.02. 1.0 gpf Topspud Siphon Jet Urinal; Metroflush Piston-Operated Exposed Flush Valve; Z5978 Urinal Strainer (flat urinal strainer). Suggested Carriers: Z1221, Z1222 Provide YB, YC and YK suffix for flush valve. Equal By: American Standard, Kohler and Crane. Flush valve equal to Sloan.

L-1: Zurn One Number: Z5348.157.4.18.41.5 – 20" x 18" Wall Hung Concealed Carrier Arm Lavatory – 8" Centerset; widespread, 5" cast spout – 2'-6" lever handles; Grid Drain (1-1/2: tailpiece); 1-1/2" Cast Brass P-Trap less Cleanout; Heavy-Duty Loose Key Stop and Lavatory Supply Kit with Braided Stainless-Steel Supplies; ADA Combination Trap and Supply Wrap Protector Kit. Suggested Carriers: Z1224 or Z1231. Comparable products by Kohler, Crane, American Standard, Sloan and Moen. Mount 34" rim to finished floor.

L-2: Zurn One Number: Z5348.157.4.18.41.5 – 20" x 18" Wall Hung Concealed Carrier Arm Lavatory – 8" Centerset; widespread, 5" cast spout – 2'-6" lever handles; Grid Drain (1-1/2: tailpiece); 1-1/2" Cast Brass P-Trap less Cleanout; Heavy-Duty Loose Key Stop and Lavatory Supply Kit with Braided Stainless-Steel Supplies; Suggested Carriers: Z1224 or Z1231. Comparable products by Kohler, Crane, American Standard, Sloan, and Moen

MB-1: Mop Basin, Molded Stone 24"x24"x10": Zurn Z1996-24-HH-BS-MH-SDL: Drain with Stainless Steel Dome Strainer: long Hose and Hose Bracket; Mop Hanger: Zurn Z843 M1-RC; Service Faucet with Vacuum Breaker, Integral Stops and Pail Hook: Silicone Sealant (Located at all points where Basin meets wall or floor): Comparable products by: Fiat, Williams, or Mustee.

EWC-1: Electrical Water Cooler: Elkay Bi-Level Model LZSTL8WSSK with EXH2O station. Comparable products by: Oasis, Halls, Halsey Taylor, or White Westinghouse. P-Trap, Supplies with stops: McGuire. Comparable products by: Zurn or Acorn. Mount 36" spout to finished floor. Finish to be stainless steel. Provide Flex Guard Safety Bubbler.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install fixtures level and plumb according to roughing-in drawings.
- G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- L. Install toilet seats on water closets.
- M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

- S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by the Contracting Officer.

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SECTION 15485

ELECTRIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Household, storage electric water heaters.
 - 2. Light-commercial electric water heaters.
 - 3. Commercial electric booster heaters.
 - 4. Commercial, storage electric water heaters.
 - 5. Water heater accessories.

1.2 SUBMITTALS

- A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.
- D. Warranty.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. ASHRAE/IESNA-90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.
- C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric water heaters that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.

- c. Deterioration of metals, metal finishes, and other materials beyond normal use.
- 2. Warranty Period(s): From date of Substantial Completion:
 - a. Commercial Electric Water Heaters: Three years.

PART 2 - PRODUCTS

2.1 WATER HEATERS

- A. Water Heater (WH-1 & WH-2): Electric water heater 30-gallon storage capacity, recovery capacity 25 GPH at 100-degree rise, 6 KW heating element for 208/1/60 cycle current; Rheem Model EGSP30. Comparable products by Rudd, A.O Smith, State or Hubbell.
- B. Temperature Limiting Valve Acorn ST70 for all lavatories, sinks, etc., or equivalent by Watts Zurn Wilkins, Powers, Symmons or T & S.
- C. Relief Valves: Install (in accordance with USA Standard 221.22) properly sized AGA and ASME approved T&P relief valves with copper overflow lines to floor drain as indicated.
- D. Safety Pan: Minimum of 1-1/2" deep X diameter of water heater plus 3" galvanized steel with a minimum of 1" drain.
- E. Thermal Expansion Tank: Zurn Wilkins min. cap 2.1 gallons.
- F. Provide braided copper bonding jumper between cold and hot water lines for grounding purposes.
- G. Circulating Pump: Pump shall be Armstrong Astro 50B-3/4" all bronze pump with 1/20 HP motor, 120V, 1 PH with built-in overload protection. Pump shall have a capacity of 7 GPM at 10-foot head. Comparable products by: Bell & Gossett, Paco.
- H. Provide Time Clock (seven-day) for pump control 120/1/60 operating hours, 6:00 A.M. - 5:00 P.M. Monday through Friday. Verify with owner for weekend operation. Tork Model T171.

2.2 WATER HEATER ACCESSORIES

- A. Water Heater Stands: Water heater manufacturer's factory-fabricated steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.
- B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.
- C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4 (DN 20).
- D. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1-2004.
- E. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- (172.5-kPa-) maximum outlet pressure, unless otherwise indicated.
- F. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A New Auditorium for
Straughn High School for the
Covington County Board of Education

ELECTRIC WATER HEATERS
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- A. Install commercial water heaters on concrete bases.
 - 1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.
- B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial, water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- D. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains.
- E. Install thermometer on outlet piping of water heaters. Refer to Division 15 Section "Meters and Gages for Plumbing Piping" for thermometers. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
- F. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- G. Fill water heaters with water.

3.2 CONNECTIONS

- A. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections.
- B. Perform the following field tests and inspections:
 - 1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric water heaters. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

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SECTION 15700 - DUCTLESS HEAT PUMP INDOOR AND OUTDOOR SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Indoor and outdoor heat pump mini-split units.

1.3 SUBMITTALS

- A. Product Data: For each piece of equipment indicated.
 - 1. Unit dimensions and weight.
 - 2. Cabinet material, metal thickness, finishes, insulation, and accessories.
 - 3. Fans:
 - a. Certified fan-performance curves with system operating conditions indicated.
 - b. Certified fan-sound power ratings.
 - c. Fan construction and accessories.
 - d. Motor ratings, electrical characteristics, and motor accessories.
 - 4. Certified coil-performance ratings with system operating conditions indicated.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Filters with performance characteristics.
 - 7. Compressor.
- B. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.
 - 2. Support location, type, and weight.
 - 3. Field measurements.
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.
- C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430 and shall be listed and labeled by ARI.

- D. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate location of all equipment with structural, lighting and all trades prior to installation.

1.6 SYSTEM DESCRIPTION

- A. The heat pump mini-split system shall be by Mitsubishi. Equal by LG, Samsung, Trane, and Fujitsu
- B. The heat pump system shall consist of the outdoor unit, indoor units, and DDC controls (Direct Digital Controls). System shall be capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. System shall be capable of controlling associated exhaust fans via occupied/unoccupied schedule.

1.7 QUALITY ASSURANCE

- A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.
- B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
- C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
- D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the proposed ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the DOE alternative test procedure, which is based on the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standards 340/360, 1230 and ISO Standard 13256-1.
- E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Unit shall be stored and handled according to the manufacturer's recommendation.

1.9 CONTROLS

- A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications.
- B. System controls and control components shall be installed in accordance with the manufacturer's written installation instructions.
- C. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.

PART 2 - WARRANTY

2.1 Parts and Labor warranty for a period of one (2) year from date of installation.

- 1. The systems shall be:
 - a) Installed by a contractor that has successfully completed the Mitsubishi one day service course.
 - b) A completed commissioning report submitted to and approved by the Mitsubishi.

2. The compressor shall have a manufacturer's parts and labor warranty for a period of seven (7) years from date of installation.
3. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired by the manufacturer.

2.2 All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.

PART 3 – PRODUCTS

3.1 MANUFACTURERS

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Mitsubishi.
2. LG.
3. Trane.
4. Fujitsu

3.2 HEAT PUMP OUTDOOR UNIT

A. General:

The outdoor units shall be equipped with multiple circuit boards that interface to the controls system and shall perform all functions necessary for operation. The outdoor unit shall be completely factory assembled, piped, and wired. Each unit shall be run tested at the factory.

1. Outdoor unit shall have a sound rating no higher than 59 dB(A).
2. Both refrigerant lines from the outdoor unit to indoor units shall be individually insulated.
3. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.
4. The outdoor unit shall have a high-pressure safety switch, low pressure safety switch and over-current protection and DC bus protection.
5. The outdoor unit shall be capable of cooling operation down to 23°F outdoor ambient without additional low ambient controls.
6. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

B. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

1. The unit shall be furnished with two direct drive, variable speed motors.
2. The fans will be forward curved type blades for quiet operation.
3. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.
4. The fan motor shall be mounted for quiet operation.

5. The fan shall be provided with a raised guard to prevent contact with moving parts.
 6. The outdoor unit shall have horizontal discharge airflow.
- D. Refrigerant
1. R410A refrigerant shall be required for all outdoor unit systems.
- E. Coil:
1. The outdoor coil shall be of nonferrous construction with lanced or corrugated fins on copper tubing.
 2. The coil fins will have a factory applied corrosion resistant blue-fin finish.
 3. The coil shall be protected with an integral metal guard.
 4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.
- F. Compressor:
1. The compressor shall be a single high performance, inverter driven, modulating capacity scroll compressor.
 2. The outdoor unit compressor shall have an inverter to modulate capacity. The compressor shall be equipped with an internal thermal overload.
 3. The compressor shall be mounted to avoid the transmission of vibration.
- G. Electrical:
1. The outdoor unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
 2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz)
 3. The outdoor unit shall be controlled by integral microprocessors.

3.3 4-WAY CEILING-RECESSED CASSETTE WITH GRILLE, INDOOR UNIT (34" X 34")

- A. General
1. The indoor cassette shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function, a test run switch, and the ability to adjust airflow patterns for different ceiling heights. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- B. Unit Cabinet:
1. The cabinet shall be space-saving ceiling-recessed cassette.
 2. The cabinet panel shall have provisions for a field installed filtered outside air intake.
 3. Branch ducting shall be allowed from cabinet.
 4. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.
 5. The grille vane angles shall be individually adjustable from the wired remote controller to customize the airflow pattern for the conditioned space
- C. Fan:
1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.

2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.
 3. The indoor fan shall consist of five (5) speed settings, Low, Mid1, Mid2, High and Auto.
 4. The fan shall have a selectable Auto fan setting that will adjust the fan speed based on the difference between controller set point and space temperature.
 5. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.
 6. The indoor unit shall have switches that can be set to provide optimum airflow based on ceiling height and number of outlets used.
 7. The indoor unit vanes shall have 5 fixed positions and a swing feature that shall be capable of automatically swinging the vanes up and down for uniform air distribution.
- D. The vanes shall have an Auto-Wave selectable option in the heating mode that shall randomly cycle the vanes up and down to evenly heat the space.
- E. Return air shall be filtered by means of a long-life washable filter.
- F. Coil:
1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.
 2. The tubing shall have inner grooves for high efficiency heat exchange.
 3. All tube joints shall be brazed with phos-copper or silver alloy.
 4. The coils shall be pressure tested at the factory.
 5. A condensate pan and drain shall be provided under the coil.
 6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 33 inches above the condensate pan.
 7. Both refrigerant lines to the indoor units shall be insulated in accordance with the installation manual.
- G. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
 2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz).
- H. Controls:
1. This unit shall use controls provided by unit manufacturer to perform functions necessary to operate the system.
 2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

PART 4 - CONTROLS

4.1 OVERVIEW

A. General:

All indoor units shall have wall mounted programmable controller.

PART 5 - EXECUTION

5.1 INSTALLATION

- A. General:
Rig and install in full accordance with manufacturer's requirements, project drawings, and contract documents. Refer to the manufacturer's installation manual for full requirements.
- B. Location:
Locate indoor and outdoor units as indicated on drawings. Coordinate with lighting, structural and all trades prior to installation. Notify architect immediately of any conflicts or issues. Provide service clearance per manufacturer's installation manual. Adjust and level outdoor units on support structure.
- C. Components / Piping:
Installing contractor shall provide and install all accessories and piping for a fully operational system. Refer to manufacturer's installation manual for full instructions.

Traps, filter driers, and sight glasses are NOT to be installed on the refrigerant piping or condensate lines.

Standard ACR fittings rated for use with R410A are to be used for all connections. Proprietary manufacturer-specific appurtenances are not allowed.

Refrigerant pipe for shall be made of phosphorus deoxidized copper and has two types.

A. ACR "Annealed": Soft copper pipe, can be easily bent with human's hand.

B. ACR "Drawn Temper": Hard copper pipe (Straight pipe), being stronger than Type-O pipe of the same radical thickness.

The maximum operation pressure of R410A air conditioner is 4.30 MPa [623psi]. The refrigerant piping should ensure the safety under the maximum operation pressure. Refer to manufacturer recommend piping specifications. Pipes of radical thickness 0.7mm or less shall not be used.

Flare connection should follow dimensions provided in manufacturer's installation manuals.

- D. Insulation:
See specification section 15088 HVAC Piping Insulation.
- E. Electrical:
Installing contractor shall coordinate electrical requirements and connections for all power feeds with electrical contractor.

END OF SECTION

SECTION 15735 - PACKAGE AIR CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes packaged, outdoor, rooftop units with the following components and accessories:
 - 1. Packaged Air Conditioning Units

1.3 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Performance:
 - 1. Basic Wind Speed: 90 mph.
 - 2. Minimum 10 lb/sq. ft (48.8 kg/sq. m) multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each packaged unit, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which packaged units will be attached.
 - 2. Roof openings
 - 3. Roof curbs and flashing.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For packaged units to include in emergency, operation, and maintenance manuals.
- F. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 210/240 and ARI 340/360 for testing and rating energy efficiencies for packaged units.
 - 2. Comply with ARI 270 for testing and rating sound performance for packaged units.
- B. UL Compliance: Comply with UL 1995.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of packaged units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
 - 2. Warranty Period for Control Boards: Manufacturer's standard, but not less than five years from date of Substantial Completion.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan Belts: 2 sets for each belt-driven fan.
 - 2. Filters: 4 sets of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Carrier
 - 2. Trane
 - 3. JCI

2.2 PACKAGE UNIT

- A. General: The units shall be convertible airflow. The operating range shall be between 115°F and 0°F in cooling as standard from the factory for units with microprocessor controls. Operating range for units with electromechanical controls shall be between 115°F and 40°F. Cooling performance shall be rated in accordance with ARI testing procedures. All units shall be factory assembled, internally wired, fully charged with R-410A, and 100% run tested to check cooling operation, fan and blow rotation, and control sequence before leaving the factory. Wiring internal to the unit shall be colored and numbered for simplified identification. Units shall be UL listed and labeled, classified in accordance for Central Cooling Air Conditioners.
- B. Casing: Unit casing shall be constructed of zinc coated, heavy gauge, galvanized steel. Exterior surfaces shall be cleaned, phosphatized, and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 672 hours in a salt spray test in compliance with ASTM B117. Cabinet construction shall allow for all maintenance on one side of the unit. Service panels shall have lifting handles and be removed and reinstalled by removing two fasteners while providing a water and airtight seal. All exposed vertical panels and top covers in the indoor air section shall be insulated with a cleanable foil-faced, fire-retardant permanent, odorless glass fiber material. The base of the unit shall be insulated with 1/8", foil-faced, closed-cell insulation. All insulation edges shall be either captured or sealed. The unit's base pan shall have no penetrations within the perimeter of the curb other than the raised 1-1/8" high downflow supply/return openings to provide an added water integrity precaution if the condensate drain backs up. The base of the unit shall have provisions for forklift and crane lifting, with forklift capacities on three sides of the unit.
- C. Powered Convenience Outlet: This is a GFCI, 120V/15-amp, 2 plug, ground-fault protected powered convenience outlet. When the convenience outlet is powered, a service receptacle disconnect will be available. The convenience outlet is powered from the line side of the disconnect or circuit breaker, and therefore will not be affected by the position of the disconnect or circuit breaker. This option can only be ordered when the "Through the Base Electrical with either the Disconnect Switch or Circuit Breaker" option is ordered.
- D. Unit Top: The top cover shall be one-piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top.
- E. Filters: Throw away filters shall be standard on all units. 2" MERV 13 filters.
- F. Compressors: All units shall have direct-drive, hermetic, scroll type compressors with centrifugal type oil pumps. Motor shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10% of unit nameplate voltage. Internal overloads shall be provided with the scroll compressors.
- G. Crankcase heaters shall be included.
- H. Evaporator and Condenser Coils: Internally finned, 5/16" copper tubes mechanically bonded to a configured aluminum plate fin shall be standard. The microchannel type of condenser coil is standard for the 10-ton models and 7.5-ton models. Coils shall be leak tested at the factory to ensure the pressure integrity. The evaporator coil and condenser coil shall be leak tested to 600 psig. The assembled unit shall be leak tested to 465 psig. A removable, reversible, double-sloped condensate drain pan with through the base condensate drain shall be provided.

- I. Outdoor Fans: The outdoor fan shall be direct-drive, statically and dynamically balanced, draw-through in the vertical discharge position. The fan motor shall be permanently lubricated and shall have built-in thermal overload protection.
 - J. Plenum Fan: The following unit shall be equipped with a direct drive plenum fan design. Plenum fan design shall include a backward-curved fan wheel along with an external rotor direct drive variable speed indoor motor. All plenum fan designs will have a variable speed adjustment potentiometer located in the control box.
 - K. Controls: Unit shall be completely factory wired with necessary controls and contactor pressure lugs or terminal block for power wiring. Unit shall provide an external location for mounting a fused disconnect device. A choice of microprocessor or electromechanical controls shall be available. Microprocessor controls provide for volt control functions. A centralized microprocessor shall provide anti-short cycle timing and time delay between compressors to provide a higher level of machine protection.
 - L. Refrigerant Circuits: Each refrigerant circuit offers thermal expansion valves as standard. Service pressure ports and refrigerant line filter driers are factory installed as standard. An area shall be provided for replacement suction line driers.
 - M. Hot Gas Reheat: Provide factory installed hot gas reheat coil and controls for dehumidification as scheduled.
 - N. Phase Monitor: Phase monitor shall provide 100% protection for motors and compressors against problems caused by phase loss, phase imbalance and phase reversal. Phase monitor is equipped with an LED that provides an ON or FAULT indicator. There are no field adjustments. The module will automatically reset from a fault condition.
 - O. Gas Fired Furnace (Where noted on plans): Provide gas fired heat modules for unit. Gas heating furnace shall be UL listed and AGA certified. Provide stainless steel heat exchanger.
 - P. Provide disconnect switch. Three-pole, molded case, disconnect switch shall be provided. The disconnect switch shall be installed in the unit in a watertight enclosure with access through a swinging door. Wiring will be provided from the switch to the unit high voltage terminal block. The switch will be UL/CSA certified.
- Note: The disconnect switch will be sized per NEC and UL guidelines but will not be used in place of unit overcurrent protection.
- Q. Accessory-Tool-Less Hail Guards: Tool-less, hail protection quality coil guards shall be provided for condenser coil protection.
 - R. Outside Air Intake Hood and Barometric Relief Hood: Outside air hood and barometric relief hood shall be provided. The assembly shall include motor and dampers, minimum position setting, preset linkage, wiring harness with plug, spring return actuator and fixed dry bulb control. The barometric relief shall provide a motor operated damper that shall close and shall prohibit entrance of outside air during the equipment off cycle.

2.3 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
- B. Low-ambient kit using staged condenser fans for operation down to 35 deg F (1.7 deg C).

- C. Hail coil guards.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of package unit.
- B. Examine roughing-in for package unit to verify actual locations of piping and duct connections before equipment installation.
- C. Examine grade for suitable conditions where package unit will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.
- B. Install piping adjacent to package unit to allow service and maintenance.
- C. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 - 1. Install ducts to termination at top of roof curb.
 - 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
 - 3. Connect supply ducts to package unit with flexible duct connectors specified in Division 15 Section "Duct Accessories."
 - 4. Install return-air duct continuously through roof structure.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- C. Tests and Inspections:
 - 1. After installing package unit and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup check according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, coils, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean condenser coil and inspect for construction debris.
10. Remove packing from vibration isolators.
11. Inspect operation of barometric relief dampers.
12. Verify lubrication on fan and motor bearings.
13. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
16. Inspect and record performance of interlocks and protective devices; verify sequences.
17. Operate unit for an initial period as recommended or required by manufacturer.
18. Calibrate thermostats.
19. Adjust and inspect high-temperature limits.
20. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
21. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
22. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
23. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Return-air volume.
 - c. Relief-air volume.
 - d. Outdoor-air intake volume.

24. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
25. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
26. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.5 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing packaged unit and air-distribution systems, clean filter housings and install new filters.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain package unit. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

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SECTION 15815 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single wall round ducts and fittings.
 - 3. Double-wall round and oval ducts and fittings.
 - 4. Sheet metal materials.
 - 5. Duct liner.
 - 6. Sealants and gaskets.
 - 7. Hangers and supports.
- B. Related Sections:
 - 1. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
 - 2. Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.

9. Penetrations through fire-rated and other partitions.
 10. Equipment installation based on equipment being used on Project.
 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
- D. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Manufacturer shall be Eastern Sheet Metal or approved equal. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

A New Auditorium for
Straughn High School for the
Covington County Board of Education

METAL DUCTS
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- a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 EXTERIOR DUCTWORK AND FITTINGS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Thermaduct, LLC.
- B. Rectangular Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct. The panel shall be manufactured of CFC-free Kingspan Kooltherm closed cell rigid thermoset resin thermally bonded on both sides to a factory applied .001" (25 micron) aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, IR reflective 1000-micron high impact resistant titanium infused vinyl is factory bonded using a full lamination process. The lamination process shall permanently bond the vinyl clad to the outer surfaces of the phenolic foam panel to provide a zero-permeability watertight barrier and to form a structurally insulated panel (SIP) in which to form duct segments. Processes that do not employ a full lamination process are not acceptable. Self-applied adhesives such as tapes, caulks or cladding that incorporate pressure sensitive or spray adhesives are not acceptable.
- C. The thermal conductivity shall be no greater than $0.146 \text{ BTU} \cdot \text{in} / \text{Hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}$ ($.018 \text{ W} / \text{m} \cdot ^\circ\text{C}$), the thermal conductivity shall be no greater than $0.146 \text{ BTU} \cdot \text{in} / \text{Hr} \cdot \text{ft}^2 \cdot ^\circ\text{F}$ ($.018 \text{ W} / \text{m} \cdot ^\circ\text{C}$)
- D. The density of the Kooltherm foam shall not be less than 3.5 pcf (56 Kg/m³) with a minimum compressive strength of 28 psi (.2 MPa).

- E. The standard panel is (31 mm) thickness panel with R-8.1 (1.5 RSI) shall be utilized unless indicated otherwise on the print.
1. Maximum Temperature: Continuous rating of 185 degrees F (70 deg C) inside ducts or ambient temperature surrounding ducts.
 2. Maximum Thermal Conductivity: 0.146 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 3. Permeability: 0.00 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
 4. Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.
 5. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.
 6. Required Markings: All interior duct liner shall bear UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for internal closure materials.
 7. All insulation materials shall be closed cell with a closed cell content of >90%.
8. R-value:
- a. 1 3/16 inch (31 mm) Thick Panel: 8.1 R
 - b. 1 3/4 (45 mm) Thick Panel: 12 R
 - c. 2 3/8" Double wall (62 mm) Thick Panel: 16.2 R
 - d. 3" Double wall (76 mm) Thick Panel: 20.1 R
 - e. 3.5" Double wall (100 mm) Thick Panel 24 R
- F. Closure Materials:
1. V-Groove Adhesive: Silicone (interior only).
 2. UV stable 1000-micron high impact resistant titanium infused vinyl (exterior).
 - a. Factory manufactured seamless corners for zero perms.
 - b. Cohesive bonded over-lap at corner seam covers for zero perms.
 - c. Water resistant titanium infused welded vinyl seams.
 - d. Mold and mildew resistant.
 3. Polymeric Sealing System:
 - a. Structural Membrane: Aluminum scrim with woven glass fiber with UV stable vinyl clad applied
 - b. Minimum Seam Cover Width: 2 7/8" inches (75 mm)
 - c. Sealant: Low VOC.
 - d. Color: White (colors, matched by architect optional).
 - e. Water resistant.
 - f. Mold and mildew resistant.
 4. Duct Connectors.
 - a. Factory manufactured galvanized 4-bolt flange.
- G. Outdoor Cladding
1. Thermaduct outdoor Installations: Duct segments shall incorporate UV stable 1000-micron high impact resistant titanium infused vinyl which is introduced during the manufacturing process.
- H. Flange coverings
- a. Flanges are field sealed airtight before flange covers are installed. Flange covering consists of the following:
 1. Foam tape insulation with molded 39 mil covers.
 2. Air gap (heating only application) with molded 39 mil covers.
- I. Reinforcement
1. Thermaduct shall provide designed and built with adequate reinforcement to both; withstand air pressure forces from within the duct from blower pressure and shall be built to handle expected snow load for the location where the Thermaduct is being installed.

Thermaduct will employ Airtruss™ reinforcement system when both specified static pressure and duct sizes dictate the need. This is a factory installed system and no field installation of the reinforcement system is required.

J. Weight

1. Thermaduct shall provide low weight stresses on the building framing and support members. Assembled Thermaduct shall have a weight of 0.86 lbs. per square foot to maximum weight of 2.7 lbs. per square foot (depending on R-value and reinforcement requirement). Hangers and tie-downs are to be detailed on the manufacturer's installing contractors detail drawings prior to installation but not exceeding 13' for duct girth <84" and 8' for duct girth >85" between hangers and designed to carry the weight and wind load of the ductwork.

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS:

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. McGill AirFlow LLC.
2. SEMCO Incorporated.
3. Sheet Metal Connectors, Inc.
4. Eastern Sheetmetal.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

a. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.

b. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch (0.7-mm) solid galvanized sheet steel.

- E. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
 - 1. Maximum Thermal Conductivity: 0.25 Btu x in./h x sq. ft. x deg F (0.034 W/m x K) at 75 deg F (24 deg C) mean temperature.

2.5 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.6 DUCT LINER

- A. Flexible Elastomeric Duct Liner: Manufacturer's shall be Aeroflex USA Inc., Armacell LLC, Rubatex International, LLC or approved equal. Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
 - 1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 2. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- B. Insulation Pins and Washers:
 - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
 - 1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
 - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
 - 3. Butt transverse joints without gaps, and coat joint with adhesive.
 - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted edge overlapping.
 - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
 - 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s) or less.
 - 7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse

joints and at intervals not exceeding 18 inches (450 mm) longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

2.7 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- C. Flanged Joint Sealant: Comply with ASTM C 920.
 1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.8 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 15 Section "Duct Accessories" for fire.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
 - 3. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 4. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.7 START UP

- A. Air Balance: Comply with requirements in Division 15 Section "Testing, Adjusting, and

Balancing."

3.8 DUCT SCHEDULE

- A. Supply Ducts:
 - 1. Ducts Connected to AC Units:
 - a. Pressure Class: Positive 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- B. Return Ducts:
 - 1. Ducts Connected to AC Units:
 - a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 12.
- C. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting Air:
 - a. Pressure Class: Negative 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: C if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- D. Outdoor-Air Ducts:
 - 1. Ducts Connected to AHU:
 - a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: C.
 - c. SMACNA Leakage Class for Rectangular: 12.
 - d. SMACNA Leakage Class for Round and Flat Oval: 6.
- E. Intermediate Reinforcement:
 - 1. Galvanized-Steel Ducts: Galvanized steel.
- F. Liner:
 - 1. Supply Air Ducts: Flexible elastomeric, 1 inch (25 mm) thick (15' from AHU).
 - 2. Return Air Ducts: Flexible elastomeric, 1 inch (25 mm) thick (15' from AHU).
 - 3. Exhaust Air Ducts: None.
 - 4. Transfer Ducts: Flexible elastomeric, 1 inch (25 mm) thick.
- G. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm (5 m/s) or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

- c. Velocity 1500 fpm (7.6 m/s) or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

- 2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Welded.

- H. Branch Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
 - 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION

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SECTION 15820 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Barometric relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Fire dampers.
 - 5. Turning vanes.
 - 6. Duct-mounted access doors.
 - 7. Flexible ducts.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper installations, including sleeves; and duct-mounted access doors.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Exposed-Surface Finish: Mill phosphatized.

2.2 BAROMETRIC RELIEF DAMPERS

- A. Suitable for horizontal or vertical mounting.
- B. Maximum Air Velocity: 2000 fpm (10 m/s).
- C. Maximum System Pressure: 2-inch wg (0.5 kPa).
- D. Frame: 0.064-inch- (1.6-mm-) thick, galvanized sheet steel, with welded corners and mounting flange.
- E. Blades:
 - 1. Multiple, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
 - 2. Maximum Width: 6 inches (150 mm).
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- F. Blade Seals: Vinyl.
- G. Blade Axles: Galvanized steel.
- H. Tie Bars and Brackets:
 - 1. Material: Aluminum.
 - 2. Rattle free with 90-degree stop.
- I. Return Spring: Adjustable tension.
- J. Bearings: Synthetic.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Standard leakage rating, with linkage outside airstream.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch (1.62-mm) minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized steel, 0.064 inch (1.62 mm) thick.
 - 5. Blade Axles: Galvanized steel.
 - 6. Bearings:
 - a. Oil-impregnated bronze.

- b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

2.4 CONTROL DAMPERS

- A. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- B. Frames:
 - 1. Hat shaped.
 - 2. Galvanized-steel channels, 0.064 inch (1.62 mm) thick.
 - 3. Mitered and welded corners.
- C. Blades:
 - 1. Multiple blades with maximum blade width of 8 inches (200 mm).
 - 2. Opposed-blade design.
 - 3. Galvanized steel.
 - 4. 0.064 inch (1.62 mm) thick.
 - 5. Blade Edging: Closed-cell neoprene edging.
 - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- D. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
 - 1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
- E. Bearings:
 - 1. Oil-impregnated bronze.
 - 2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 3. Thrust bearings at each end of every blade.

2.5 FIRE DAMPERS

- A. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- B. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 4000-fpm (20-m/s) velocity.
- C. Fire Rating: 1-1/2 hours.
- D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 - 1. Minimum Thickness: 0.052 or 0.138 inch (1.3 or 3.5 mm) thick, as indicated, and of length to suit application.
 - 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In

place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

- H. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.

2.6 FLANGE CONNECTORS

- A. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- B. Material: Galvanized steel.
- C. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions.
- B. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- C. Vane Construction: Single wall.

2.8 DUCT-MOUNTED ACCESS DOORS

- A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
 - d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.9 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.
 - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- B. Insulated, Flexible Duct: UL 181, Class 1 duct, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 - 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 - 3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
 - 4. R-8 insulation value.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. Control devices requiring inspection.
 - 8. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).

3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- J. Label access doors according to Division 15 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect flexible ducts to metal ducts with draw bands.
- M. Install duct test holes where required for testing and balancing purposes.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
1. Install steel volume dampers in steel ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. On both sides of duct coils.
 2. Upstream from duct filters.
 3. At outdoor-air intakes and mixed-air plenums.
 4. At drain pans and seals.
 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 6. Adjacent to and close enough to fire dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 7. Control devices requiring inspection.
 8. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).

3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
 5. Body Access: 25 by 14 inches (635 by 355 mm).
 6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).
- J. Label access doors according to Division 15 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- K. Install flexible connectors to connect ducts to equipment.
- L. Connect flexible ducts to metal ducts with draw bands.
- M. Install duct test holes where required for testing and balancing purposes.

4.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

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SECTION 15838 - POWER VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Ceiling-mounted ventilators.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- C. UL Standard: Power ventilators shall comply with UL 705.

PART 2 - PRODUCTS

2.1 CEILING-MOUNTED VENTILATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Loren Cook Company.
 - 2. Penn Ventilation.
 - 3. Greenheck
- D. Description: Fan shall be ceiling mounted, direct driven, centrifugal exhaust fan.
- E. Construction: The fan wheel housing and integral outlet duct shall be injection molded from a specially engineered resin exceeding UL requirements from smoke and heat generation.

- F. Fan Wheel: Centrifugal forward curved type, injection molded of polypropylene resin. Wheel shall be balanced in accordance with AMCA 204-05.
- G. Grille: Painted aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.
- H. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.
- I. Accessories:
 - 1. Fan Speed Controller: Pre-wired adjustable fan speed controller.
 - 2. Ceiling Radiation Damper (where required): Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
 - 3. Isolation: Rubber-in-shear vibration isolators.
 - 4. Manufacturer's standard roof jack or wall cap, and transition fittings.

2.2 MOTORS

- A. Comply with requirements in Division 15.
- B. Type: Motor shall be open drip proof type with permanently lubricated bearings and include impedance or thermal overload protection and disconnect plug.

2.3 INLINE VENTILATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - 1. Loren Cook Company.
 - 2. Penn Ventilation.
 - 3. Greenheck
- D. Description: Fan shall be suspended from structure above ceiling, direct driven, centrifugal exhaust fan.
- E. Construction: The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation.
- F. Fan Wheel: Centrifugal backward inclined, aluminum construction with precision machined cast aluminum hub. Wheel shall be balanced in accordance with AMCA 204-05.
- G. Electrical Requirements: Junction box for electrical connection on housing and NEMA 1 disconnect switch.
- H. Accessories:
 - 1. Fan Speed Controller: Pre-wired adjustable fan speed controller.
 - 2. Isolation: Rubber-in-shear vibration isolators.
 - 3. Motorized backdraft damper, aluminum frame and blades.

2.4 MOTORS

- A. Comply with requirements in Division 15.
- B. Type: Motor shall be NEMA design B with class B insulation rated for continuous duty. Motor shall be heavy duty type with permanently lubricated sealed bearings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Ceiling Units: Suspend units from structure; use factory vibration isolation kit.
- C. Install units with clearances for service and maintenance.
- D. Label units according to requirements specified in Division 15 Section "Mechanical Identification."
- E. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section 15820 "Duct Accessories."
- F. Install ducts adjacent to power ventilators to allow service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.

 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

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SECTION 15855 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Fixed face registers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:

- 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static pressure drop, and noise ratings.
- 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

- B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

- 1. Ceiling suspension assembly members.
- 2. Method of attaching hangers to building structure.
- 3. Size and location of initial access modules for acoustical tile.
- 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- 5. Duct access panels.

- D. Source quality-control reports.

1.4 MANUFACTURERS

- 1. TITUS.
- 2. Metalaire.
- 3. Price.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Rectangular and Square Ceiling Diffusers:

- 1. Devices shall be specifically designed for variable-air-volume flows.
- 2. Material: Aluminum.
- 3. Finish: Baked enamel, white.
- 4. Mounting: Surface or T-bar (see plans).
- 5. Pattern: Adjustable.
- 6. Dampers: Butterfly.

- B. Louver Face Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
 2. Material: Aluminum.
 3. Finish: Baked enamel, white.
 4. Mounting: See plans.
 5. Pattern: See plans.
 6. Dampers: See plans.
 7. Accessories:
 - a. Square to round neck adapter.
 - b. Adjustable pattern vanes.

2.2 REGISTERS AND GRILLES

1. Material: Aluminum.
 2. Finish: Baked enamel, color selected by Architect.
 3. Face Blade Arrangement: Vertical spaced 1/2 inch (13 mm) apart.
 4. Core Construction: Removable.
 5. Rear-Blade Arrangement: Horizontal spaced 1/2 inch (13 mm) apart.
 6. Frame: 1-1/4 inches (32 mm) wide.
 7. Mounting: Concealed.
 8. Damper Type: Adjustable opposed blade.
- B. Fixed Face Register:
1. Material: Aluminum.
 2. Finish: Baked enamel, white.
 3. Face Arrangement: 1/2-by-1/2-by-1/2-inch (13-by-13-by-13-mm) grid core.
 4. Core Construction: Integral.
 5. Mounting: Lay in.
 6. Damper Type: Adjustable opposed blade.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

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SECTION 15900 - HVAC INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION:

- A. General: Furnish and install a complete system of automatic temperature controls, as specified herein, as shown on the drawings and as required for a complete installation. All temperature control equipment shall be of the electric type.

1.2 APPROVED CONTROL SYSTEM CONTRACTORS AND MANUFACTURERS:

- A. Approved Control System Contractors and Manufacturers: Schneider Electric (Albireo Energy), Trane, Automated Logic (Gulf States Automation) and Honeywell. Control work shall be installed by a controls contractor.

PART 2 - PRODUCTS

2.1 CONTROL EQUIPMENT AND SYSTEMS:

- A. Thermostats (T): Shall be Honeywell Vision Pro 8000 (architect to select housing color) series or approved equal.
1. Supply Input Voltage: 24 V AC 50/60Hz $\pm 15\%$
 2. Input Voltage: 0-10 VDC
 3. Input Type: Dry contact 2, Analog 5
 4. Temperature Sensor Type: 10kOhm T2 NTC thermistor
 5. Accuracy: Temperature $\pm 0.5^{\circ}\text{C}$, Humidity $\pm 5\%$, 20-80% RH
 6. Output Voltage: 24V AC/DC relay output 0-10V AC/DC voltage output
 7. Output Type: 5 relay output, 4 universal
 8. Communication port protocol: BACnet/MS/TP, Modbus RTU, Zigbee Pro
- B. Carbon Dioxide (CO₂) Sensors: Shall be Senva CT1R-A3D or approved equal.
1. Power Supply: 12-30 VDC / 24 VAC, 100mA max.
 2. Analog Output: 3-wire 4-10mA and 0-5V/0-10V (dip switch selectable)
 3. Digital Setpoint Output: Solid State, 1A @ 30VAC/DC, N.O.
 4. Sensor Type: Non-dispersive infrared (NDIR)
 5. Accuracy: $\pm(30\text{ppm} + 3\%\text{reading})(400-2000\text{ppm}), @ -10-50^{\circ}\text{C}$
 6. Range: 0-2000/5000ppm: Programmable up to 10,000ppm
 7. Response Time: 60s to 90% reading
- C. Humidity (H) Sensors: Shall be Veris HW2L or approved equal.
1. Power Supply: Class 2; 20 to 30 VDC, 24 VAC, 50 to 60 Hz
 2. Analog Output: Selectable 4 to 20 mA, 0 to 5 V, 0 to 10 V
 3. Digital Setpoint Output: 0 to 10 V Output, Scale: 50 to 95°F/32 to 122°F
 4. Sensor Type: Thin-film capacitive, replaceable
 5. Accuracy: $\pm 2\%$ from 10 to 80% RH @ 77°F
 6. Range: 0 to 100% RH
- D. Control Damper: Shall be furnished by temperature control contractor. See "Motor Operated Volume Damper" specification. Ruskin CD40 or approved equal.
- E. Control Damper Actuators:

1. Electronic damper operators: shall be two positions direct coupled with spring return. Belimo or equivalent.
2. Motors: shall be low voltage synchronous type and shall be non-overloading at a continuous stall.
3. Actuators: shall be selected, mounted, and tested for proper operation based on size, type, and torque requirements.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Interface with Other Work:
 1. Calibrate room thermostats as required during air test & balance.
 2. Instruct air test & balance personnel in proper use and setting of control system components.
- B. Run wiring in conduit in exposed areas. No exceptions.
- C. Safety Controls:
 1. Mount smoke detector in supply ducts of each ducted heating and/or cooling system and interlock to keep heating and cooling from operating if detector is energized.
 2. Interlock electric heaters with cooling compressors and supply air fan.
 3. Check high limit thermostats furnished with heating equipment for correct operation. Electric heaters shall cut-off when duct temperature exceeds high limit setting.
 4. Fresh air dampers shall close on fan shut-down, power failure, open fan motor disconnect switch, and when thermostat is in UNOCCUPIED mode.
- D. Provide adjustable time delay timer for each AC system to offset unit starts.
- E. Mount damper actuators and actuator linkages external of air flow.
- F. Provide fresh battery in each thermostat and instruct owner in battery replacement.
- G. Paste copy of record control wiring diagram on back of relay panel door cover for each heat pump system.
- H. Manufacturer's Field Service:
 1. Calibrate, adjust, and set controls for proper operation, operate systems, and be prepared to prove operation of any part of control system. This work is to be completed before pre-final inspection.
- I. Program thermostats per owner's request time schedule.

END OF SECTION

SECTION 15940 -SEQUENCE OF OPERATION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes control sequences for HVAC systems, subsystems, and equipment.
- B. See Division 15 Section "HVAC Instrumentation and Controls" for control equipment and devices and for submittal requirements.

1.2 CONTROL SEQUENCES

- A. Constant Volume Package AC Units (PAC-1, 2, 3, 4, 5, 6, 7, and 8):
 - 1. Each Package Unit shall be started and stopped by a 7-Day Programmable Touch Screen Thermostat – (Honeywell Vision Pro 8000).
 - 2. When the Thermostat activates the unit, the fan shall start, and the room sensor shall control the unit. The Thermostat shall stage the DX cooling or modulating gas furnace to maintain temperature setpoint. When the Thermostat de-activates the unit, the fan shall stop, and the outdoor air damper shall close.
 - 3. Each unit shall have a low limit and high limit sensor for sequencing. On a drop in space temperature below 55° F. (adj.) the unit shall cycle the modulating natural gas furnace until space temperature reaches 60° F (adj.). On a rise in space temperature above 85°F (adj.) the unit shall start the DX cooling and run until space temperature reaches 80°F (adj.).
 - 4. Outdoor Air: When unit runs in occupied mode, the O.A. damper shall open to maximum position and the return damper shall close to minimum position. When unit runs in unoccupied mode, the O.A. damper shall close, and the return air damper shall open to maximum position. CO2 Sensors – When CO2 level reaches 1000 ppm, the O.A. damper shall open to maximum position and the return damper shall close to minimum position. When CO2 level drops below 1000 ppm, the O.A. damper shall close to minimum position and the return air damper shall open to maximum position.
 - 5. Dehumidification: On a call for dehumidification, the hot gas reheat valve shall energize and both compressors shall enable. When the humidity control setpoint is satisfied, the valve shall de-energized and both compressors shall be disabled. If there is a call for 1st stage cooling while in dehumidification mode, no action shall take place. If there is a call for 2nd stage cooling, the hot gas reheat valve shall be de-energized, and the unit shall revert to the cooling mode. If 2nd stage cooling is satisfied and there is still a call for dehumidification, the hot gas reheat valve shall once again be energized.
 - 6. Economizer (PAC-1, 2, 3, 4 and 5): Enable (Reference Dry Bulb): Outside Air (OA) temperature shall be compared with a reference dry bulb setpoint. The economizer shall enable when the OA temperature is less than reference dry bulb setpoint. The economizer shall be disabled when OA temperature is greater than reference dry bulb setpoint +2.0 deg. F.
The unit shall measure the dry bulb supply air temperature and dry bulb outdoor air temperature and economizer shall be enabled when the outdoor air temperature is below the dry bulb change over setpoint. When economizing is enabled and the unit is operating in the cooling mode, the economizer damper shall be modulated between its minimum position and 100% to maintain the discharge air temperature setpoint. The

economizer damper shall modulate toward minimum position in the event the discharge air temperature falls below the discharge low limit temperature setpoint.

7. Relief Air and Building Pressure Control: The barometric relief dampers shall open with increased building pressure. As the building pressure increases, the pressure in the return section also increases, opening the dampers and relieving air.
 8. Occupied Mode Operation: During occupied times, the supply fan shall run continuously, and the outdoor air dampers shall open to maintain minimum ventilation requirements. The DX cooling and the gas furnace shall control the active discharge air temperature setpoint.
 9. Unoccupied Mode Operation: When the space temperature is below the unoccupied heating setpoint of 60.0 deg. F. (adj.) the supply fan shall be commanded on, the outside air damper shall remain closed, and the gas furnace shall be enabled. When the space temperature rises above the unoccupied heating setpoint of 60.0 deg. F. (adj.) the supply fan shall stop, and the gas furnace shall be disabled. When the space temperature is above the unoccupied cooling setpoint of 85.0 deg. F. (adj.) the supply fan shall be commanded on, the outside air damper shall remain closed, and the DX cooling shall be enabled. When the space temperature falls below the unoccupied cooling setpoint of 85.0 deg. F. (adj.) the supply fan shall stop, and the DX cooling shall be disabled.
- B. Ceiling Mounted Exhaust Fans: Each fan shall be interlocked/controlled as indicated in Exhaust Fan Schedule. Provide a manual motor starter and fan speed controller with an "Off-On" switch at each fan. See electrical drawings for switch location.
- C. Inline Supply and Exhaust Fans: Each fan shall be interlocked/controlled as indicated in Exhaust Fan Schedule. Provide a manual motor starter and fan speed controller with an "Off-On" switch at each fan. See electrical drawings for switch location.
- D. Fire Alarm Control: Upon a receipt of an alarm from the building fire alarm system, all AC units shall be shut down.
- E. Operational Schedules: Obtain yearly operational schedule from Owner. If no schedule can be confirmed, program controller to place all equipment into occupied mode from 6:00 am to 6:00 am, Monday through Friday, with the exception of holidays.
- F. Ductless Mini-Split Heat Pump Unit: Control with factory 7-day programmable wall mounted thermostat.
1. When the Thermostat activates the unit, the fan shall start, and the room sensor shall control the unit. The Thermostat shall stage the DX cooling or heat pump heat to maintain temperature setpoint. When the Thermostat de-activates the unit, the fan shall stop.
 2. Each heat pump shall have a low limit and high limit sensor for sequencing. On a drop in space temperature below 55° F. (adj.) the heat pump shall cycle the heat pump until space temperature reaches 60° F (adj.). On a rise in space temperature above 85°F (adj.) the heat pump shall start the DX cooling and run until space temperature reaches 80°F (adj.).

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

SECTION 15950 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS:

- A. Certified TAB reports.
- B. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.
 - 1. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard TAB contractor's forms.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 COORDINATION

- A. Notice: Provide three days' advance notice for each test. Include scheduled test dates and times.

- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Division 15 Section "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- K. Examine operating safety interlocks and controls on HVAC equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

2.2 PREPARATION:

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - Permanent electrical-power wiring is complete.
 - 1. Automatic temperature-control systems are operational.

2. Equipment and duct access doors are securely closed.
3. Balance, smoke, and fire dampers are open.
4. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
5. Windows and doors can be closed so indicated conditions for system operations can be met.

2.3 GENERAL PROCEDURES FOR TESTING AND BALANCING:

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 15 Section "Duct Accessories."
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 15 Section "HVAC Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

2.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS:

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 15 Section "Metal Ducts."

2.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS:

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 1. Measure total airflow.

- a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 15 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

2.6 PROCEDURES FOR MOTORS:

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer's name, model number, and serial number.

2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

2.7 PROCEDURES FOR CONDENSING UNITS:

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

2.8 PROCEDURES FOR HEAT-TRANSFER COILS:

- A. Measure, adjust, and record the following data for each electric heating coil:
 1. Nameplate data.
 2. Airflow.
 3. Entering- and leaving-air temperature at full load.
 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 5. Calculated kilowatt at full load.
 6. Fuse or circuit-breaker rating for overload protection.
- B. Measure, adjust, and record the following data for each refrigerant coil:
 1. Dry-bulb temperature of entering and leaving air.
 2. Wet-bulb temperature of entering and leaving air.
 3. Airflow.
 4. Air pressures drop.
 5. Refrigerant suction pressure and temperature.

2.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS:

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the refrigerant charge.
 4. Check the condition of filters.
 5. Check the condition of coils.
 6. Check the operation of the drain pan and condensate-drain trap.
 7. Check bearings and other lubricated parts for proper lubrication.
 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Bearings and other parts are properly lubricated.
 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan speed and the face velocity of filters and coils.

2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
4. Balance each air outlet.

2.10 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus, or minus 10 percent.
 2. Air Outlets and Inlets: Plus, or minus 10 percent.

2.11 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

2.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 1. Fan curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 1. Title page.
 2. Name and address of the TAB contractor.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer's name, type, size, and fittings.
 14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Other system operating conditions that affect performance.

- D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
 1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Pipe and valve sizes and locations.
 4. Balancing stations.

- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches (mm), and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.

 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Filter static-pressure differential in inches wg (Pa).
 - f. Preheat-coil static-pressure differential in inches wg (Pa).
 - g. Cooling-coil static-pressure differential in inches wg (Pa).
 - h. Heating-coil static-pressure differential in inches wg (Pa).
 - i. Outdoor airflow in cfm (L/s).
 - j. Return airflow in cfm (L/s).
 - k. Outdoor-air damper position.
 - l. Return-air damper position.

- F. Apparatus-Coil Test Reports:
 1. Coil Data:
 - a. System identification.
 - b. Location.

- c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch (mm) o.c.
 - f. Make and model number.
 - g. Face area in sq. ft. (sq. m).
 - h. Tube size in NPS (DN).
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
2. Test Data (Indicated and Actual Values):
- a. Air flow rate in cfm (L/s).
 - b. Average face velocity in fpm (m/s).
 - c. Air pressures drop in inches wg (Pa).
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).
 - h. Water pressure differential in feet of head or psig (kPa).
 - i. Entering-water temperature in deg F (deg C).
 - j. Leaving-water temperature in deg F (deg C).
 - k. Refrigerant expansion valve and refrigerant types.
 - l. Refrigerant suction pressure in psig (kPa).
 - m. Refrigerant suction temperature in deg F (deg C).
- G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
1. Unit Data:
- a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in Btu/h (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Air flow rate in cfm (L/s).
 - i. Face area in sq. ft. (sq. m).
 - j. Minimum face velocity in fpm (m/s).
2. Test Data (Indicated and Actual Values):
- a. Heat output in Btu/h (kW).
 - b. Air flow rate in cfm (L/s).
 - c. Air velocity in fpm (m/s).
 - d. Entering-air temperature in deg F (deg C).
 - e. Leaving-air temperature in deg F (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
- a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.

- g. Sheave make, size in inches (mm), and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
2. Motor Data:
- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
- a. System and air-handling-unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated air flow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual air flow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- J. Instrument Calibration Reports:
1. Report Data:
- a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

2.13 INSPECTIONS:

- A. Initial Inspection:
1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- B. Final Inspection:
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Engineer.
 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Engineer.

3. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

2.14 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

Division 16



Prepared by Kenneth R. Gunn Jr., P.E.

SECTION 16100
ELECTRICAL

PART 1 - GENERAL

1.01. RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections apply to work specified in this section.

1.02. QUALIFICATIONS OF ELECTRICAL CONTRACTORS:

- A. Electrical contractor must be properly established as an electrical contractor by the State of Alabama. Electrical contractor shall have had previous experience in the satisfactory installation of at least three systems of this type and size in the State of Alabama.

1.03. CODES, PERMITS AND INSPECTIONS:

- A. Comply with applicable laws of the community, with latest edition of National Electrical Code (NEC), NFC 70, and the International Building Code (IBCC) or the edition adopted by the local authority having jurisdiction, where not in conflict with those laws, and with the service rules of the local utility company.
- B. Obtain and pay for all permits and deposits, and arrange for inspections as required.
- C. After completion of the work, submit certificate of final inspection and approval from the local electrical inspector, certifying that the installation complies with all regulations governing same.

1.04. MATERIALS:

- A. All materials shall be new, and UL approved where a standard has been established.
- B. Manufacturers' names and model numbers shown on the plans and in the specifications are given to indicate the type and general quality of items to be provided. Equal products by other manufacturers will be accepted.
- C. Material substitutions will be considered only when evidence of equality and suitability, satisfactory to the Architect/Engineer has been presented in writing, with samples if requested by the Architect/Engineer. All prior approvals must have the approval of the engineer of record at the offices of Gunn and Associates, P.C. located at 3102 Highway 14, Millbrook, AL 36054, Phone: 334-285-1273
- D. All proposed substitutions shall be approved in writing at least ten (10) days prior to the bid date.
- E. It shall be understood that the Architect/Engineer has the authority to reject any material or equipment used which is not specified or approved, or showing defects of manufacture or workmanship, before or after such material or equipment is installed.

1.05. WORKMANSHIP:

- A. Execute all work so as to present a neat and workmanlike appearance when completed.

1.06. DESCRIPTION OF WORK:

- A. Furnish all labor and materials required to complete the electrical work indicated on the drawings or herein specified. Major work included in Section 16 shall be:
- B. Prior to bid it is the contractor's responsibility to re-affirm with the power company the service requirements to the facility as indicated on the electrical drawings. If any changes or additions to the service lateral installation indicated on the drawings is required by the utility company the contractor shall include the cost of these changes in his/her bid. Additionally, any/all charges for electrical service to the facility (aid-to-construction) by the utility company shall be included in the contractor's bid price.

- C. Remove or relocate all electrical or electronic services located on or crossing through the project property, either above or below grade, which would obstruct the construction of the project or conflict in any manner with the complete project or any code pertaining thereto.
- D. Furnish and install a complete electrical light and power system including but not limited to the connection of all meters, switchboards, panelboards, circuit breakers, power outlets, convenience outlets, lighting fixtures, switches, and/or other equipment forming part of the electrical system.
- E. Connect all electrical equipment whether furnished by this contractor or by others.
- F. Furnish and install all disconnect switches not included as an integral part of equipment.
- G. Furnish and install a complete Lighting Control System.
- H. Furnish and install a complete Fire Alarm System compliant with applicable provisions of the International Building Code (IBC) and the National Fire Protection Association (NFPA) Standard No. 72.
- I. Furnish and install a complete Intercom System.
- J. Complete the alterations, additions, and renovations to the electrical system in the existing building as specified herein or as shown on the drawings.
- K. Procure and pay for permits and certifications as required by local and state ordinances and Fire Underwriters certificate of inspection.
- L. Visit the site and determine conditions that affect this contract. Failure to do so will in no way relieve the Contractor of his responsibility under his contract.
- M. Submit to the Architect a certificate of final inspection from local and/or state inspection authorities.
- N. Establish and maintain temporary electrical services for construction purposes.

1.07. DRAWINGS AND SPECIFICATIONS:

- A. This Contractor shall examine drawings and Specifications relating to the work of all trades and become fully informed as to the extent and character of work required and its relation to all other work in the project prior to submission of bid and prior to the start of any construction.
- B. Drawings and Specifications shall be considered as complementary each to the other. What is called for by one shall be as binding as if called for by both. Where conflicts occur, secure clarification from the Architect in advance of bidding; otherwise incorporate the more stringent conditions into the bid price.
- C. Omissions from the drawings and specifications or the mis-description of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such omissions and details of work; they shall be performed as if fully and correctly set forth and described in the drawings and specifications.
- D. The drawings indicate diagrammatically the extent, general character, and the approximate location of the work to be performed. In the interest of clearness, the work is not always shown to scale or exact location. Check all measurements, locations of conduit, fixtures, outlets, and equipment with the detailed architectural, structural, and mechanical drawings, and lay out work so as to fit in with ceiling grids, ductwork, sprinkler piping and heads, and other parts. Take finished dimensions at the job site in preference to using scale dimensions.
- E. Where the work is indicated but with minor details omitted, furnish and install the work complete so as to perform its intended functions.
- F. Where doubt arises as to the meaning of the plans and specifications, obtain the Architect's decision before proceeding with parts affected; otherwise assume liability for damage to other work and for making necessary corrections to work in question.
- G. Except as noted above, make no changes in or deviations from the work as shown or specified except on written order of the Architect.

1.08. EXISTING CONDITIONS:

- A. Before submitting a bid, visit the site and ascertain all existing conditions.
- B. Make such adjustments in work as are required by the actual conditions encountered.
- C. No consideration will be given after bid opening for alleged misunderstandings regarding utility connections, integration of work with existing system, or other existing conditions.

1.09. SUBMITTALS:

- A. Follow procedure outlined in Division 1.
- B. Submittals shall be bound together and shall include a coversheet indicating the following:
 - 1. Project name
 - 2. Trade contractor's name
 - 3. Supplier's name
 - 4. Name and phone number of supplier's contact person
 - 5. A list of each item submitted with manufacturers' names and model numbers.
- C. Within 20 days of award of contract and prior to beginning any work on the project submit six (6) copies of manufacturer's drawings/data sheets for the following items to the Engineer for review:
 - 1. Conductors
 - 2. Cable Pulling tensions. Provide cable pull tension calculations (lateral and longitudinal) on all underground cable runs over 150 feet for cables sized #1 and larger. Provide one line diagram indicating pulling tensions on each run and number and size of each pull box along anticipated route. Calculations shall include changes in direction or elevation of feeder runs.
 - 3. Wiring Devices
 - 4. Conduit Wrapping Tape
 - 5. Panelboards
 - 6. Power system breaker coordination. Submit proper breaker settings recommendations with breaker coordination study.
 - 7. Contractor shall coordinate with mechanical/plumbing shop drawings prior to submitting power package to engineer. Adjust overcurrent devices accordingly.
 - 8. Disconnect Switches
 - 9. Fire Stopping
 - 10. Lighting Control System: Include conduit and cable layout, terminal to terminal wiring showing color code and wire numbers, and complete technical data on each system component. Furnish the Owner one set of as built drawings at completion of the project. Coordinate with lighting control riser on drawings for further shop drawings requirements.
 - 11. Lighting Fixtures (include photometric data for each fixture)
 - 12. Fixture Support Equipment
 - 13. Lighting Standards (Poles)
 - 14. Data/Telecommunications System
 - a. Cable
 - b. Equipment
 - c. Installer qualifications
 - d. Makes and Model Numbers of Testing Equipment to be used.
 - 15. Secondary Surge Arresters
 - 16. Transient Voltage Surge Suppressors(Surge Protective Devices)
 - 17. **Fire Alarm System: The fire alarm shop drawings shall bear the approval of the fire protection provider to ensure all supervisory valves and flow switches are being monitored by the fire alarm system. Coordinate with fire protection provider prior to bid and provide monitoring for all supervisory valves and flow switches for entire building. Bid accordingly. Include conduit and cable layout, battery calculations, terminal to terminal wiring showing color code and wire numbers, and complete technical data on each system component. Additionally, the contractor or his/her fire alarm system vendor shall provide audibility calculations indicating compliance with all applicable provisions of NFPA 72 and the IBC. The contract drawings indicate a minimum design required to comply with applicable codes. However,**

since devices vary from manufacturer to manufacturer the contractor shall be responsible for furnishing any/all additional devices as required to provide audibility and visibility levels that comply with applicable sections of NFPA 72 and IBC. Furnish the Owner one set of as built drawings at completion of the project. Provide a copy of the fire alarm contractor's State Fire Marshal's Permit with the submittals for approval.

18. Intercom System

19. J-Hooks

- D. Submit samples upon request.
- E. The Contractor is responsible for verifying all quantities and for verifying and coordinating dimensional data with the available space for items other than the basis of design.
- F. Provide a 1/2"= 1'- 0" scale drawing of all electrical rooms containing more than a single panelboard section or containing a panelboard and other electrical and/or mechanical equipment. These drawings shall be submitted along with equipment data sheets.
- G. The contractor shall review and approve, or make appropriate notations on each item prior to submittal to the architect. Submittals without contractor's approval will be rejected.

1.10. COORDINATION OF SERVICE WITH OTHER TRADES:

- A. It shall be the responsibility of the Electrical Contractor to coordinate the electrical service characteristics to each piece of electrically operated equipment with all trades providing electrically operated equipment.
- B. Within ten (10) working days of notification to proceed with construction from the Architect, the Electrical Contractor shall notify, in writing, all trades providing electrically operated equipment the characteristic of the electrical power being supplied to each piece of electrically operated equipment.
- C. A copy of this notification shall be provided to the General Contractor and the Architect.
- D. Be informed as to equipment being furnished by other trades, but not liable for added cost incurred by equipment substitutions made by others which require excess electrical wiring or equipment above that indicated on drawings or specified.
- E. The contractor providing the equipment shall be responsible for the additional costs.

1.11. PROGRESS OF WORK:

- A. Schedule work as necessary to cooperate with other trades, Do not delay other trades. Maintain necessary competent mechanics and supervision to provide an orderly progression of the work.

1.12. PROTECTION OF PERSONS AND PROPERTY DURING CONSTRUCTION:

- A. Take all precautions necessary to provide safety and protection to persons and the protection of materials and property.
- B. Protect items of equipment from stains, corrosion, scratches, and any other damage or dirt, whether in storage, at job site or installed. No damaged or dirty equipment, lenses, or reflectors will be accepted.
- C. Live panelboards, outlets, switches, motor control equipment, junction boxes, etc., shall be protected against contact of live parts and conductors by personnel.

1.13. CLEANING UP:

- A. During the progress of work, keep the Owner's premises in a neat and orderly condition, free from accumulation of debris resulting from this work. At the completion of the work, remove all material, scrap, etc. not a part of this Contract.

1.14. AS-BUILT DRAWINGS, AND OPERATING AND MAINTENANCE INSTRUCTIONS:

- A. Prior to the Final Acceptance Inspection the Contractor shall turn over to the Architect one set of reproducible "as built" drawings, including corrected fire alarm system shop drawings, three

(3) sets of all equipment catalogs and maintenance data, manufacturers' warranties, and three (3) sets of shop drawings on all equipment.

1.15. TESTING:

- A. Upon completion of the work, conduct a thorough test in the presence of Architect or his representative, and demonstrate that all systems are in perfect working condition.

1.16. INSPECTIONS:

- A. The contractor shall have all systems ready for operation and an electrician available to remove panel fronts, coverplates, fixture doors, etc., at the final inspection and any other scheduled inspections.
- B. It is the contractor's responsibility to have the job ready for inspections when they are scheduled. We will perform inspections as required by our contract. If project is not ready during inspection and requires a re-inspection by Gunn & Associates, then the contractor shall pay Gunn & Associates, P.C. for the re-inspection. The payment shall be made directly to Gunn & Associates, P.C. in the amount to be determined by engineer. Not to exceed \$1,500 for single re-inspection fee. Payment must be received by Gunn & Associates prior to scheduling re-inspection.
- C. Inspections for Temporary or Permanent Power required by any utility companies are not in our scope of work. If contractor needs Gunn & Associates, P.C. to perform inspections, contractor must include an inspection cost of \$1,000 per inspection in their base bid. Payment must be received by Gunn & Associates prior to scheduling inspection.

1.17. DEMONSTRATION:

- A. By on-off, stop-start operation, demonstrate to the Owner or his representative, the use, working, resetting, and adjusting of each and every system. Submit statement initialed by the Owner that such demonstration has been made.

1.18. WARRANTY:

- A. Warrant the entire electrical system in proper working order. Replace, without additional charge, all work or material that may develop defects (ordinary wear and tear or damage resulting from improper handling excepted) within a period of one year from date of final to general contractor. Provide the owner with two bound copies of all manufacturers' warranties.

1.19. TEMPORARY SYSTEMS:

- A. The Electrical Contractor shall be responsible for furnishing and installing equipment and materials necessary for providing electrical power and lighting where needed for the construction of the project.
- B. Electrical Contractor will be responsible for paying for and providing temporary construction power and lighting for entire job site. Coordinate with local jurisdictions and utility companies and pay all fees necessary to get temporary power to the job site. General Contractor shall be responsible for all monthly utility cost for duration of project or date of substantial completion.

1.20. SERVICE INTERRUPTION CLEARANCE WITH OWNER:

- A. Before submitting a proposal, check with the Owner concerning interruption of service to the existing electrical systems. No interruption shall be made except at such time and for such duration as approved by the Owner. The Contractor's bid shall include all necessary over-time and weekend work.

1.21. DEFINITIONS:

"AWG" - American Wire Gauge

"ADA" - Americans with Disabilities Act

"As required" - Any and all items required to complete the installation of an item so as to perform its intended function.

"Circuiting" - Conductors, raceways, raceway fittings, and associated hardware.

"EMT" - Electrical Metallic Tubing, "thin wall"

"IBC" - International Building Code

- "Install" - furnish, install, and make all necessary connections to and/or for the item(s) indicated or specified.
- "NEC" - National Electrical Code, ANSI/NFPA 70, latest edition or the edition adopted by the authority having jurisdiction.
- "Necessary" - Any and all items required to complete the installation of an item so as to perform its intended function.
- "NEMA"- National Electrical Manufacturers' Association
- "NFPA" - National Fire Protection Association
- "PVC Conduit" – Rigid Nonmetallic Polyvinyl Chloride conduit
- "RGS Conduit" – Rigid galvanized steel conduit
- "UL" - Underwriters' Laboratories, Inc.

PART 2 - MATERIALS

2.01. GENERAL:

- A. This section includes all basic materials for raceways, fittings, busways, conductors, panelboards, switchboards, lighting fixtures and accessories, etc., as required for a complete installation.
- B. All materials shall be new and listed by the Underwriters Laboratories. Material substitutions will be considered only when evidence of equality and suitability, satisfactory to the Architect has been presented in writing, with samples if requested by the Architect.
- C. It shall be understood that the Architect/Engineer has the authority to reject any material or equipment used which is not specified or approved, or showing defects of manufacture or workmanship, before or after such material or equipment is installed.

2.02. CONDUITS:

- A. Rigid Metal (Galvanized Steel-RGS) Conduit: Rigid metal conduit shall be mild steel piping, galvanized inside and outside, and conform to ASA Specification 080.1 and Underwriters' Laboratories Specifications. By Sprang, Republic, Wheatland, Triangle or Pittsburgh.
- B. Intermediate Metal Conduit (IMC): IMC shall be hot dipped galvanized inside and outside and manufactured in accordance with U.L. Standard #6 or #1242. By Allied or approved equal.
- C. Electrical Metallic Tubing (EMT): EMT shall be high grade steel electro-galvanized outside and lacquer or enamel coating inside and conform to ASA Specifications 080.1 and Underwriters' Laboratories Specifications. By Sprang, Republic, Wheatland, Triangle or Pittsburgh.
- D. Rigid Nonmetallic Conduit (PVC): PVC conduit where exposed shall be high impact Schedule 80; below ground and below or in slab PVC shall be of high impact Schedule 40 PVC and shall conform to Underwriters' Laboratories Standard UL-651. By Carlon, Kralely Pittsburgh, R.G. Sloan or Southwestern.
- E. Rigid Aluminum: Rigid Aluminum conduit shall be manufactured from 6063, t-1 aluminum alloy and shall meet the requirements of Federal Spec. WW-C-540c and ANSI C80.5 and shall be U.L. listed in accordance with UL-6. Equal to products by V.A.W. of America.

2.03. COUPLINGS, FITTINGS, AND CONNECTORS:

- A. RGS & IMC: By Appleton, Crouse-Hinds, Efcor, O-Z/Gedney, Raco, or Republic.
- B. EMT: EMT fittings shall be all steel type setscrew or insulated throat compression type. Pressure indented or slip fit type will not be accepted. All connectors to be insulated. By Appleton, Efcor, Raco Steel City, or Thomas & Betts.
- C. PVC: PVC fittings shall be of high impact PVC Schedule 40 or Schedule 80 to match the installed conduit. Joints shall be made with PVC solvent cement as recommended by manufacturer. By Pittsburgh, R.G. Sloan or Carlon.
- D. Rigid Aluminum: Fittings used with Rigid Aluminum conduit shall be formed of the same alloy as the conduit or shall be copper free cast aluminum unless specifically indicated otherwise.

2.04. CONDUIT BODIES:

- A. Conduit bodies shall be shall be malleable iron except in kitchen, dishwashing, and waste water treatment areas conduit bodies shall be copper free cast aluminum with stamped aluminum covers.
- B. Covers shall be screw retained with wedge nut or threaded body. Covers on bodies installed outdoors shall be approved and rated for installation outdoors.
- C. Bodies shall comply with NEC 370 and 373.
- D. RGS & IMC: By Appleton, Crouse-Hinds, Efcor, O-Z/Gedney, Raco, or Republic.
- E. Conduit cannot be used as ground. Provide separate insulated green grounding wire.

2.05. BUSHINGS:

- A. Bushings up to and including 1" shall have a tapered throat.
- B. Bushings 1-1/4" and larger shall be the insulating type.
- C. Grounding bushings shall be specification grade insulated grounding type bushings with tin plated copper grounding saddles and shall be equal to O-Z/Gedney Type BLG or HBLG.
- D. Bushings shall be zinc plated malleable iron or copper free cast aluminum.
- E. Bushings for terminating Data, Telecommunications, control, CATV, and similar conduits above ceilings and at backboards may be PVC or Polyethylene insulating bushings equal to those manufactured by Arlington Industries and Bridgeport Fittings.

2.06. EXPANSION FITTINGS:

- A. Conduit Expansion Joints shall be UL Listed.
- B. Expansion joints in rigid metal conduits shall consist of a threaded malleable iron body, pressure bushing, watertight packing, pressure ring, gasket, insulating bushing, and external grounding jumper, and shall be equal to O-Z Gedney Type AX with Type BJ bonding jumper.
- C. Expansion joints for EMT conduit shall be same as above with additional EMT couplings and connectors, and shall be equal to O-Z Gedney Type TX with Type BJ bonding jumper.
- D. Expansion joints in PVC conduit shall be equal to Carlon Series E945.
- E. Expansion joints shall provide a minimum of 4" of conduit movement.

2.07. BELOW GRADE THRU WALL WATER SEALS:

- A. Thru wall water seals for conduits penetrating exterior below grade concrete walls shall be seal systems by O-Z/Gedney or The Metraflex Company.
- B. Thru wall water seals for conduits penetrating exterior below grade concrete walls shall be Metraseal thru wall water seals by The Metraflex Company.

2.08. CONDUIT ACCESSORIES:

- A. Conduit clamps and supports for metallic conduit shall be galvanized steel by Efcor, Steel City, or Mineralac. Conduit fittings by Appleton, Crouse-Hinds, O-Z/Gedney, Pyle-National or approved equal.
- B. Conduit clamps and supports for nonmetallic conduit shall be nonmetallic high impact PVC by Carlon, Pittsburg, or Sloan.
- C. Conduit clamps for aluminum conduits shall be stainless steel or cast copper free aluminum with stainless steel fasteners.

2.09. FLEXIBLE CONDUIT:

- A. Liquidtight flexible metal conduit:
 - 1. Neoprene-jacketed liquidtight flexible metal conduit.
 - 2. Equal to Anaconda Sealite.

2.10. ELECTRICAL TAPES:

- A. General use electrical tape shall be 8 mil (.008") thick, minimum, premium grade, pressure sensitive, flame retardant, vinyl electrical tape meeting UL 510, ASTM-D-3005, and MIL-I-24391C. The tape shall be equal to 3M No. 88 or Plymouth Premium 85 CW.

- B. Rubber tape used as primary tape shall be a 30 mil (.030") thick, minimum self-amalgamating, low voltage rubber tape rated for use through 600 V. Rubber tape shall be equal to 3M No. 2150 or Plymouth 122 Rubber Tape.
- C. Electrical filler tape shall be a 125 mil (.125") thick, minimum, self-amalgamating, low voltage insulating compound rated for use through 5 kV. Filler tape shall be equal to 3M SCOTCHFILL or Plymouth 125 Electrical Filler Tape.

2.11. PIPE WRAPPING TAPE:

- A. Pipe wrapping tape shall be a 10 mil (.010") thick, minimum, pressure sensitive, vinyl tape manufactured for pipe wrapping applications.
- B. The tape shall be UV, bacteria, and fungus resistant.
- C. The manufacturer's name and tape type shall be printed on the back of the tape.
- D. Pipe wrapping tape shall be equal to Plymouth Rubber Co. PLYWRAP 11, or 3M No. 50.

2.12. WIRE NUTS:

- A. Wire nuts for conductor splicing shall be winged type connectors with a square, plated steel spring and flame retardant thermoplastic shell.
- B. The connector shall be rated for the number and size conductors being connected.
- C. The Wire Nuts shall be rated for 105°C. And UL 486C listed.
- D. Wire nuts shall be equal to connectors by Ideal/Buchanan, 3M/Scotch, or T & B,

2.13. SPLIT BOLT CONNECTORS:

- A. Split bolt connectors for splicing conductors shall be UL 486A listed, shall be tin plated copper, and shall have a hexagonal head and nut.
- B. Split bolt connectors for conductors size AWG #4 and larger shall have a serrated spacer bar between conductors.
- C. Split bolt connectors for splicing conductors AWG #12 through #6 shall be equal to IlSCO Type SEL and Type SK for AWG #4 and larger conductors.

2.14. MULTI-TAP CONNECTORS:

- A. Multi-tap connectors shall be insulated type
- B. Multi-tap connectors shall be rated for the conductor sizes indicated on the drawings.
- C. The connectors shall be provided for the number of conductors indicated, including any future taps shown, plus a minimum of one additional tap.
- D. Multi-tap connectors shall be equal to IlSCO Type PCT or Type PED-CP.

2.15. WATERPROOF WIRE JOINTS:

- A. Splices made below grade shall be made connectors, UL listed as waterproof, for below grade applications.
- B. Waterproof Twist On Connectors for Up to 2#6 W/1#12 tap Conductors: Single piece wire nut pre-filled with silicone sealant. Sealant shall be rated for 45-400 degrees F. Connectors shall have same insulation rating as conductors. Sizes shall be available for connecting up to 2 #6 w1#12 tap conductors. Connectors shall be UL listed as waterproof for below grade applications and equal to Ideal Buchanan B-Cap Twist and Seal Wire Connectors, King Safety Products, Tyco/Raychem GelCap SL, or equal.
- C. Waterproof Stub Splice Kit for up to #2/0 Conductors: Kit containing connector block, outer waterproof sleeve, and lubricant. Sleeve shall have same insulation rating as conductors. Kit shall be rated for feeder wire sizes #14 through #2/0 and tap wire sizes of #14 through #6. Connectors shall be UL listed as waterproof for below grade applications and equal to Tyco/Raychem GelCap SL.
- D. Waterproof In-line Splice Kit for up to #2/0 Conductors: Kit containing connector block, outer waterproof sleeve, and lubricant. Sleeve shall have same insulation rating as conductors. Kit

shall be rated for wire sizes #6 through #350 kcm. Connectors shall be equal to Tyco/Raychem GTAP.

- E. Waterproof Splice Kit for Conductors above #2/0: Kit containing connector block, outer waterproof sleeve, and lubricant. Sleeve shall have same insulation rating as conductors. Kit shall be rated for wire sizes #14 through #2/0. Connectors shall be equal to Tyco/Raychem GHFC.

2.16. PLASTIC MARKING TAPE FOR MARKING UNDERGROUND CABLES AND CONDUITS:

- A. Plastic marking tape shall be acid and alkali-resistant polyethylene film, 6 inches wide with minimum thickness of 0.004 inch.
- B. Tape shall have a minimum strength of 1750 psi lengthwise and 1500 psi crosswise.
- C. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 3 feet deep.
- D. The tape shall be of a type specifically manufactured for marking and locating underground utilities.
- E. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion.
- F. Tape color shall be as specified in the table below and shall bear a continuous printed inscription describing the specific utility.

Red:	Electric
Orange:	Data, Telephone, Television,

2.17. FIRE STOPPING:

- A. Fire sealant shall be intumescent caulk, putty, sheet and/or wrap/strip as required to attain the proper rating.
- B. Caulk shall be equal to 3M CP25 N/S and/or S/L.
- C. Putty shall be equal to 3M Fire Barrier Moldable Putty.
- D. Sheet equal to 3M CS195.
- E. Wrap/strip equal to 3M FS195.
- F. Equal products by Dow Corning, Hilti, and Metacaulk will be accepted.

2.18. SPACERS FOR CONCRETE ENCASED ELECTRICAL DUCTS:

- A. Spacers shall be interlocking high impact plastic assemblies, which provide horizontal and vertical spacing, and hold the ducts and re-bar, where applicable, in place.
- B. The spacers shall be equal to Carlon Snap-Lok Spacers.

2.19. JUNCTION BOXES (THRU 4-11/16"):

- A. Sheet Metal: To be standard type with knockouts made of hot dipped galvanized steel, By Steel City, Raco, Appleton or approved equal.
- B. Cast: To be type FS, FD, JB, GS or SEH as required for application.

2.20. JUNCTION AND PULL BOXES (LARGER THAN 4-11/16"):

- A. Shall be cast metal for all below grade exterior use and where indicated on plans. All other shall be oil tight, JIC boxes not less than 16 gauge, equal to Hoffman type "CH" boxes.

2.21. PULL BOXES:

- A. Galvanized sheet metal screw-cover type with UL label as produced by Austin, B & C Metal Stamping Company, E-Box, Hoffman, Wiegmann, or approved equal.

2.22. JUNCTION AND TERMINAL BOXES FOR AUXILIARY SYSTEMS:

- A. Junction boxes for auxiliary system circuiting splicing shall be formed of galvanized steel.
- B. Boxes shall have hinged front, locking door(s).
- C. Metal back plates shall be provided for mounting terminal strips or other devices.

- D. Screw terminal strips shall be provided with a minimum of 25 percent spare terminals.
- E. Boxes shall be sized to accommodate the terminal blocks and conductors, providing code required bending space.
- F. Boxes for auxiliary systems shall be manufactured by Austin, E-Box, Hoffman, or Wiegmann.
- G. Provide complete back boxes for all surface mounted devices. Back box shall have knockout on top and bottom as needed. Surface mounted junction boxes with devices mounted to it will not be accepted. Wiremold boxes will be accepted.

2.23. AUXILIARY GUTTERS (WIRING TROUGHS):

- A. Gutters shall be of sizes shown and/or required by the NEC (whichever is larger), constructed of code gauge, galvanized sheet steel, painted ANSI 61 gray.
- B. Gutters shall be UL listed and shall be of NEMA 3R construction in wet or damp locations or shall be as indicated on the drawings.
- C. Gutters shall be as produced by Austin, B & C Metal Stamping Company, E-Box, Hoffman, Wiegmann, or approved equal.

2.24. STRUT SYSTEM FOR SUPPORT OF ELECTRICAL EQUIPMENT:

- A. Strut shall be 1-5/8" except where heavier strut is required to support the load, for rigidity, or where specifically indicated otherwise.
- B. Cold-formed steel, ASTM A 570 or A 446 GR A.
- C. Stainless Steel Strut: Type 304, ASTM A 240.
- D. Hot Dipped Galvanized Steel Strut: Zinc coated after manufacturing operations are complete, ASTM A 123 or A 153
- E. Electro-galvanized Steel Strut: Electrolytically zinc coated, ASTM B 633 Type III SC 1.
- F. Fittings: Same material as strut, ASTM A 575, A 576, A 36, A 635, or A 240.
- G. Zinc Primer: As recommended by strut manufacturer.
- H. Strut Systems shall be as manufactured by B-Line, Erico, Globe, Kindorf, MasterStrut, Power Strut, T&B SuperStrut, or Unistrut.

2.25. OUTLET BOXES:

- A. General: Except as noted, boxes shall be standard hot dipped galvanized steel at least 1-1/2" deep, of metal at least 1/16" thick; sized to accommodate devices and conductors per NEC Article 370; product of Appleton, National, Steel City, or approved equal.
- B. Ceiling and Wall Bracket Outlets: 4" octagonal boxes with plaster rings appropriate for finish surface.
- C. Typical boxes (for switches, receptacles and auxiliary systems):
 - 1. 4" square boxes ganged as required. Box volume shall be in accordance with NEC Section 370 – provide extensions as required.
 - 2. Furnish with 3/4" plaster rings where employed in plaster, 1" tile covers where used in ceramic tile, 1" plaster rings where set in exposed concrete, and otherwise appropriate for surface and construction.
 - 3. Use 4-11/16" square, 2-1/8" deep boxes where more than 10 conductors enter the boxes. Provide extensions as required to provide volume per NEC.
 - 4. Where existing walls are furred out with shallow hatch channel and sheet rock then the contractor will be required to use a shallow junction as required.
 - 5. All exposed junction boxes for receptacles, communications devices, switches, and fire alarm devices shall be provided with back boxes. Do not use standard junction boxes when exposed. No exposed edges of devices plates will be allowed. No knockouts on the side of the box. Boxes shall be similar to Wiremold 500 & 700 Series.
- D. Boxes in Exposed (or Thin-Coat Plastered) Masonry: Where conduit connections permit, employ solid flush-type, square-cornered, masonry boxes with turned-in device holders; otherwise employ typical box with 1-1/2" square-cut tile cover.

- E. Multiple Outlet Floor Boxes:
 1. Floor boxes shall be multi-outlet type providing space for four separate services for duplex outlets and/or Data/Telecommunications outlets.
 2. Floor boxes shall be provided with covers equal to Walker S36CCTCAL(BK)(BS) flush access hatch with carpet trim for carpeted floors and S36BBTCAL(BK)(BS) trim for vinyl covered floors.
 3. Floor boxes shall be provided with 20 amp duplex grounding duplex receptacles, isolated ground receptacles, and Data/Telecommunications outlets as indicated on the drawings.
 4. Data outlets shall be modular type capable of housing up to six (6) Cat 5e jacks. Boxes shall be provided with two (2) active jacks unless indicated otherwise on the drawings. Provide with communications bracket(s) equal to Wiremold #RFB4-LPB.
 5. Provide blank plates for all unused openings.
 6. The boxes shall be equal to what is specified on drawings.
- F. Boxes used with Exposed Conduit: 4" square utility boxes.
- G. Exterior Boxes: Galvanized cast-metal boxes, Crouse-Hinds Type FS or FD as appropriate. Make weatherproof with gasketed covers. Equal products by Appleton, Killark, O-Z/Gedney, or approved equal will be accepted.
- H. Exterior Boxes: All receptacle boxes shall be recessed unless specifically called out not to be. This includes exterior receptacles in all masonry type walls including but not limited to Pre-cast, Brick, Block, etc.
- I. Boxes used with Recessed Lighting Fixtures: Provide a 4" square box with blank cover.
- J. Boxes in Dry Wall Construction: Sectional type switch boxes at least 2-1/2" deep may be used instead of typical box (but not where dry wall finish is applied over masonry back-up and not where multi-gang devices occur).
- K. Boxes installed exposed in kitchen and dishwashing areas shall be copper free cast aluminum with gasketed cast coverplates, without lift cover, unless specifically indicated otherwise on the drawings.

2.26. CONDUCTORS AND CABLES:

- A. Power Conductors
 1. The ungrounded conductors (phase) and the grounded conductor (neutral) of each voltage system being installed shall be phase identified the full length of the conductor with the color characteristics manufactured in the insulation of cable from the cable manufacturer. Required color cable will then be installed for the specific voltage system as identified in these specifications.
 2. All conductors shall be copper with not less than 98% conductivity and with current carrying capacities per N.E.C. for 60°C. for sizes through #1 AWG and 75°C for conductors #1/0 and above.
 3. All conductors shall have manufacturer's name, type insulation, and conductor size imprinted on jacket at regular intervals.
 4. Conductors of size #10 and smaller shall be solid copper conductors with 600 volt type THHN or THWN insulation.
 5. Conductors of size #8 and larger shall be stranded copper conductors with 600 volt type THHN or THWN insulation.
 6. All motor branch circuits, HVAC, and plumbing equipment shall be stranded copper conductors with 600 volt type RHH-RHW insulation.
 7. All conductors installed in conduit below grade shall be rated for wet location.
 8. Manufacturer: Conductors shall be products of GE, Triangle, Phelps- Dodge, Anaconda, Rome, Habirshaw, General Cable, or approved equal.
 9. Fixture Wire:
 - a. Conductors feeding into fixtures, other than fluorescent fixtures, of 300 watts or less shall be #14, 200°C., type SF-2, for fixtures of more than 300 watts #12, 200 °C., type SF-2 shall be used.
 - b. Conductors pulled through fluorescent fixtures shall have Type TFN or TFFN fixture wire, rated 90oC.

- c. Conductors shall be by Dodge, Anaconda, Rome General Cable or Southwire.
- B. Control and Signal Wire: Conductor type TFF, minimum size #16 copper and fully color-coded, shall be used. Conductors shall be by Anaconda, Houston Wire & Cable, General Cable, Phelps Dodge, Rome, or Southwire.

2.27. WIRING DEVICES:

- A. General: Manufacturer's and catalog numbers listed are used to establish style, type and quality. Unless otherwise indicated on drawings, all wiring devices shall be UL listed, side-wired specification grade.
- B. Manufacturers: Equal devices by Hubbell, Leviton, and P & S will be accepted. All devices shall have plaster ears.
- C. Wall switches: 120/277V, 20A, AC, flush enclosed, quiet type switches with thermoplastic body and polycarbonate toggles. Switches shall meet Federal Specification WS-896. Switches shall be, Hubbell 1200 series, Leviton 1200 series, or P & S PS20AC series single pole, 2-pole, 3-way, or 4-way as required.
- D. Duplex receptacles (general purpose): 125V/20A flush duplex back and side wired hard use specification grade receptacles, NEMA 5-20R configuration, with nylon face and body, grounding terminal and break-off fins for converting to 2-circuit use. Receptacles shall meet Federal Specification WC-596. Color to match wall switches. Equal to P & S 5362, Hubbell CR20, or Leviton 5362.
- E. Tamper Resistant Duplex receptacles,: 125V/20A flush duplex, hospital grade, tamper resistant receptacles, NEMA 5-20R configuration, with nylon face and body, grounding terminal. Receptacles shall meet Federal Specification WC-596. Color to match wall switches. Equal to P & S TR62-H, or Hubbell HBL8300SGDuplex combination 125/250 volt receptacles: receptacles shall be 20 amp, combination 125 volt(NEMA 5-20R)/250 volt(NEMA 6-20R) grounding receptacles.
- F. Ground Fault Circuit Interrupt Receptacles: 125V/20 amp ground fault circuit interrupting receptacle for personnel protection, NEMA 5-20R configuration, Equal to Hubbell #GF5362, Leviton #6599, or P & S 2091. Each GFCI symbol on drawing indicates a GFCI type receptacle. Do not through-wire non-GFCI receptacles from GFCI receptacles where ground fault protection is required. All exterior receptacles shall be ground fault interrupting type with weatherproof coverplates.
- G. Faceless Ground Fault Circuit Interrupter: 125V, 20 amp ground fault circuit interrupter UL listed for personnel protection, equal to Hubbell GFR5350 Series, Leviton 6490, or Pass & Seymour Series 2081.
- H. Single Receptacles: Flush Bakelite receptacles with side wiring and grounding terminal, voltage, amperage, and configuration as required for circuit indicated.
- I. Each single or multi outlet receptacle, other than straight blade, 15 or 20 amp, 120 volts, NEMA 5-15R or NEMA 5-20R, shall be provided with matching cord plugs.
- J. Multioutlet Assemblies, Strip outlets, 15 amp, 125V, grounded, outlets on 6" centers, equal to Wiremold V20GBx06. Where x = length indicated on the drawings.
- K. Plugs for kitchen equipment to be plugged into wall mounted straight blade receptacles shall be angled type.
- L. Wiring devices shall be of color as directed by Architect. Devices must be available in ivory, brown, black, white, and gray. Devices connected to the emergency generator shall be red in color.
- M. All receptacles shall be tamper proof type receptacles where required by the National Electrical Code.
- N. Pin and Sleeve Devices:
 - 1. Pin and Sleeve Devices shall be watertight plugs and receptacles of the ratings shown on the legend and/or schedules.

2. Devices shall be listed to UL Standard 498 and UL Classified to IEC Standards 309-1 and 309-2.
3. Devices shall be furnished as matching plugs and receptacles with cast aluminum angled backbox.
4. Devices shall be manufactured by Hubbell, Leviton, or P&S.

2.28. DEVICE PLATES:

- A. Type appropriate for the associated wiring device, equal to Sierra Stainless Steel Smoothline. Device plates shall be of color as directed by Architect. Devices must be available in ivory, brown, black, white, and stainless steel. Provide single plate of proper gang where more than one device occurs (do not gang dimmers with rocker switches).
- B. Damp Location: 20 amp, 125 and 250 volt receptacles - Covers shall be weatherproof when plugs are not installed, provide cast aluminum weatherproof coverplates with single lift cover and gasket equal to Hubbell CWP26H.
- C. Wet Locations, 20 amp, 125 and 250 volt receptacles: Covers shall be weatherproof In-Use covers, rated NEMA 3R when in use and shall be constructed of cast aluminum with sealing gasket. Covers shall be equal to products by Hubbell, Leviton, Steel City, T & B, and Taymac.
- D. Coverplates for exposed cast aluminum boxes in kitchen and dishwashing areas shall be cast coverplates, without lift cover, unless specifically indicated otherwise on the drawings.
- E. Color: Wiring device cover plates shall be of color as indicated on drawings or directed by Architect. Devices must be available in ivory, brown, black, white, gray, and stainless steel.
- F. Jumbo and Mini-Jumbo plates will not be accepted.

2.29. OCCUPANCY SENSORS AND ACCESSORIES FOR LIGHTING CONTROL:

- A. Occupancy sensors shall be totally passive in nature, in that the sensors shall not emit or interfere with any other electronic device, or human characteristic. Sensors shall be dual technology, i.e.: Passive Infrared (PIR) and Microphonic.
- B. PIR shall initiate an "on" condition and the PIR or microphones shall maintain the load "on".
- C. Upon detection of human activity by the detector the lights shall come on and a time delay shall be initiated to maintain the lights on for a pre-set time period. The time delay shall be factory set and field adjustable from 30 seconds to 20 minutes.
- D. All devices shall be factory warranted for 5 years.
- E. All sensors shall be low voltage, 12 to 24 volts and shall work in conjunction with remote power packs.
- F. Occupancy sensors shall be as shown on drawings.

2.30. GROUNDING:

- A. Ground Rods shall be ¾" x 10' copperclad steel.
- B. All grounding conductors shall be copper.

2.31. LIGHTING FIXTURES

- A. General:
 1. All Lighting Fixtures shall be UL labeled.
 2. Fixtures installed in fire rated ceilings or ceiling assemblies shall be rated for installation in fire rated ceilings.
 3. Furnish fixtures complete with lamps, ballasts and internal wiring factory installed.
 4. Fixtures shall be furnished as specified herein and as shown on the fixture schedule on the plans. Catalog numbers shown are for basic units; furnish all fixtures complete with flexible connections, trim, plaster frames, and all other appurtenances necessary to the installation.
 5. Substitutions: Reference to a specific manufacturer's product is made to establish a standard of quality and design, and to give a general description of the basic type desired. Equal products by the listed manufacturers will be accepted subject to the Engineer's approval.

6. It shall be the responsibility of the contractor to verify the exact type ceiling, type fixture mounting and trim, and recessing depth of all recessed fixtures prior to purchasing any fixtures.
 7. Stems on stem mounted fixtures shall be approved ball aligner type, swivel 30 degrees from vertical with swivel below canopy. Paint stems the same color as the fixture trim. Stems in unfinished areas may be unpainted conduit.
 8. High and low bay fixtures shall be equipped with safety chains. Every suspended fixture in Gymnasium shall have safety chains.
 9. Fixtures installed on the exterior of buildings, on poles, or on pedestals shall be rated for wet location installation.
 10. All lighting fixtures installed in gymnasiums, hangars or similar use areas shall be provided with wire guard.
- B. Emergency and Exit lighting Fixtures shall be equipped with a Self-testing module which shall perform the following functions:
1. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.
 2. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. The battery capacity test may be conducted by using a synthetic load.
 3. Manual test switch to simulate a discharge test cycle.
 4. Modules shall have low voltage battery disconnect (LVD) and brownout protection circuit.
 5. All lighting fixtures and exit signs shown as emergency on drawings shall be provided with a minimum 1100 lumen emergency battery ballast capable of 90 minutes of illumination. No exceptions.
- C. Lamps: Type and Lumen Output as scheduled.
1. LED bulb shape shall comply with ANSI C79.1. Lamp base shall comply with ANSI C81.61.
 2. Minimum CRI of LED lamps shall be 80 with a color temperature as shown on drawings.
 3. Rated life of all LED lamping shall be a minimum of 50,000 hours failure to 75% of lamp output.
 4. LED lamping shall be capable of dimming from 100% to 0%.

2.32. LIGHTING STANDARDS:

- A. Lighting Standards(Poles) shall be as specified on light fixture schedule anchor base poles rated for sustained wind's for the wind chart of this specific job's location and a 1.3 gust factor.
- B. Poles shall be of the length required to provide the scheduled fixture mounting height.
- C. Poles shall be factory predrilled for arm and fixture mounting.
- D. Hand holes shall be provided at the base end of the pole for wiring access. Handholes shall be a minimum of 3" x 5" with gasketed, weatherproof covers and stainless steel mounting hardware.
- E. A grounding lug shall be provided inside the handhole.
- F. The poles shall be furnished with a dark bronze, corrosion resistant finish, applied after fabrication.
- G. The base plate shall be furnished with slotted holes for pole alignment.
- H. A base cover shall be furnished with the pole with matching finish.
- I. Anchor bolts shall be 36" long.
- J. Contractor shall include concrete bases for all exterior pole mounted and grade mounted lighting.

2.33. PANELBOARDS:

- A. General: All panelboards shall be dead front type manufactured and installed in accordance with UL and NEMA standards, and shall carry a UL label. Ampacity, service voltage, and

configuration shall be as indicated on drawings. Panelboards shall be clearly marked with ampacity, voltage, and maximum short current ratings.

- B. Manufacturer: Panelboards shall be as manufactured by Cutler-Hammer, GE, Square D or Siemens.
- C. Enclosure:
 - 1. Panelboard enclosures shall be as indicated on drawings.
 - 2. Unless otherwise indicated, all boxes shall be constructed of galvanized (or equivalent rust-resistant) sheet steel with hinged front trim.
 - 3. Fronts shall be door in door with two lockable latches to open door, lock, and latch. All panelboard locks shall be keyed alike. Piano hinges with screw latches will not be permitted.
 - 4. Fronts shall be finished with gray baked enamel over a rust-inhibiting phosphatized coating.
 - 5. All dual section panels shall be equal in size. Sub-Feed circuit breakers will not be allowed to feed second section.
 - 6. Sub-Feed circuit breakers feeding additional panels or equipment shall be branch mounted.
 - 7. Provide permanent numbering of the panelboards. Stickers are not considered permanent.
 - 8. Any panelboard schedule that indicates more than 42 circuits shall be provided in two equally sized panelboards.
 - 9. Main circuit breakers shall be centered mounted. Main breaker cannot be mounted on buss bars with other circuit breakers.
- D. Buss Assembly:
 - 1. Bussing shall be copper.
 - 2. The buss assembly A.I.C. shall be rated as indicated on drawings. Ratings shall be established by heat rise tests, in accordance with UL Standard 67.
 - 3. All bussing shall accept bolt on circuit breakers.
 - 4. Current carrying parts of all bussing shall be plated. In lighting and receptacle panels, bussing shall be designed for connection to the branch circuit breakers in the phase sequence format. Distribution panelboards shall be fully bussed.
 - 5. Ground bars shall be provided in all panelboards.
 - 6. Neutral bar shall be fully sized with lugs suitable for incoming and outgoing conductors.
 - 7. Provide insulated ground buss where indicated on the panelboard schedules.
- E. Circuit Breakers:
 - 1. Circuit breakers shall be quick-make, quick-break, thermal magnetic, molded case, bolt on type.
 - 2. Circuit Breakers shall be numbered and arranged as indicated on the panelboard schedules and/or single line wiring diagrams. Numbers shall be permanently attached to trim.
 - 3. SWD Circuit Breakers: Single pole circuit breakers rated 15 and 20 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be UL rated for switching duty and shall be marked "SWD".
 - 4. HACR Circuit Breakers: Circuit breakers 60 amperes or below, 240 volts, 1-, 2-, or 3-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be UL listed as HACR type and shall be marked "Listed HACR Type."
 - 5. Circuit breakers serving fire alarm systems, dedicated emergency/exit lighting circuits, and area of rescue communications systems shall be equipped with a screw-on, mechanical handle blocking device which locks the circuit breaker in the "ON" position.
 - 6. Circuit breakers serving circuits in residential bedrooms shall be Arc Fault Interrupting(AFI) type circuit breakers and shall be UL 1699 listed.
- F. Directories:
 - 1. Each panelboard shall be equipped with a metal directory frame with a clear cover welded to the inside of the door.

- G. Equipment Short Circuit Rating: Short Circuit Interrupting Ratings shall be as indicated on the plans and schedules. Unless specifically indicated otherwise all rating are "Fully Rated" capacities. Where no rating is given, the contractor shall verify the available short current with the serving utility and provide equipment rated accordingly.
- H. Lighting panelboard cans shall be a maximum of 20" wide and 5 ¾" deep. Cans of multi-section panelboards shall be the same size.
- I. Provide nameplate as called out on drawings.
- J. All circuit breakers 1200-amp and up shall comply with NEC Article 240.87 Arc Energy Reduction.
- K. All flush mounted panel shall be provided with six (6) ¾" conduit stubbed up above accessible ceiling.

2.34. DISTRIBUTION PANELBOARDS:

- A. Furnish and install distribution and power panelboards as indicated in the panelboard schedule(s) or single line wiring diagrams and where shown on the plans.
- B. Panelboards shall be dead front, safety type equipped with thermal magnetic, molded case circuit breakers with trip ratings as indicated on the schedule(s).
- C. Panelboard bussing shall be copper.
- D. Panelboard buss structure and main lugs or main breaker(s) shall have the fault current ratings as indicated on the drawings. Ratings shall be established by heat rise tests conducted according to UL Standard UL67.
- E. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other.
- F. Main circuit breakers shall be centered mounted. Main breaker cannot be mounted on buss bars with other circuit breakers.
- G. An engraved phenolic label shall be permanently attached to the front of the panelboard adjacent to each circuit breaker identifying the load served by the circuit breaker.
- H. Automatic tripping shall be clearly shown by the breaker handle taking a position between ON and OFF when the breaker is automatically tripped.
- I. Provisions for additional breakers shall be such that no additional connectors or hardware will be required to add breakers.
- J. The panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel shall be as specified in UL Standards. End walls shall be removable. The size of wiring gutters shall be in accordance with the National Electrical Code, NEMA, and UL Standards for panelboards.
- K. Cabinets shall be equipped with four piece fronts.
- L. The panelboard interior assembly shall be dead front with panelboard front removed.
- M. Main lugs or main breaker shall be barriered on live sides.
- N. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the buss structure opposite the mains shall be barriered.
- O. Circuit breakers serving Fire Alarm Systems, Security Systems, and/or Emergency/Exit lights shall be equipped with mechanical, screw-on type, locking devices. These devices shall not be padlock type devices.
- P. Panelboards shall be listed by Underwriters' Laboratories and to bear UL label. Panelboards shall be rated for use as Service Entrance Equipment where required by the National Electrical Code. Panelboards shall be by Cutler-Hammer, General Electric, Square D, or Siemens.
- Q. Provide nameplate as called out on drawings.
- R. All circuit breakers 1200-amp and up shall comply with NEC Article 240.87 Arc Energy Reduction.

- S. All flush mounted panel shall be provided with six (6) ¾" conduit stubbed up above accessible ceiling.
- T. All service entrance main circuit breakers shall be 100% rated.

2.35. SAFETY SWITCHES:

- A. Furnish and install safety switches as indicated on the drawings.
- B. Switches installed on 277/480 volts systems shall be rated for 600 volts and those installed on 120/208 volt or 120/240 volt systems shall be rated for 240 volts.
- C. Switches shall be NEMA Heavy Duty Type HD and Underwriters' Laboratory listed. Safety switches shall be Cutler Hammer, Siemens, Square D, or GE.
- D. General Duty disconnects will not be accepted.
- E. Enclosures for switches mounted outdoors shall be NEMA 3R or as indicated on the plans.
- F. Enclosures for switches installed in kitchen and dishwashing areas shall be NEMA 4X stainless steel or as indicated on the plans.
- G. All safety switches for equipment with remote controls shall be equipped with a control circuit disconnect interlock.
- H. Switches shall be lockable in the "ON" and in the "OFF" positions.
- I. Provide each disconnect with a nameplate that indicates equipment name, voltage/phase, and feed from location.
- J. Provide keyed brass locks on all disconnects that is located on the exterior of the building or in any area that is accessible to children or the public. All the brass locks shall be keyed the same, and turn over 10 sets of keys to the owner at substantial completion.
- K. Disconnect locations shown on drawings is diagrammatically shown. Disconnects shall be coordinated with other trades and placed in the optimal locations to serve equipment and shall be installed in the least obtrusive location. Disconnects will have to be moved at the cost of the contractor when there is conflicts with NEC clearances, access to space, or servicing of equipment. Architect/Engineer will have final judgment of proper location.

2.36. MANUAL MOTOR STARTERS (TUMBLER SWITCH TYPE WITH OVERLOAD PROTECTION):

- A. Starting and thermal overload protection for single phase motors 1/8 Hp to 1 HP shall be provided by manual motor starters with overload units rated as required by the specific motor to be served.
- B. Switches installed for site disconnect switches shall be equipped with padlocking provisions.
- C. Starters shall be by Cutler Hammer, General Electric, or Siemens with NEMA Type 1 enclosure or NEMA Type 3R enclosure where installed outdoors.

2.37. TRANSIENT VOLTAGE SURGE PROTECTORS (SURGE PROTECTIVE DEVICES):

- A. Provide transient voltage surge protectors (Surge Protective Devices) where indicated on the plans. At a minimum provide on all service entrance panelboards/switchboards and any panelboard/switchboards on the secondary side of a dry-type transformer.
- B. Service Entrance Panelboards and at Subpanel Protectors shall be listed and labeled and components recognized in accordance with UL 1283 and UL 1449 Second Edition, including highest fault current of Section 37.3.
- C. All devices shall meet or exceed the following:
 - 1. NEMA LS 1-1992.
 - 2. Minimum surge current capability, single pulse rated, per mode:
 - a. Service Entrance – 100 kA (200 kA per phase)
 - a. Distribution and branch panelboards – 80 kA (160 kA per phase)
 - 3. UL 1449, Second Edition, Listed and Labeled, and Recognized Component Suppressed Voltage Ratings shall not exceed (1.2x50□s, 6kV open circuit and 8x20□s, 500A short circuit test wave forms at end of 6" lead):

Voltage	L-N	L-G	N-G	L-L
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208Y/120v	400	400	330	700
480Y/277V	800	800	800	1500

4. Testing shall be done at the end of 6" leads with the complete unit including any fuses and all other components making up the unit.
- D. The devices shall have a minimum EMI/RFI filtering of –50dB at 100kHz with an insertion ratio of 50:1 using MIL-STD-220A methodology.
- E. Devices shall utilize MOV's of 25 mm diameter or larger, shall have pilot lights visible on the outside of the enclosure to indicate device operating condition, and shall provide contacts for remote monitoring of device condition.
- F. Devices shall be modular in design with individual module fusing and thermal protection.
- G. Devices shall incorporate visual alarm signals that indicate the failure of a single MOV and total loss of protection.
- H. Wye connected devices shall provide L-L, L-N, L-G, and N-G surge diversion with L-N/L-G bonded at service entrance devices. Delta connected devices shall provide L-L and L-G protection.
- I. Data Line Surge Protectors: Data Line Surge Protectors shall be UL 497B listed and labeled. The units shall be heavy duty devices utilizing a combination of silicone diodes and gas tube technology to provide surge protection.
- J. All devices shall have a minimum warranty period of five years, incorporating unlimited replacement of suppressor parts if they fail during the warranty period.
- K. Transient voltage surge suppressors shall be manufactured by AC Data Systems, Advanced Protection Technologies, Current Technologies, Cutler-Hammer, General Electric, Joslyn, Liebert, or MCG.

2.38. SECONDARY SURGE ARRESTERS:

- A. Secondary surge arresters shall be UL listed under UL Classification (Lightning Protection) Surge Arresters(OVHX).
- B. Surge arresters shall be rated at same voltage and phase configuration as service.
- C. Arresters shall be equal to Cooper Power Systems ASZH Series, Cutler-Hammer, GE Tranquell, Joslyn Electronic Systems, Leviton, models as required to match the voltage of the system served.

2.39. FUSES:

- A. General: Fuses shall be UL listed time delay types with a minimum interrupting rating of 100,000 amps symmetrical.
- B. 200 amps and below: Provide Class RK-5 current limiting, time delay, rejection type as manufactured by Busman Manufacturing, Ferraz Shawmut, or Littlefuse.
- C. 201 to 600 amps: Class RK-1, current limiting, time delay, rejection type as manufactured by Bussman, Ferraz Shawmut, or Littlefuse.
- D. Above 600 amps: Class L current limiting, time delay, as manufactured by Busman Manufacturing, Ferraz Shawmut, or Littlefuse.

2.40. LABELING:

- A. Provide laminated plastic nameplates for each panelboard, equipment enclosure, relay, switch, and device.
- B. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic 0.125 inch thick, white with black center core.
- C. Provide red laminated plastic label with white center core where indicated.
- D. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core.
- E. Minimum size of nameplates shall be one by 2.5 inches.
- F. Lettering shall be a minimum of 0.25 inch high normal block style.

- G. See Panelboard details for proper labeling of all panelboards.

2.41. PHOTOCELLS, TIME SWITCHES AND CONTACTORS:

- A. Photocells: Units shall have 1" diameter, hermetically sealed, cadmium sulfide sensing cell with 3-prong NEMA locking plug, rated for wet locations. Units shall have built-in time delay. Units shall be equal to Tork 5231 of correct voltage to match load or use with matching receptacle equal to Tork 2421.
- B. Time switches:
 - 1. Unless otherwise indicated on drawings, time switches shall be 24 hour electromechanical type having synchronous motor drive with two single pole double throw contacts rated 20 amps minimum.
 - 2. Unit shall have spring back up, with automatic rewind, capable of providing 16 hours minimum of reserve power upon electric power failure.
 - 3. Units shall be furnished in an enclosure, NEMA 1 indoor and NEMA 3 outdoors. Enclosures shall be flush mount unless otherwise indicated on drawings.
 - 4. Units shall be Tork 7120L, or equal by Paragon or Sangamo.
 - 5. Time switch(es) shall be digital, seven day format, two channel time switches with 9v lithium battery 30 day back-up and with metal indoor enclosure. The controllers shall be equal to Tork #DW200A-Y.
- C. Contactors: Units shall be electrically held or electrically operated mechanically held, as indicated on drawings, and shall be recommended by manufacturer for type of load served.
- D. Contacts shall double-break type of same ampere rating as line side circuit wiring.
- E. Contacts shall be field-convertible to normally open or normally closed.
- F. Contactor coils shall be encapsulated. Electrically held contactors shall have continuously rated coils. Mechanically held contactors shall be equipped with coil-clearing contacts to energize coils only when switching.
- G. Units shall be furnished in an enclosure, NEMA 1 indoor and NEMA 3 outdoors.
- H. Units shall be equal to GE CR460 series in NEMA 1 or NEMA 3R enclosure as indicated.

2.42. FIRE ALARM SYSTEM (ADDRESSABLE):

- A. General: The contractor shall furnish and install a complete power limited automatic and manual fire alarm system, as specified herein and indicated on the drawings. The system shall include a central control panel, power supply, signal initiating devices, audible and visual alarm devices, provisions for connection of remote monitoring, a wiring system, and all necessary devices required to provide a complete operating system. The system shall comply with the applicable provisions of the National Fire Protection Association Standard Number 72 and meet all requirements of the local authorities having jurisdiction. The Underwriter's Laboratories, Incorporated, or approved by the Factory Mutual Laboratories shall list all equipment and devices. The equipment shall be EST to match existing. No deviation will be considered unless submittals are received and approved in writing, not less than ten days prior to bid date.
- B. Fire Alarm Document Box: The contractor shall furnish and install a fire alarm document enclosure as mandated by NFPA 72 Chapter 7.7.2.1. The system records documents box shall be constructed of 18 gauge cold rolled steel. It shall have a red powder coat epoxy finish. The cover shall be permanently screened with 1" high lettering and read "FIRE ALARM DOCUMENTS" with white indelible ink. The access door shall be locked with a ¾" barrel lock which is keyed the same as the manufacturer's fire alarm panel. The enclosure shall supply 4 mounting holes to securely fasten to the wall. Inside the enclosure will accommodate standard 8.5" x 11" manuals and loose document records that may be placed in a three ring binder. All documents & software will be protected within the enclosure. A legend sheet will be permanently attached to the door for system required documentation, key contacts, and system information. The fire alarm document will have securely mounted inside the enclosure a minimum of 4 Gigabyte digital flash memory drive with a standard USB type B connector for uploading and downloading electronic information. The drive shall not be accessible without

tools to any person whom gains access to the enclosure. The enclosure shall also provide 2 Key ring holders with a location to mount standard business type cards for key contact personnel. The password to the fire alarm programming shall be provided to the owner in the fire alarm document box. The password must be provided, fire alarm contractors that refuse to give password will not be accepted. Contractor will be responsible for replacing the entire fire alarm system at their cost and cost of delaying the project if password is not provided.

- C. Control Panel: The control panel shall be an addressable type panel capable of handling up to 256 devices, with 60 hour minimum standby battery. The panel shall provide for the connection of alarm circuits as indicated and shall include the following features.
1. The fire alarm panel shall detect the operation of any initiating device, indicate by annunciator lamps the area of the alarm condition, and operate all alarm auxiliary devices.
 2. A pilot light shall normally be on, indicating that the system is receiving power from the building service supply. A failure of the building service supply shall cause the lights to go out.
 3. A trouble light and trouble buzzer, operating together, shall signal any trouble condition. Failure of the building service supply, disarrangement in the system wiring, or alarm condition shall cause that trouble light to come on and the trouble buzzer to sound. A self restoring silencing switch shall be provides to silence the trouble buzzer, which shall be arranged so the trouble light will remain on until the system is restored to normal.
 4. All notification signals shall be automatically locked in at the control panel until the operating device is returned to its normal condition, and the panel is manually reset. A switch shall be provided on the control panel for silencing the notification devices. The manual reset switch and the alarm-silencing switch shall be of the self-restoring type, which cannot be left in the abnormal position.
 5. The control panel shall provide relay contacts, of quantity as shown on the drawings, for control of heating, ventilation and air conditioning equipment. Such contacts shall be connected to air conditioning equipment, as indicated on drawings, for shutdown of individual units. Unit shutdown shall be initiated by duct-mounted smoke detectors unless otherwise indicated. Operation of any initiating device shall open all control contacts and release all mechanically held doors.
 6. The control panel shall be equipped with a front mounted Drill switch.
 7. Metal oxide varistors (MOV's) shall be provided on the system power supply and the municipal connection circuit to provide transient suppression protection to the control panel.
 8. Power Supply: The power supply shall be 24 Volt DC, filtered and regulated, and shall provide sufficient power for all system functions. The fire alarm system main power supply shall operate at 120 Volt AC obtained from the building service. The 120-volt AC main power shall be converted to low voltage direct current for system operation. The system shall operate on 24 volts DC with trickle charged batteries provided as an emergency source of supply for operating the system in the event of interruption of main power. A changeover relay in the control panel shall transfer to standby power automatically upon main power failure and automatically reconnect to main power upon restoration.
 9. **Fiber Optic Cards. The control panel and all remote nodes shall be equipped with fiber optic, node-to-node capabilities at time of installation. Fiber Optic Transmission Cards shall be equal to EST Model SMXLO. All buildings shall be connected via fiber. No copper connections will be permitted.**
 10. **In existing building, all panels, annunciators, and other items shall be converted/upgraded to new panels with fiber nodes to allow for fiber only connection of new building(s). Once project is completed the system shall be a fully functional code compliant system. No allowances will be made for changes due lack of knowledge of existing system and what will be required to upgrade to fiber optic connected panel after the bid. Contractor shall verify number of annunciators and all other equipment to be replaced prior to bid.**
- D. Manual Stations: Manual Fire alarm stations shall be an addressable double acting, semi-flush mounted type. Stations with two sets of contacts will not be acceptable.

- E. Smoke Detectors: Smoke detectors shall be addressable photoelectric type with base.
- F. Heat Detectors: Addressable 135 degree/rate of rise type with base.
- G. Duct Mounted Smoke Detectors: Duct detectors shall be addressable photoelectric type with sampling tube.
- H. Contractor shall be responsible for coordinating prior to bid with mechanical drawings to confirm all duct mounted smoke detector locations and quantities. Contractor shall include in their base bid price the cost of all additional duct mounted smoke detectors and circuitry needed for locations.
- I. Duct Detector Remote Test Station: Test stations shall be keyed with indicator light.
- J. Audible/Visual Notification Devices: Audible/visual notification devices shall be four wire, horn/strobe units capable of 90 dB audible output, 100 candela-second output, shall be ADA compliant. Devices using incandescent lamps will not be acceptable.
- K. Visual Notification Devices: Visual notification devices shall be strobe units capable of 100 candela-second visual output, shall be ADA compliant. Devices using incandescent lamps will not be acceptable.
- L. Voice Control Panel: The Voice Control Panel shall play a digitally recorded message or microphone input for evacuation instructions.. The unit shall be installed next to the FACP, shall be equipped with emergency battery power, and shall provide a minimum of 75 watts of amplification.
- M. Remote Microphone Panel: Remote Microphone Panels shall have a keyswitch control and shall be supervised.
- N. Remote Amplifier: Remote amplifiers shall be 120 watt with battery backup.
- O. Speaker/Visual Notification Devices: Speaker/Visual Notification devices shall be semi-flush, wall mounted, combination strobe/speaker assemblies with a minimum strobe output of 100 candela-second and equal to Simplex #4903-9144 Notifier #E70-24110W-FR for wall installation or Notifier #E70-W for speaker only ceiling installations.
- P. Interface Relay:
 - 1. Provide addressable control modules equal to Notifier #CMX-2 or interface relays equal to Notifier #MR-101/CR as required for interface of the Fire Alarm System with HVAC shut down, door holders, kitchen hood fire suppression system, and fan shut down, and any other locations required for proper interface and operation of systems.
 - 2. A control module or interface relay shall be provided for each duct mounted smoke detector and shall be the point of interface between the Fire Alarm System and the HVAC Control System.
 - 3. Contacts shall be rated for 10 A at 120 V.
- Q. Flow and Tamper switch Monitoring: Individual Addressable Module.
- R. Door Holders: Door Holders: Door holders shall be magnetic semi-recessed wall-mounted type, or where indicated to be floor mounted.
- S. Annunciator Panel: Provide and install an annunciator that provides an audible and visual indication of an alarm or trouble condition for each zone, an alarm silence switch, and a key operated test and reset switch..
- T. Auxiliary Remote Power Supplies/Notification Appliance Circuit Extenders (NAC Panels):
 - 1. Provide auxiliary power supplies and/or NAC Panels where required for notification devices, door holders, annunciators, or for other devices requiring supplemental power.
 - 2. Remote power supplies shall include a filtered and regulated 24 VDC output, provisions for automatic transfer to battery back-up in case of primary power failure, and batteries sized for 60 hours of operation.
- U. Wire Guards: Wire guards shall be made of 3/16" minimum steel wire with a corrosion resistant coating equipped with integral mounting rings. Provide wire guards for all devices located in gymnasium.
- V. All devices installed on the exterior shall be weatherproof.

- W. All A/V devices in gymnasium at bleachers or any other facility with bleachers shall mount the fire alarm devices 80" above top of bleachers.
- X. **Provide fiber optic interface/network cards in fire alarm and control panels for the school campus. Provide fiber optic cable as required by manufacturer to connect the main school building panel and the new panel. Fiber optic link shall allow full communications between the two fire alarm and control panels. Provide necessary electronic modules, equipment, cables and programming for communications between the allfire alarm panels.**

2.43. CONCRETE:

- A. Concrete for electrical requirements shall be:
 - 1. Composed of fine aggregate (sand), coarse aggregate (graded from three-sixteenth (3/16) inch to one (1) inch), Portland cement, and water proportioned and mixed so as to produce a plastic, workable mixture.
 - 2. Aggregates shall be free from detrimental amounts of dirt, vegetable matter, soft fragments, or other foreign substances.
 - 3. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities.
 - 4. Concrete shall have a minimum 3000 psi ultimate twenty-eight day compressive strength and a maximum three (3) inch slump.

PART 3 - EXECUTION

3.01. GENERAL:

- A. This section includes the installation of the complete electrical system.

3.02. ELECTRICAL SYSTEM DEMOLITION:

- A. Before any new work begins the Contractor shall determine and document in writing to the satisfaction of the Engineer the condition of existing electrical work and auxiliary systems that are to remain in service. After the new work begins any existing electrical work or systems that are found to be inoperative or defective and not so documented shall be repaired or replaced by the Contractor at no additional cost to the Owner.
- B. Existing electrical equipment and materials to be reused shall be tested and repaired as required and installed for first class operation.
- C. General: The manner in which the remaining portions of the electrical system are terminated, supported and generally maintained for permanent use shall comply with all applicable regulations of the National Electrical Code, applicable NFPA codes and any local codes.
- D. Refer carefully to construction drawings prior to commencing with demolition to determine the intent of demolition. Contact the Engineer if there appears to be any conflict between the demolition and construction drawings.
- E. See "Renovation" Section regarding modification and relocation of circuits.
- F. Phasing: Phasing shall be as coordinated by the General Contractor.
- G. Work in Occupied Areas: Coordinate work carefully with General Contractor to provide minimum disruption to occupied portions of project. Provide minimum of 24 hours advance notice to Owner of demolition activities that will affect Owner's normal operation.
- H. Protections: Take necessary measures as required for protection of the Owner's personnel and the general public, as well as Owner's property. Provide temporary barricades, partitions, bracing, and weather protection as needed. Remove all temporary protections at completion of work.
- I. Flame Cutting: Do not use cutting torches for removal until work area is cleared of flammable materials. Maintain portable fire suppression equipment during flame-cutting operations.
- J. System Protection: Protect and maintain all portions of existing system not indicated for demolition, including but not limited to light fixtures, panelboards and circuits.

- K. Fire Protection: Coordinate with general contractor to insure that all penetrations of fire-rated decks and partitions are properly sealed.
- L. Removal of Circuits: All circuits indicated for removal shall be entirely removed, including raceway, back to take-off point or as far as possible without chasing (unless chasing is indicated). Where it is not possible to remove conduit, all conductors shall be removed and the conduit shall be permanently capped. Floor outlets indicated for removal shall be entirely removed, including outlet box, and capped below floor level (minimum 4" below floor level if in slab).
- M. Where floor slab is damaged in the course of demolition, it shall be permanently repaired as soon as practicable.
- N. Leave existing branch circuits and feeders which run through reworked areas and serve existing equipment to remain in service, continuous and uninterrupted.
- O. Where service interruptions are required, obtain approval for interruptions in writing from Architect 14 days prior to interruption. Submit schedule of work to be performed and the time required to accomplish work with request for interruption.
- P. Disposition of Material: Where electrical equipment is indicated for removal and not indicated for re-use, the owner shall have the option of taking possession of the equipment, the Contractor shall deliver any such material to a local site designated by the owner. The Contractor shall be responsible for disposing of all other materials in accordance with applicable codes and laws.

3.03. ELECTRICAL SYSTEM RENOVATION:

- A. General: Provide renovations as indicated on drawings and specified herein as required for a complete, operational system, even though every item is not indicated.
 - 1. This Section is intended to serve as a supplement to the applicable sections within this Division, and in no way relieves the contractor from the requirements of any other Section.
 - 2. All renovations shall comply with all applicable regulations of the National Electric Code, applicable NFPA codes and any local codes
- B. Materials and workmanship: Execute all work so as to present a neat and workmanlike appearance when completed. Except where otherwise indicated, all materials shall be new, UL approved where a standard has been established. Where specific means and methods for affecting renovations are not covered in drawings and specifications, the contractor shall exercise prudent judgment in following accepted practices.
- C. Modifications: All major deviations from the drawings and specifications shall be approved in writing by the Engineer.
- D. Inspection:
 - 1. Inspect all existing electrical system components which are accessible, including fixtures, wiring devices, raceway and panelboards.
 - 2. Perform minor repairs to loose or damaged connections, damaged or missing supports, replacement of broken devices, replacement of missing plates and junction box covers and other visible damage or disrepair.
 - 3. Report major damage to Engineer.
- E. Renovation Services: In addition to the scope of work indicated on the drawings and specified herein, it shall be the responsibility of this Division to provide minor modification and repair services made necessary to electrical system components through the normal course of renovation. Such services shall include but not be limited to minor repair or relocation of branch circuits necessitated by the work of other trades, as coordinated by the General Contractor.
- F. Penetrations: Coordinate penetrations of existing walls, decks, and roofs required for electrical system with General Contractor. Do not cut structural members without the prior consent of Structural Engineer.
- G. Raceway.
 - a. Unless specifically indicated otherwise, existing raceway may not be used.

- b. Where existing raceway is indicated for possible re-use, it shall be the responsibility of this Division to verify that the condition and configuration of the raceway is in compliance with the NEC.
- H. Panelboards: Where new circuits are run to an existing panelboard, thoroughly inspect the panelboard for any indications of arcing, overheating, or other damage. Report damage to the Engineer. Unless specifically allowed, tandem circuit breakers shall not be utilized.
- I. Clearing of Neutral Faults: Any and all neutral faults to ground on existing system shall be corrected.
- J. Service Ground: Visually inspect existing service ground electrode system for damage and code compliance. Check continuity from panel to each electrode with a meter. Make repairs as required.
- K. Lighting Fixtures: Where existing lighting fixtures are indicated for re-use, they shall be thoroughly cleaned and relamped, no exceptions. Where existing lighting fixtures are indicated for replacement, it shall be the responsibility of this Division to verify the compatibility of new fixtures with existing ceiling type, existing penetrations, available support, and other existing conditions prior to submittal of fixtures. Any variances or required modifications shall be clearly indicated on the fixture submittal.
- L. Backfilling, Grading, and Sodding:
 - 1. Restore surface features, including vegetation, at areas disturbed by Work of this Section.
 - 2. Reestablish original grades, unless otherwise indicated.
 - 3. If sod has been removed, replace it as soon as possible after backfilling is completed.
 - 4. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition.
 - 5. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces.
 - 6. Restore disturbed paving as indicated.

3.04. ELECTRICAL SERVICE:

- A. General: Arrange with local electric Utility Company for service to be brought to the building, and for installation of meter. Provide all material and labor not supplied by Utility Company so as to produce a complete installation meeting the Utility regulations.
- B. Service requirements: It is the responsibility of this Section, prior to bid, to reaffirm with the Utility Companies involved, that locations, arrangement, Power Company voltage, phase, metering required, and connections to utility service are in accordance with their regulations and requirements. If their requirements are at variance with these drawings and specifications, contract price shall include an additional cost necessary to meet those regulations without extra cost to Owner after bids are accepted.
- C. Notify Architect of any changes required before proceeding with work.
- D. Fees and deposits:
 - 1. The Electrical Contractor shall be responsible for verification and payment of all utility fees associated with installation of the electrical service.
 - 2. The Owner shall pay the cost of establishing an electrical service account and permanent meter deposit.
- E. Metering: Obtain metering equipment from Utility Company and install in compliance with the Utility Company's requirements. The Electrical Contractor shall provide and install all necessary metering raceways, fittings, supports, connectors and ground conductor necessary for a complete installation. Provide 100# pull wire in all metering conduits.
- F. Main Service Equipment: Provide UL approved service entrance components as indicated on drawings or specified herein.
- G. Provide a full size copy of the AS-BUILT Power Riser Diagram framed behind plexiglass screwed to the wall near service entrance in main electrical room.
- H. Service lateral or feeder: Extend lateral or feeder of the size shown on drawings from service equipment to the point of service as indicated (verify exact location with Utility Company).

1. For Overhead Service, provide and install service entrance fitting on conduit and leave sufficient slack conductor for connection to utility feeder 10' above finish grade, 12' above drive and 18' above street.
2. For Underground Service, provide and install underground conduit to utility riser, as directed by Utility Company. Conduit shall be of size and quantity as indicated on drawings. Provide 480# polypropylene pull line in each empty conduit.
3. For Underground Service, provide and install transformer pad, primary underground conduit to utility riser as directed by Utility Company, underground secondary conduit, and secondary conductors. Conduit shall be of size and quantity as indicated on drawings. Provide spare 4" conduit in transformer pad extending 2' beyond edge of pad with PVC cap. Provide 480# polypropylene pull line in each empty conduit.
4. On service transformers with multiple taps, it shall be the responsibility of this section to coordinate tap selection with the electric utility to insure the proper nominal voltage.

3.05. GROUNDING:

- A. Bond the neutral conductor and various conductive materials in the building per NEC Article 250.
- B. Grounding Electrode System: A bare copper grounding conductor shall be bonded to grounding electrodes as specified below. This conductor shall serve as ground for system neutral and for building equipment bonding. Where conductor is #6, or smaller, or is subject to injury, it shall be run in conduit, Schedule 80 PVC or Rigid Galvanized to which the conductor shall be bonded at both ends.
 1. Grounding electrodes shall be as follows:
 - a. Cold water piping, if metal and in direct contact with the earth for 10 feet or more, at the point of entry into the building. Grounding electrode shall be attached with UL approved bronze clamp.
 - b. Building structural steel, if present and accessible.
 - c. Grounding electrode shall be attached with exothermic weld connector.
 - d. Foundation reinforcing bar system. Coordinate with General Contractor to provide turned up re-bar (sleeved) near service point for attachment of grounding electrode above grade. Grounding electrode shall be attached with UL approved bronze clamp or exothermic weld connector.
 - e. Driven ground rod(s).
 - 1) Three 3/4" x 10' copper weld rods shall be driven into the ground at the lowest point adjacent to the building, spaced a minimum of 10' apart.
 - 2) Ground rods shall be driven to 12" below grade.
 - 3) The grounding electrode conductor shall be attached to the rod(s) with UL approved bronze clamp or exothermic weld connector.
 - f. Existing grounding electrode system. If an existing electrical service is in place, it must be bonded to the new grounding electrode system.
- C. Connections to grounding rods, building structure, counterpoise, and conductor junctions shall be made by exothermic weld unless specifically noted otherwise.
- D. Electric system (neutral) ground: The current carrying neutral leg of the wiring system shall be of insulated conductor, and shall be connected to the grounding electrode conductor only via the neutral connection at the service equipment. Each branch circuit or multi-outlet branch circuit shall be provided with a dedicated neutral conductor.
- E. Equipment grounding conductors:
 1. An equipment grounding conductor (copper with green insulation except where bare copper is used) shall be provided in all wiring raceways.
 2. Sizes shall be in accordance with NEC 250.
 3. The equipment grounding conductor shall originate in the same panelboard, panelboard section, as the circuit conductors.
 4. The equipment grounding conductor bonding the sections of multi-section panelboards shall be sized per NEC 250.

5. The equipment grounding conductor is not included in number of branch circuit conductors indicated on the drawings.
- F. Gas piping: Bond interior above grade gas piping to the grounding electrode.
- G. Telephone service ground: provide a minimum #6 bare, solid copper grounding conductor from the electrical service grounding connection to the TBB. Leave six (6) feet minimum of free conductor. Install the conductor in PVC conduit where inside the building.
- H. Computer backboard ground: provide a minimum #6 bare, solid copper grounding conductor from the electrical service grounding connection to the CBB. Leave six (6) feet minimum of free conductor. Install the conductor in PVC conduit where inside the building.
- I. Metal Lighting poles: Provide a grounding electrode at poles supporting outdoor lighting fixtures in addition to installing a separate equipment grounding conductor with supply branch-circuit conductors.
- J. Grounding electrode resistance shall be less than 15 ohms. The resistance of the grounding electrode shall be tested by the Fall of Potential Method.
- K. Lighting Standards (Poles): Install 10' driven ground rod at each pole. On non-metallic poles, ground metallic components of lighting unit and foundations. Connect fixtures to grounding system with No. 6 AWG conductor.
- L. Each grounding conductors at the service entrance ground bus bar shall be provided with a brass round identifying tag. Tag shall indicate where ground wire is terminated.

3.06. EXCAVATION, CUTTING AND BACKFILLING:

- A. Provide cutting and patching, under the supervision of the General Contractor, as required for the work in Section 16.
- B. Locate all existing below grade and/or below floor utilities prior to beginning any site excavation or cutting of existing floor slabs. The Contractor shall repair any damage to existing utilities or systems.
- C. Saw cut existing concrete slabs and asphalt paving.
- D. Trenching:
 1. Dig trenches true to line, with a flat, even bottom.
 2. Width of the trench shall provide not less than 3 inches clearance from the conduit to each side of the trench.
 3. Insure that foundation walls and footings and adjacent load bearing soils are not disturbed in any way.
 4. Conduits shall be installed below footings where possible. Where a line passes under a footing, make crossing with the smallest possible trench to accommodate the conduits/sleeves.
 5. Where a line must pass adjacent to and below the bottom of a column footing, or the corner of a continuous footing, backfill the trench with concrete up to the level of the footing bottom, for a distance away from the footing equal to the depth of the fill.
 6. Keep excavation free from water, by pumping if necessary.
 7. Where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level to proper elevation with sand or earth free from particles that would be retained on a 1/4 inch sieve.
 8. Remove and relocate existing obstructions as directed.
 9. The Contractor shall be responsible for the repair and/or replacement of any damage to existing utilities, structure, or finishes.
 10. Coordinate work with other trades as work progresses so cutting and patching will be minimal.
 11. Refer to Section "Earthwork" for shoring, sub-soil assumptions and data, work around trees, surplus earth, etc.
- E. See Section 16100, "Conduit Installation, Below grade and below slab conduit installation", for installation of conduits in trenches.
- F. Backfilling:

1. Immediately after inspection, cover conduits with 3" of compacted sand or earth free from particles that would be retained on a 1/4 inch sieve. Do not to disturb the alignment or joints of the conduits.
2. Carefully backfill with 4" of earth free from clods, brick, etc., firmly puddling and tamping.
3. Thereafter, puddle and tamp every vertical 4" for hand tamping or 8" for heavy duty mechanical tamping.
4. Backfill shall meet the compaction requirements set forth in Division 2.
5. Backfilling Beneath Slabs and Pavement: Trenches beneath future slabs or pavement, including but not limited to buildings, drives, parking areas, sidewalks, playground surfaces, and equipment pads, shall be backfilled, from 3" above top of conduits to final grade, with crushed aggregate, AHD 825, type B, compacted in 4" layers to 100% ASTM 698.
6. Install marking tape above conduits at 12 inches below grade.

3.07. SLEEVES, INSERTS, AND SUPPORTS:

- A. Provide and install No. 16 gauge galvanized steel or iron sleeves in all walls, floors, ceilings, and partitions. Sleeves shall have no more than 1/2" clearance around pipes and insulation.
- B. The contractor shall furnish to other responsible trades all sleeves, inserts, anchors and other required items which are to be built in by other trades for securing of all hangers or other supports by the Contractor.
- C. The contractor shall assume all responsibility for the placing and sizing of all sleeves, inserts, etc., and shall either directly supervise or give explicit instructions to other trades for their installation.
- D. The contractor shall seal all conduits through floors, smoke partitions, and floor partitions, with a sealant approved for the application.
- E. All sleeves through sound barrier walls and partitions shall be sealed with mineral wool.
- F. Through the floor conduit penetrations shall be sealed watertight.
- G. Furnish and install steel angles and channels as required for mounting and bracing heavy equipment and conduits. Steel shall be securely bolted or welded to structure and equipment bolted to the steel framework. Obtain the approval of the Architect prior to welding.

3.08. BELOW GRADE THRU WALL WATER SEALS:

- A. Each conduit penetrating exterior, below grade, cast concrete walls shall have the annular space around the conduit sealed with an approved Thru Wall Water Seal System.
- B. Where the system includes water seal thru wall sleeves, the Electrical shall provide properly sized sleeves to the contractor responsible for constructing the walls and shall be responsible for the proper location of each sleeve.
- C. Where openings are to be core drilled, the Electrical Contractor shall be responsible for the core drilling and for coordinating proper sizing and location of each opening.

3.09. FIRE STOPPING:

- A. The Electrical Contractor shall be responsible for firestopping of all penetrations of fire rated partitions made by any and all lighting, power, and auxiliary circuiting, sleeves and/or equipment.
- B. The Electrical Contractor shall submit manufacturers' UL System drawings for the systems to be utilized. The systems shall be compatible with the partition ratings as indicated on the Architectural drawings and in accordance with details on the Electrical drawings.
- C. Penetrations of fire rated partitions shall be sealed with an approved fire sealant resulting in the completed penetration having the same fire rating as the partition.
- D. The installation shall be in accordance with the manufacturer's UL system detail and installation instructions to attain the required fire partition rating.
- E. Empty sleeves through 1 and 2 hour rated partitions shall be plugged with mineral wool.

- F. Sleeves through 4 hour rated partitions shall be plugged with mineral wool and fire stopping material.

3.10. ROOF PENETRATIONS:

- A. Furnish roof flashing for all equipment, installed under Section 16, which penetrates through the roof. Flashing shall be approved by the Architect prior to installation.

3.11. CONDUIT INSTALLATION:

- A. Conduits shall be as follows:
 1. Overhead Service Entrance - Rigid Galvanized Steel (RGS) Conduit or IMC.
 2. Underground Service Laterals: Schedule 40 rigid PVC in horizontal runs with rigid galvanized steel elbows turning up to vertical RGS.
 3. Where subject to moisture or mechanical injury - RGS conduit.
 4. ALL conduits exposed to moisture or subject to mechanical damage shall be RGS. Where conduit exits building, the changeover from EMT to rigid shall be inside exterior wall.
 5. In open shop and industrial installations RGS shall be run to 10' A.F.F.
 6. All conduit exposed on the outside of the building envelope shall be Rigid Galvanized Steel (RGS) conduit. This includes all conduits on and/or under canopies or awnings.
 7. In concrete or solid masonry – RGS conduit
 8. Above furred spaces or in cells of hollow masonry - EMT
 9. Concealed inside drywall construction walls and above lay-in ceilings – EMT.
 10. Exposed conduits:
 - a. Conduits installed exposed in shop, warehouse, and manufacturing areas shall be RGS up to 12' A.F.F. Conduits in such spaces above 12' A.F.F. may be EMT unless indicated otherwise on the drawings.
 - b. Exposed indoors in non-hazardous unfinished areas not subject to physical damage - EMT
 - c. Exposed in kitchen and dishwashing areas: Rigid aluminum.
 11. Branch circuits in slab (3/4") - PVC. Turn up through slab with RGS ells - no exceptions. Extend rigid turn-ups 2" minimum above finish floor level.
 12. Circuits beneath building vapor barrier - PVC. Turn up through slab with RGS ells - no exceptions. All elbows 45° and greater shall be RGS. Extend RGS turn-ups 2" minimum above finish floor level.
 13. Below Grade – PVC with RGS, or rigid aluminum where applicable, elbows turning up to vertical. All below grade elbows 45° and greater shall be RGS.
 14. Motor, HVAC equipment, and vibrating equipment connections - flexible metal conduit, liquid tight flexible metal conduit outdoors, in kitchen and dishwashing area, or in other wet areas. Liquidtight flexible nonmetallic conduit shall be used only where specifically indicated.
 15. IMC may be used where RGS is indicated.
- B. Conduit sizes:
 1. Unless specifically indicated otherwise herein or on the drawings, the minimum conduit size shall be 3/4".
 - a. All conduits installed below grade or below slab shall be 3/4" minimum.
 - b. The minimum size for flexible lighting fixture "whips" shall be 3/8" and the maximum length shall be 6 feet. Lighting fixture "whips" shall be defined as flexible conduits with conductors feeding one or more recessed lighting fixtures installed in suspended, lay-in, acoustical ceiling systems from a single junction box.
 - c. 1/2" conduit may be for final connections to equipment or fixtures where conduit is less than three (3) feet in length and is extended from a junction box or from a 3/4" conduit stub up.
 2. Conduits shall be sized in accordance with the National Electrical Code as adopted by the local authority having jurisdiction or as amended to date, except where a larger size is indicated on the drawings or specified herein.
- C. Layout:

1. Generally follow the conduit layout shown on the drawings. However, the layout is diagrammatic only and must be adjusted for structural conditions, built-in equipment and other factors. Offsets are not indicated and must be furnished as required.
 2. Install all conduits concealed except in equipment rooms and where exposed runs are specifically indicated.
 3. Install conduit runs to avoid proximity to steam or hot water pipes. In no place shall a conduit be run within 6" of such pipes except where crossings are unavoidable, then conduit shall be kept at least 1" from the covering of the pipe crossed.
 4. Eliminate trapped runs insofar as possible.
 5. Do not chase new work, but instead build in conduit as work progresses.
 6. Do not run conduit in cavity of exterior walls.
 7. Run concealed conduits in direct line with long sweep bends and offsets where practicable.
 8. Install exposed conduit with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings, with right-angle turns consisting of cast-metal fittings or symmetrical bends.
 9. Where conduits are indicated exposed overhead, runs down to wall outlets shall be concealed in wall.
- D. Conduit Installation:
1. Securely fasten conduits to all sheet metal outlets, cabinets, junction and pull boxes with locknuts and bushings, taking care to see that stout mechanical and solid electrical connections are obtained.
 2. All conduits shall have bushings with smooth beveled throats installed at both ends prior to installing conductors. Split bushings around conductors shall be taken to indicate that the conductors were pulled into conduit without the proper bushings installed and a basis for requiring the replacing of the conductors.
 3. Conduits entering service enclosures (panelboards, disconnect switches, switchboards, motor control centers, etc. used as service entrance equipment) shall be provided with specification grade, insulating, grounding type bushings. Grounding bushing shall be bonded together and bonded to the service grounding buss.
 4. Support:
 - a. Raceways shall be securely and rigidly supported to the building structure in a neat and workmanlike manner, and wherever possible, parallel runs or horizontal conduit shall be grouped together on adjustable trapeze hangers.
 - b. Support shall be provided at appropriate intervals not exceeding eight(8) feet with straps, hangers, and brackets specifically designed for the application.
 - c. Channels shall be 1 inch for 18-inch wide trapeze, 1-3/8 inch for 24 to 30 inch, and 1-5/8 inch for over 30 inch wide trapeze.
 - d. Perforated steel straphangers, "butterfly clips", or tie-wire supports are not acceptable.
 - e. Conduits shall not be supported from ceiling support wires.
 - f. Conduits installed along wall surfaces shall be supported with galvanized steel brackets specifically designed for conduits and sized for the conduit used.
 - g. PVC conduits shall be supported per the NEC with PVC or stainless clamps and stainless steel hardware.
 - h. Attach to supporting devices with screws, bolts, expansion sleeves or other workmanlike means appropriate to the surface.
 - i. In stud walls, anchors shall be completely rattle proof.
 - j. For conduits in damp and wet locations, use stainless steel clamps and stand-offs, or galvanized malleable or cast iron clamps and spacers.
 - k. All mounting hardware for aluminum conduit shall be stainless steel.
 - l. Surface mounted conduits installed in kitchen and dishwashing areas shall be supported off walls approximately 3/16".
 5. Thread rigid conduits so that the ends meet in couplings; cut ends square, ream smooth and draw up tight.
 6. All field cut threads shall be cleaned with a solvent such as mineral spirits and painted with two coats of galvanize primer.

7. Cap conduit ends to keep out water and trash during construction.
 8. Field made bends:
 - a. Avoid field-made bends where possible, but where necessary, use a proper hickey or conduit-bending machine.
 - b. Field made bends in PVC conduit shall be made with a heated PVC conduit bender.
 - c. Make no bends with radius less than six times the conduit diameter, nor more than 90 degrees.
 9. Make changes in direction with pull boxes, symmetrical bends and/or cast-metal fittings.
 10. Total bends in any conduit run shall not exceed the equivalent of four, quarter (90°) bends for a total of 360°, per NEC, between pull boxes.
 11. Replace any crushed or deformed conduits.
 12. Conduits passing through roofs shall be in place before roof is installed.
 13. Conduits installed in concrete/grout filled CMU walls shall be Rigid steel or IMC conduits installed field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay. Painted on coating shall not be acceptable.
 14. Where conduits pass through or across building expansion joints, provide hot-dipped galvanized expansion fittings with bonding jumpers.
 15. Insure that all penetrations of firewalls are sealed per NEC and IBCC.
 16. Right and left couplings shall not be used; conduit couplings of the Erikson type shall be used at location requiring such joints.
 17. Paint all conduits exposed in finished spaces. Paint shall consist of one coat of zinc rich primer plus two top coats of water-based latex paint, color to match adjacent finishes. Verify colors and paint system with Architect.
 18. All conduit runs entering the building from outdoors shall be sealed against moisture migration and condensation by filling with insulating type foam.
 19. All conduits passing through walls of coolers or freezers shall have seal fitting installed on the outside of the cooler/freezer wall and within 3" of the wall. Fitting shall be sealed per manufacturer's recommendations.
 20. Install telephone, data, intercom, and signal system raceways, 2-inch trade size and smaller, in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements, in addition to requirements above.
- E. Below grade and below slab conduit installation:
1. See Section 16100, "Excavation, Cutting, and Backfilling" for trenching and backfilling requirements.
 2. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system. Painted on coatings shall not be acceptable. Wrap shall extend a minimum of 1" above slabs or 3" above finished grade where there is no slab. Alternate methods must be approved by Engineer prior to bids.
 3. Top of the conduit shall be not less than 30 inches below grade.
 4. Run conduit in straight lines except where a change of direction is necessary.
 5. Conduits stubbed up from below grade or slab into exterior walls shall be turned toward the interior of the building below slab fill perpendicular to the wall. Conduits shall not be turned out toward the exterior unless specifically indicated to do so.
 6. Placing of conduits below slab on grade:
 - a. Conduits 1-1/4" and larger shall be installed a minimum of 12" below the bottom of slab in the clay/sand fill below any gravel fill material.
 - b. Conduits 1" and smaller may be installed in the porous/gravel fill below the vapor barrier.
 7. Multiple Conduits:
 - a. Separate multiple conduits by a minimum distance of 2-1/2 inches horizontally and 3 inches vertically, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches horizontally and vertically.

- b. Where multiple layers of conduits are to be placed in a trench, each layer shall be placed in the trench, straight and parallel, clear fill material (see Excavation, Cutting, and Backfilling) placed and tamped in place to provide the specified spacing, and each subsequent layer placed in the same manner.
 - c. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly.
 - d. Conduits shall not be placed haphazardly in the trench.
8. Where conduits pass through footings or foundation walls:
 - a. Conduits roughed in beneath slab shall exit the foundation perpendicular to the building spaced approximately 3" apart. Conduits shall be arranged in a single horizontal row where practical.
 - b. Secure approval from the Architect and Structural Engineer prior to penetrating any footing or foundation wall.
 - c. Schedule 40 PVC sleeves shall be cast in the footings or foundation wall for the conduits to pass through.
 - d. Multiple sleeves shall have 3" clearance, vertically and horizontally, between the sleeves unless directed otherwise by the Architect and/or Structural Engineer.
 9. Where PVC conduit is installed below grade a PVC to rigid metallic conduit coupling shall be installed in the horizontal run and a rigid galvanized steel conduit elbow installed to turn up to above grade. Where above grade conduits are indicated to be rigid aluminum the elbow turning up to vertical shall be rigid aluminum.
 10. Rigid aluminum conduit shall be wrapped same as RGS through concrete from 2" each side of the concrete.
 11. Rigid galvanized conduit shall extend a minimum of 6" above the finished floor level.
 12. In hazardous areas the coupling shall be below grade and a single section of conduit installed up to 18" A.F.F. to accept the required seal fitting.
 13. Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used from 6 inches above the floor to the served equipment.
 14. Conduits shall exit concrete slabs vertically.
 - a. Where adequate support cannot be obtained by wiring to reinforcing steel, obtain support with solid iron stakes (which may be driven through membrane) cut off flush with slab after pouring.
 - b. At turn-ups of adjacent runs of exposed conduit, obtain alignment by wiring members to a temporary horizontal member.
 15. Empty or spare conduit stub-ups shall be capped with a threaded cap.
 16. Encasement Under Roads, Structures, and at other locations indicated on the drawings:
 - a. Under roads, paved areas, railroad tracks, and other locations indicated on the plans install conduits in concrete encasement of rectangular cross-section providing a minimum of 3 inch concrete cover around ducts.
 - c. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assemblies shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in conduit assembly.
 - d. Install #4 rebar at each corner of the encasement and at not more than 18" on center vertically and horizontally on the sides of the encasement. #4 rebar hoops shall be installed at not more than 18" on center along the length of the encasement.
 - e. Concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads, and 12 feet beyond the rails on each side of railroad tracks.
 17. Conduits to be installed under existing paved areas, which are not to be disturbed, and under roads and railroad tracks, shall be installed through a zinc coated, rigid steel, sleeve, jacked into place.
 18. Conduits installed between handholes, manholes or other accessible areas shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points.
 19. The contractor shall provide properly rated and sized junction and pull boxes as required on all underground conduit runs 150 feet and greater so as to minimize pulling tensions on

cables to be installed in conduits. In no case shall pull or junction boxes be further than 300 feet apart. Provide pulling tension calculations on all underground runs over 200 feet as required in Paragraph 1.09 Submittals.

- F. Conduit Installation in concrete slabs:
 - 1. Conduit installed in concrete slabs shall be rigid steel or IMC. Rigid steel or IMC conduits installed in slabs-on-grade shall be field wrapped with 0.010 inch thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system. Painted on coatings shall not be acceptable.
 - 2. At slabs on grade, conduit, 3/4" maximum, may be run in the slab; larger conduit shall be run below slab.
 - 3. Where adequate support cannot be obtained by wiring to reinforcing steel, obtain support with solid iron stakes (which may be driven through membrane) cut off flush with slab after pouring.
 - 4. At turn-ups of adjacent runs of exposed conduit, obtain alignment by wiring members to a temporary horizontal member.
- G. Flexible conduit:
 - 1. At motor or equipment connections:
 - a. The maximum length allowable for flexible conduit shall be 36 inches except at lighting fixtures.
 - b. Flexible conduit installed outdoors shall be installed so as to provide an 8 inch minimum drip loop as measured from the lowest end of the conduit.
 - 2. At lighting fixture connections provide flexible steel conduit by one of the manufacturers named for rigid.
 - a. Maximum length allowable shall be 72 inches.
 - b. Support flexible conduit such that it does not contact the ceiling system, ductwork, or other equipment above the ceiling. The conduit shall not be attached to a ceiling or ceiling support system.
 - c. All fixture whips shall be supported within 12" of outlet/junction boxes with single hole clamps.
- H. Empty conduit:
 - 1. Install a #14 galvanized fish wire or polypropylene pull cord with 14-inch free ends in all empty power and/or auxiliary conduits.
 - 2. All conduits indicated to be terminated above the ceiling shall have an elbow turned out above the ceiling and shall be terminated with an insulating bushing.
 - 3. Empty conduits stubbed out of buildings below grade:
 - a. Empty conduits stubbed out of buildings below grade shall extend 5 feet outside of the building foundation.
 - b. Install a 12"x 12"x 6" concrete marker at grade, above the end of the conduits, with "ELEC" inscribed on top.
 - f. Note on as-built drawings the exact location where empty conduit(s) are stubbed out below grade to the building exterior. Indicate conduit sizes and number of each size.
 - g. The contractor shall provide properly rated and sized junction and pull boxes as required on all underground conduit runs 150 feet and greater. In no case shall pull or junction boxes be further than 200 feet apart.
- I. Conduit entries into enclosures, panelboards, and wiring troughs:
 - 1. Layout conduit entries carefully to allow clearances for the number and sizes of conduits, electrical equipment, and future expansion.
 - 2. In sheet metal equipment use Greenlee Knock-Out punch, or equal, to cut holes for conduit installation. Do not drill holes, or cut holes out with snips or torch.
 - 3. In cast enclosures and boxes drill conduit openings with correct size drill for tight fit.
- J. **All junction box covers above the ceiling shall be labeled to which circuits or systems they contain.**

3.12. CONDUIT BODIES:

- A. Conduit bodies shall be sized in accordance with NEC 370, and 373.
 - 1. Conduit bodies for conductor sizes AWG #4 and larger shall be mogul type bodies sized in accordance with NEC 370-28.
 - 2. Conduit bodies for conductor sizes AWG #6 and smaller shall be sized in accordance with NEC 370-16(c).

3.13. JUNCTION AND PULL BOXES:

- A. Junction and pull boxes shall be sized per NEC to accommodate the installed number and size of conductors and conduits.
- B. Boxes shall be securely fastened in place.
- C. Boxes serving lighting fixtures installed in accessible, suspended ceilings:
 - 1. Provide number of boxes as required to maintain fixture whips within the 6' maximum length.
 - 2. Generally attach to underside of structure above, in accessible location, to accommodate a maximum 6' flexible conduit connection to each fixture or fixture run.
 - 3. Where the structure above is more than 18" above the ceiling the boxes shall be supported within 18 inches of the ceiling with all thread rod and/or strut.
- D. Install galvanized steel utility box plates, by box manufacturer, at exposed conduit fittings or boxes.
- E. **All junction box covers above the ceiling shall be labeled to which circuits or systems they contain.**

3.14. WIRE AND CABLE INSTALLATION:

- A. No conductor shall be smaller than #12 except where so designated on the drawings or specified elsewhere.
- B. Multiwire lighting branch circuits shall be used where indicated.
- C. Wiring devices shall be connected such that each device can be removed without interrupting the neutral or equipment grounding conductors serving other outlets on the same circuit(s).
- D. Joints and splices in wire shall be made with solderless connectors, and covered so that insulation is equal to conductor insulation. Wire nuts shall not be used for conductor #8 and larger.
- E. No splices shall be pulled into conduit.
- F. Both conductors and conduit shall be continuous from outlet to outlet.
- G. No conductor shall be pulled into the conduit until the conduit is cleaned of all foreign matter.
- H. When installing parallel conductors, it is mandatory that all conductors making up the feeder be exactly the same length, the same size, and type of conductor with the same insulation. Each group of conductors making up a phase or neutral must be bonded together at both ends in an approved manner.
- I. MC cable or Romex cable will not be accepted unless specifically called for on drawings.
- J. Wiring thru light fixtures and receptacles will not be accepted.

3.15. AUXILIARY GUTTERS (WIRING TROUGHS):

- A. Auxiliary Gutters shall be sized per NEC to accommodate the installed number, size, and orientation of conductors and conduits.
- B. Conductors serving a gutter shall be extended without reduction in size, for the entire length of the gutter.
- C. All taps and splices shall be made with insulated multi-tap connectors.

3.16. CIRCUITS AND BRANCH CIRCUITS:

- A. Outlets shall be connected to branch circuits as indicated on the drawings by circuit number adjacent to outlet symbols, and no more outlets than are indicated shall be connected to a circuit.

3.17. WIRE JOINTS:

- A. Except for motor circuits, wire joints for #8 and smaller wire shall be made with twist on connectors.
- B. Wire joints and splices for motor circuits, for conductors #6 and larger, and for smaller conductors where other connectors are not rated for the number of conductors involved shall be made with split bolt connectors rated for the applicable conductor size, number of conductors, and conductor material.
 - 1. Properly tape and insulate all joints to attain the same insulation rating as the cable insulation.
 - 2. Splices for #6 through #1 shall have a minimum of two (2) layers of rubber tape covered by a minimum of three (3) layers of electrical tape.
 - 3. Splices for #1/0 and larger conductors shall have a minimum of two (2) layers of electrical filler tape covered by a minimum of three (3) layers of electrical tape.
- C. Splices in control conductors shall be avoided as much as possible. Stranded control conductor up to #12 may be connected or spliced with hand crimped type compression connectors. The connectors shall be of the proper size for the conductors being connected.
- D. Splices and joints made with mechanical/hydraulic type compression connectors:
 - 1. Connections and splices shall be made with connectors rated for the applicable conductor size and conductor material.
 - 2. Dies used shall leave the die number embossed in the connector. The Contractor shall provide the Engineer with the Manufacturer's connector and die chart prior to final inspection.
- E. Taps and splices in auxiliary gutters/troughs shall be made with insulated multi-tap connectors.
- F. Wire joints and splices made below grade shall be made with UL listed waterproof connectors, wire nuts, or splice kits.
- G. All joints and splices shall be made in junction boxes, wiring troughs, or conduit bodies sized per NEC.
- H. All connections to switchboards, panelboards, transformers, generators, ATS, or any other type electrical distribution type equipment shall be compression type fittings. Mechanical fittings will not be accepted in these applications.

3.18. STRUT SYSTEM FOR SUPPORT OF ELECTRICAL EQUIPMENT:

- A. Strut Systems: Strut shall be utilized to rack exposed piping vertically or horizontally on walls and across slabs (where applicable). Strut may be utilized to support piping above ceilings, for support of equipment, and elsewhere as deemed appropriate.
 - 1. Strut in conditioned spaces and above accessible ceilings shall be electro-galvanized.
 - 2. Strut installed outdoors, in mechanical rooms, and in other unconditioned spaces shall be hot-dipped galvanized.
 - 3. Strut installed in waste water treatment facilities, kitchens, dishwashing spaces, and labs shall be stainless steel.
 - 4. Strut fittings and hardware, including anchors, shall be same material as strut.
 - 5. Saw cut strut square, 6" minimum lengths. Strut on continuous runs of pipe shall be same length. File or grind burrs from saw cuts.
 - 6. After installation, electro-galvanized and hot-dipped galvanized strut shall be painted with two coats of zinc primer.

3.19. OUTLET BOX INSTALLATION:

- A. General: The drawings indicate approximate locations only; determine the exact location at the building in view of all structural and architectural conditions. Obtain Architect's verification of final locations.
- B. Outlet boxes shall be sized per NEC to accommodate the installed number and size of conductors, wiring devices, and conduits.
- C. Ceiling and Wall Bracket Outlets: 4" octagonal boxes with plaster rings appropriate for finish surface.

- D. Typical boxes (for switches, receptacles and auxiliary systems): 4" square boxes ganged as required. Furnish with 3/4" plaster rings where employed in plaster, 1" tile covers where used in ceramic tile, 1" plaster rings where set in exposed concrete, and otherwise appropriate for surface and construction.
- E. Boxes in Exposed (or Thin-Coat Plastered) Masonry: Where conduit connections permit, employ solid flush-type, square-cornered, masonry boxes with turned-in device holders; otherwise employ typical box with 1-1/2" square-cut tile cover. .
- F. Multiple Outlet Floor Boxes:
 - 1. Verify the exact location of the floor boxes with the Architect prior to rough-in.
 - 2. Set the boxes in accordance with the manufacturer's instructions.
 - 3. Boxes shall be set so that the box is flush with the finished floor; the boxes shall not cause a rise or fall in the floor.
 - 4. The power outlets shall be connected to the circuits indicated by the numbers next to the symbol.
 - 5. For Data outlets, install a 1" C. to above the nearest corridor ceiling..
- G. Boxes used with Exposed Conduit: 4" square utility boxes.
- H. Exterior Boxes: Cast-metal boxes, Crouse-Hinds Type FS or FD as appropriate. Make weatherproof with gasketed covers. Equal products by Appleton, Killark, O-Z/Gedney, or approved equal will be accepted.
- I. Boxes used with Recessed Lighting Fixtures in suspended acoustical tile ceilings:
 - 1. Provide a 4" square box with blank cover adjacent to each fixture or fixture group.
 - 2. Install a flexible metal conduit fixture "whip" from the box to the fixtures. The "whip" shall not be longer than 72".
 - 3. Attach the box to the underside of the structure above, in an accessible location, not more than 18" above the lay-in ceiling.
 - 4. Where structure is more than 18" above the ceiling, the boxes shall be supported from all-thread rods, strut, or a combination of rod and strut.
- J. Boxes in Dry Wall Construction:
 - 1. Outlet boxes shall be securely fastened in place.
 - 2. Outlet boxes installed in metal stud construction shall be supported by brackets screwed to studs. Clip on brackets shall not be accepted.
 - a. Where a single outlet box is installed adjacent to a stud, brackets may attach to a single stud with a brace against the back of the opposite wall. Use a bracket equal to Caddy Fasteners "H" Series.
 - b. Where outlets do not fall next to a stud or where more than one outlet is installed between studs use a metal bracket attached to both studs. Brackets shall be equal to Caddy Fasteners "SGB", "TSGB", or "RBS" series brackets.
 - c. Outlet boxes three gangs and wider shall be supported with support member screwed to the two adjacent studs. Brackets equal to Caddy Fasteners SGB or TSGB brackets may be used.
- K. Sectional type switch boxes at least 2-1/2" deep may be used instead of typical box (but not where dry wall finish is applied over masonry back-up and not where multi- gang devices occur).
- L. Outlets in unfinished masonry walls may be slightly adjusted upward or downward to suit masonry courses, provided outlets are mounted at uniform heights throughout the installation.
- M. Coordinate installation of outlet boxes in masonry walls with the masonry contractor to insure that boxes are flush with face of wall and grouted smooth around boxes such that covers, fixtures or devices install flush on face of wall.
- N. Where outlets at different levels are shown adjacent, install in one vertical line where possible. Avoid conflict with wainscot caps, splash backs and upper cabinets by adjusting height slightly up or down as directed.
- O. Back to back boxes shall be staggered with at least 3 inches between boxes.

- P. Back to back boxes in fire rated partitions shall have a minimum of 24" horizontal and/or vertical separation between them.
- Q. Backs of boxes three gang and larger installed in fire rated partitions shall be wrapped with self adhesive fire stopping tape.
- R. Locate switch outlets on the lock side of doors and so that the first switch in a single or gang installation is approximately 6" to 10" from the doorjamb. Verify door swings on Architectural Drawings.
- S. Dimmers shall be ganged together in accordance with the manufacturer's instructions where appropriate, but shall not be ganged with toggle switches.
- T. Coordinate carefully with appropriate trades the size and orientation (vertical, horizontal) of outlet boxes for thermostats, data outlets, fire alarm equipment, security equipment, and other control and communications outlets.
- U. Mounting Heights:
 Confirm all mounting height with local codes and authorities prior to bid and adjust as required:

Switches, generally	48" A.F.F. to top of outlet
Safety switches	Center of Switch 48" A.F.F. or as required.
Receptacles, generally	16" A.F.F. to bottom of outlet
Receptacles over counters	Bottom of outlet 6" above countertops or 2" above backsplashes
Telephone Outlets	16" A.F.F. to bottom of outlet
Computer Outlets	16" A.F.F. to bottom of outlet
Television Outlets	16" A.F.F. to bottom of outlet or as indicated
Wall mounted exit and emergency lights	Bottom of fixture 7'- 6" A.F.F. or 12" below Ceiling whichever is lower
Thermostat	Top of outlet 48" A.F.F. or as noted by mechanical drawings.
Clocks & clock outlets	Top of outlet 12" below ceiling, 8' maximum.
Brass bell	Top of outlet 12" below ceiling, 8' maximum.
Electric Water Coolers	Coordinate location with plumbing contractor to locate the receptacle(s) concealed within the EWC enclosure per manufacturer's installation instructions.
- V. Install blank coverplates on all unused power and auxiliary outlet boxes. Blank coverplates shall match other cover plates installed in the facility.
- W. Furnish blank plates, matching those on the other outlets in the same area, on TV outlets and other outlets installed for future use.

3.20. WIRING DEVICES:

- A. Install wall devices vertically' unless otherwise noted, so that all devices of any given height will align exactly.
- B. Where boxes are not flush or square with the finished wall surface install wiring devices utilizing a leveler and retainer equal to Caddy #RLC or Steel City #SSF-SR.
- C. Plates shall be plumb and true with all four edges contacting wall surface.
- D. Mount receptacles with grounding terminals down.
- E. Do not install devices until plastering or other type wall covering has been completed; install ahead of painting work, but protect from paint spatter.
- F. Use screw terminal connections only.
- G. Do not gang dimmer switches with toggle switches.
- H. Each single or multi outlet receptacle, other than straight blade, 15 or 20 amp, 120 volts, NEMA 5-15R or NEMA 5-20R, shall be provided with matching cord plugs and a minimum of 8 feet of Type SOW cable matching the receptacle size and configuration.

- I. Pin and sleeve plugs for food service equipment shall be provided with a Type SOW cable connected to the equipment and plug of sufficient length to reach from the equipment to the plug with a minimum of 18" slack cord. Minimum length shall be 6 feet from equipment to plug.
- J. Provide "Kellums" type grips at the plug, cord connector, and for overhead support on all overhead cord connector drops.

3.21. OCCUPANCY SENSORS AND ASSOCIATED DEVICES FOR LIGHTING CONTROL:

- A. Occupancy sensors and associated devices and circuiting shall be installed in strict accordance with the manufacturer's instructions.
- B. Wall, corner mounted sensors shall be mounted as close to the ceiling as possible on the manufacturer's corner mounting bracket.
- C. Power packs shall be mounted above the ceiling. Power packs shall be installed utilizing two(2) 4" x 4" x 2-1/8" deep boxes joined together using the nipple on the powerpack in accordance with the manufacturer's instructions. One of the boxes shall contain the power pack and control wiring and the other shall contain the power wiring.
- D. All control and power circuiting shall be in EMT conduit. Where the devices are not equipped with conduit connections the conduit shall be brought up as close as possible to the device and terminated with insulating bushings.

3.22. ELECTRICALLY POWERED EQUIPMENT AND CONTROLS:

- A. Provide and install power circuits for all electrically powered equipment and controls.
- B. Heating, Ventilating, and Air Conditioning Control Wiring and Conduit:
 - 1. The electrical contractor shall be responsible for installing outlet boxes for flush mounted HVAC system thermostats in dry wall or masonry wall construction and, where called for on the plans, for surface mounted metallic raceway in finished areas. Extend 3/4" conduit from the outlet to above nearest accessible ceiling and terminate horizontally. Refer to the Mechanical/HVAC plans for thermostat locations and coordinate exact type outlet required and orientation with the Mechanical/HVAC contractor.
 - 2. The Mechanical Contractor shall be responsible for the installation of all outlets and conduit for surface mounted devices in unfinished areas such as shops, warehouses, industrial facilities, etc.
 - 3. The mechanical contractor shall furnish and install all low and line voltage control wiring required for the temperature control and/or ventilation systems.
- C. Where Fire Alarm system duct mounted smoke detectors and HVAC shut down interface relays are provided, the Electrical contractor shall provide wiring from the smoke detectors to the HVAC shut down interface relay. All circuiting from the shut down relay to the HVAC controls and/or starters shall be provided and installed by the Mechanical/Controls contractor.
- D. The mechanical contractor shall furnish all motor starters for the temperature control and/or ventilation equipment unless otherwise indicated on the electrical plans or elsewhere in these electrical specifications. The electrical contractor shall install all motor starters, except for equipment with factory installed starters, for the temperature control and/or ventilation equipment.
- E. Where exhaust fans are supplied with field installed speed controllers, the Electrical Contractor shall provide all necessary circuiting to the fan/speed controller and between the fan and the speed controller.

3.23. DISCONNECTING MEANS:

- A. Where required by the National Electrical Code and/or other applicable codes or authorities, or where indicated on the electrical plans, the electrical contractor shall furnish and install an approved disconnecting means for all electrically powered equipment and/or controllers for such equipment whether the disconnecting means is or is not shown on the electrical plans.
 - 1. The location, rating, and enclosure for the disconnecting means shall be as required by the National Electrical Code and/or other applicable codes or authorities.

2. Manual motor starters with thermal overload protection may be used in lieu of safety switches for individual motors under 1 horsepower.
 3. Motor rated switches may be used for the disconnecting means when supplied of correct voltage, phase, amperage rating, and enclosure type.
 4. The disconnecting means shall be as manufactured by General Electric, Cutler Hammer, or Siemens. Square D will not be accepted.
- B. Where the disconnecting means shown on the electrical plans has a rating greater than the required code rating, the greater rating device shall be installed.
 - C. An approved horsepower rated fusible safety switch shall be installed where the circuit overcurrent protection does not provide overload protection for the equipment served and where required to meet the equipment's listing requirements.
 - D. Motor rated switches may be used as service disconnect switches when supplied with a padlockable, handle locking guard.
 - E. Install an engraved phenolic nameplate on the front of each switch enclosure identifying the equipment served by the safety switch and source of power (i.e., panel name and circuit number). Plates shall be white with black lettering. The plates shall be permanently installed with stainless steel screws or stainless steel rivets.
 - F. All disconnects installed in public areas or in areas readily accessible to the public shall be lockable and shall be furnished with a brass lock. Provide 10 keys for each lock. All disconnect locks furnished on the project shall be keyed alike.

3.24. LIGHTING FIXTURES:

- A. The installation and support of all lighting fixtures shall be the responsibility of the Electrical Contractor.
- B. Lay out work as shown, and to provide attractive and efficient arrangement.
- C. Install fixtures level, plumb, and true with ceiling and walls, and in alignment with adjacent lighting fixtures.
- D. Provide adequate and substantial supports for fixtures in accordance with manufacturers' directions and as specified herein.
- E. A Re-lock system will not be accepted for installing lights.
- F. Wire grid mounted luminaries individually to junction boxes with flexible conduit not more than 6 feet in length. Individual flexible connections shall be 2 #14 and 1 #14 ground THHN in 3/8" flexible conduit. Ground wire shall be bonded at each end.
- G. Light fixtures with center baskets shall have all fixtures in a room installed with the center baskets oriented in the same direction.
- H. Fixtures mounted in inverted "T" grids:
 1. For round fixtures or fixtures smaller in size than the ceiling grid, provide a minimum of four wires per fixture located within 4 inches of each corner of the ceiling grid in which the fixture is located. Do not support fixtures by ceiling acoustical panels. Fixtures shall be supported independent of the ceiling system or shall be supported by at least two metal channels spanning the grid system, and secured to, the ceiling tees. One support wire shall be attached to the center of the fixture or to each of the metal channels.
 2. Surface mounted fixtures:
 - a. Surface mounted fixtures installed on lay-in ceiling systems shall be supported independent of the ceiling system from the building structure with a minimum of two (2) 3/8", minimum, all-thread rods.
 - b. Install nuts and washers on inside and outside of the fixture housing to provide a rigid installation.
 - c. Provide cross bracing as required such that fixtures have no lateral movement.
- I. All stems on lighting fixtures shall be installed as follows: (except fixtures with slide grip hangers) first and last stem in row in first knockout from end of fixture. One stem shall be installed between each two fixtures, stem shall center joint, where fixtures join, and attach by

use of "jointing plates". Nipples with lock nuts and bushings shall connect all fixtures in continuous rows other than recessed grid type.

- J. All suspended lighting fixtures shall be provided with chain or cable sway bracing to keep fixtures from swinging.
- K. Fixtures installed in fire rated assemblies shall be tented in accordance with the specified assembly.
- L. Means shall be provided to keep insulation 4" minimum away from fixtures not rated for direct contact with insulation.
- M. Prior to final inspection clean fixtures and lamps with a soft cloth or sponge and detergent (not soap) solution.
- N. All lighting fixtures installed in gymnasiums, hangars, high bay or similar use areas shall be equipped with wire guards.
- O. All emergency and exit lights designated on drawings shall be provided with an 1100-lumen battery ballast.
- P. All light fixtures shall be supported to the structure independent of the ceiling system on two opposite sides. Support wires shall be different color from ceiling support wires. Engage all ceiling mounting clips. If light fixture is not provided with grid support clips, then the contractor will be responsible to support the fixture on all four sides with support wires. See "Typical Lay-In Luminaire Detail" on drawings for further requirements.

3.25. STEEL(ALUMINUM) POLE SETTING:

- A. Bases for poles shall be constructed as detailed on the drawings
- B. Anchor bolts shall be set plumb and centered in the base with adequate threads left exposed for base plate, backing nuts, washers, and locking nut.
- C. Poles shall be set plumb. Adjust backing and locking nuts to plumb pole with pole base held as close to concrete base as possible.
- D. Grout space between pole base plate and concrete base with non shrinking grout to provide a smooth finish.
- E. Smooth all nicks, scratches and scrapes and recoat with factory supplied or recommended primer coat and finish coat.

3.26. PANELBOARDS:

- A. Panelboards shall be installed where shown on the drawings.
- B. Ratings and configurations shall be as scheduled and/or indicated on the drawings.
- C. The Electrical Contractor shall coordinate installation of equipment in Electrical and Electrical/Mechanical spaces with other trades such that Code required clearances and working space around the electrical equipment is maintained.
- D. Conduit termination:
 - 1. In general use panelboards with blank ends, without knockouts.
 - 2. Layout conduit entries carefully to allow clearances for drywall or CMU wall thickness, and to accommodate the number and sizes of home run conduits and specified spare conduits.
 - 3. Use Greenlee Knock-Out punch, or equal, to cut holes in panelboard ends and/or sides for conduit installation. Do not drill holes, or cut holes out with snips or torch.
- E. Phase arrangement in panelboards shall be per the NEC, phase A, B, C from front to back, top to bottom, or left to right as viewed from the front.
- F. In Delta connected systems the "high" leg shall be the B phase and shall be clearly marked with an orange outer finish.
- G. Multi-Section Panelboards:
 - 1. Sub-feed conductors shall be the same size as the conductors feeding the main section.
 - 2. Circuiting originating in one section shall not pass through another section.

3. Circuit conductors and grounding conductors shall originate in the same panelboard section.
4. A separate isolated grounding conductor shall be installed from the main section to the sub-feed section(s).
5. Where the panelboard is rated for service entrance equipment the each sub-feed section shall have a separate isolated ground buss fed from the main section ground buss.

H. Labeling:

1. Each panelboard shall have an engraved phenolic plate permanently installed on the front of the panel with the panel name, current rating, and voltage rating.
2. Where there is more than one nominal voltage system the panel shall also have an engraved phenolic plate describing the means of identification used to identify the phase and system of each ungrounded conductor of the system served by the panel.
3. Plates shall be white with black lettering.
4. Panelboard circuit numbers shall be as indicated on the panelboard schedules.

3.27. PHOTOELECTRIC CELLS, TIMERS, AND CONTACTORS FOR LIGHTING CONTROL:

- A. Install time clocks where accessible.
- B. Install photoelectric cells so that lighting fixtures do not affect the cell.
- C. Adjust time clock(s) and photoelectric cells as required for proper operation.

3.28. IDENTIFICATION AND LABELING:

A. Feeder Designation:

1. Non-ferrous identifying tags or pressure sensitive labels shall be securely fastened to all cables, feeders, and power circuits in vaults, pull boxes, manholes, switch gear and at termination of cables. Tags or labels shall be stamped or printed to correspond with markings on drawings so that feeder or cable number and phase can be readily identified.
2. Where there is more than one nominal voltage system, each ungrounded system conductor shall be identified by phase and system wherever accessible per NEC. The means of identification shall be permanently posted at each branch-circuit panelboard.

B. Color Coding of Conductors:

1. The ungrounded (phase) conductors and the grounded (neutral) conductors of each voltage system shall be identified by the following color coding method:
 - a. 120/240 Volts, Single Phase, 3 Wire:
 - 1) Grounded (Neutral) Conductor --- White
 - 2) Ungrounded (Phase) Conductors --- Red, Black
 - a. 120/240 Volts, Three Phase, 4 wire:
 - 1) Grounded (Neutral) Conductor --- White
 - 2) Ungrounded (Phase) Conductors --- Red, Orange, Black
 - b. 120/208 Volts, 3 Phase, 4 Wire:
 - 1) Grounded (neutral) Conductor --- White
 - 2) Ungrounded (phase) Conductors --- Black, Blue, Red
 - c. 277/480 Volts, 3 Phase, 4 Wire:
 - 1) Grounded (neutral) Conductor --- Gray
 - 2) Ungrounded (phase) Conductors --- Brown, Orange, Yellow
2. Green shall be used for equipment grounding conductors only.
3. The insulation color shall be visible for the entire length of wire.

C. Panelboard:

1. Each Lighting and Power Panelboard shall contain a typed circuit directory listing all circuit breakers and the load served by each.
2. Panelboard directories shall be typewritten, and shall include adequate descriptions for proper identification of individual circuits. Do not write in or on panelboards.
3. On Distribution panelboards, provide and install an engraved laminated label for each circuit, indicating circuit's number and load served.
4. Each panelboard shall have an engraved phenolic plate permanently installed on the front of the panel with the panel name, current rating, and voltage rating.

5. Where there is more than one nominal voltage system each panelboard shall have an engraved phenolic plate describing the means of identification used to identify each phase, neutral, and grounding conductors of the system served by the panelboard per NEC.
 6. Plates shall be white with black lettering.
- D. Wall Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on the wall plate.
- E. Receptacles: Install a label on the face of the coverplate and tags or wire markers inside the outlet box identifying the panelboard and circuit number from which the outlet is served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of coverplate- black print on clear tape on light colored or stainless steel plates and white print on clear tape on dark colored plates. Embossed tape labels will not be accepted. Use durable wire markers or tags within outlet boxes.
- G. Disconnect Switches:
1. Install an engraved phenolic nameplate on the front of each switch enclosure identifying the equipment served by the safety switch and source of power (i.e., panel name and circuit number).
 2. Plates shall be white with black lettering.
 3. The plates shall be permanently installed with stainless steel screws or stainless steel rivets. Plates installed with glue or other adhesives will not be accepted.
 4. Where motor rated switches are used as service disconnect switches, labeling shall be as described for receptacles.
- H. Junction boxes: Identify circuits enclosed in concealed junction boxes on the cover with permanent marking pen.
1. For power and lighting circuits indicate panelboard of origin and panelboard circuit number(s).
 2. For auxiliary systems circuiting indicate the system and zone served.
- I. Service disconnects:
1. An additional engraved sign shall be permanently attached next to panelboard circuit breakers, on enclosed circuit breaker enclosures, and/or on disconnect switches used as service disconnects to identify each main service disconnect.
 2. The sign shall be red with white lettering a minimum of ½" high.
 3. Where multiple main disconnects are utilized the labels shall identify each as one of a group, i.e., "Service Disconnect 1 of 3", etc. where there are three service disconnects.

3.29. FIRE ALARM SYSTEM:

- A. The installation shall be by a Certified Fire Alarm Contractor who has qualified and received a permit from the State Fire Marshal, with an NICET Level III on staff.
- B. All wiring shall be in accordance with the National Electric Code and the local code having jurisdiction.
- C. Unless otherwise specified, minimum wire size shall be 14 gauge for AC and power supply connections, 14 gauge for audible alarm and auxiliary circuits, and 18 gauge for signal initiating circuits. Diagrams shall be provided for device and power wiring. Color coding and permanent numbering shall be used as recommended by the equipment supplier.
- D. All system wiring shall be installed in metal raceway in accordance with Section "Raceways".
- E. Junction boxes shall have covers painted red with the letters "FA" stenciled on the cover in 2" high white letters.
- F. Auxiliary Remote Power Supplies/Notification Appliance Circuit Extender (NAC panel):
 1. Power supplies shall be sized at 133% of proposed load. Fire Alarm submittals shall include power supply capacity and loading data.
 2. Remote power supplies shall be supervised by the FACP.
 3. The power supplies shall be installed, accessible, below ceiling, in electrical rooms or where indicated on the drawings.

- G. Where air handler shut down is controlled from the fire alarm system, the fire alarm system installer shall provide circuiting as required between the Duct Mounted Smoke Detectors and the HVAC interface/shut down relays. Circuiting connecting the relay output contacts to the HVAC control system shall be provided and installed by the Mechanical/Controls contractor.
- H. Each air handling unit shall be a separate fire alarm initiating zone.
- I. Install wire guards on all smoke detectors and notification devices installed in gymnasiums or similar use areas.
- J. Final connections to the Fire Alarm Control Panel and Voice Panel shall be made by a factory certified, NICET Level III, technician.
- K. A factory-trained representative of the manufacturer shall supervise connections and final testing of this system and shall complete a Certificate of Completion per NFPA 72. The Certificate of Completion shall be completed and copies delivered to the Owner, Architect, and Engineer prior to the final inspection.
- L. On completion of the acceptance tests, the Owner or his representative shall be instructed in the operation and testing of the system.
- M. **At the acceptance tests, contractor shall provide engineer with smoke detector diagnostic reports for all smoke detectors. All smoke detectors more than 10% dirty shall be either cleaned or replaced until test show value less than 10%.**
- N. The fire alarm system shall be warranted free from defects in workmanship and materials, under normal use and service, for a period of one year from the date of acceptance or beneficial occupancy, whichever is earlier. Any equipment shown to be defective in workmanship or material shall be repaired, replaced, or adjusted free of charge.
- O. Identification and labeling:
 - 1. Provide a framed building drawing identifying each zone and/or building area.
 - 2. Each building zone on the Fire Alarm Control panel shall relate to the building drawing in a manner that will direct the fire department to the area of a fire.
 - 3. On addressable systems each addressable device shall be given a name displayed on the control panel readout that will direct the fire department to the area of the fire, i.e. – South End of Zone(Building) 5; AHU-1 – Mechanical Room 201 – Building 2. Any room number reference shall be to final room numbers assigned to rooms on completion of construction.
 - 4. Building drawing, schedule of zones, and device identification schedule shall be submitted to the Engineer for approval prior to final inspection and acceptance.
 - 5. On addressable systems the contractor shall label each device with an alpha-numeric identifier that is unique to that device. This identifier shall correspond to the identifier programmed in the fire alarm control panel such that maintenance personnel may quickly and readily identify the device.

3.30. SECONDARY SURGE ARRESTERS:

- A. Secondary surge arresters shall be installed in strict accordance with the manufacturer's recommendations.
- B. Arrester may be mounted to the side of a surface mounted panelboard or trough. If such a surface is not available, the arrester shall be mounted on a bracket in its own flush mount enclosure located immediately adjacent to the service panel. Insure that all leads are attached per manufacturer's recommendations. Excess lead length shall be cut off prior to making connections.

3.31. CONCRETE:

- A. The Electrical Contractor shall be responsible for placing concrete for electrical equipment pads, lighting standard bases, electrical equipment supports, and at other locations as indicated on the electrical drawings and/or specified herein.
- B. This Contractor shall be responsible for size, location, and orientation of the pads, bases, etc. Any required additions or modifications to concrete due to incorrect size, location, or orientation shall be the responsibility of this contractor.

- C. Concrete shall be cured for a period of not less than seven (7) days prior to setting poles, transformers, switchgear, motor control centers, or other pad mounted equipment.
- D. Forms shall be completely removed after concrete has cured and prior to setting equipment.
- E. A smooth wood float finish shall be given to exposed, unformed concrete.
- F. Honeycombed, or otherwise defective areas of concrete shall be repaired by patching with cement mortar.

3.32. SPARE MATERIAL:

- A. Provide two exit sign type XB and 50 feet of circuiting in conduit for each device complete with all labor and material for installation in a location as directed by the engineer or architect.
- B. Provide six type NEMA 5-20R receptacles complete with 75 feet of circuiting in conduit. For each device provide complete with all additional labor and materials for installation in a location as directed by the architect or engineer.
- C. Provide 4 duplex communications outlets complete with all labor, material, cabling and conduit necessary to install outlet 300 feet from the nearest communications IDF closet and terminate outlet cables on patch panels in rack. Outlets to be installed in a location as directed by architect or engineer.
- D. Provide two of each type of fire alarm notification devices (speaker/strobe units, strobe only units) and 75 feet of circuiting in conduit for each device complete with all labor, programming, and material for installation in a location as directed by the engineer or architect.
- E. Provide two of each type of fire alarm heat detector devices and 75 feet of circuiting in conduit for each device complete with all labor, programming, and material for installation in a location as directed by the engineer or architect.
- F. Provide two of each type of initiating device (pull station, zone module, duct detector, smoke detector) and 75 feet of circuiting in conduit for each device complete with all labor and material for installation in a location as directed by the engineer or architect.
- G. Provide one spare set of fuses for each size and type fuse used.

3.33. EQUIPMENT TOUCHUP AND PAINTING:

- A. Clean damaged and disturbed areas on all painted surfaces of enclosures, cabinets, and equipment, sand smooth, and apply primer, intermediate, and finish coats of paint to suit the degree of damage at each location. Paint shall be the manufacturer's supplied touch up paint or a matching paint. Prep all surfaces to be painted by removing all rust, dirt, oil, and any other material that might inhibit good paint adhesion by mechanical means and/or with solvents.
- B. Follow paint manufacturer's written instructions for surface preparation and for timing and application of successive coats.
- C. Repair damage to galvanized finishes with two coats of zinc-rich paint recommended by manufacturer.
 - 1. Paint cut ends.
 - 2. Paint all drilled and punched holes.
 - 3. Paint all knicks and scratches.
 - 4. Paint all field cut conduit threads.
- D. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

Section 16152

Intercom/Class Tone System

1 Part 1 General

- 1.A This section and associated drawings define a communications system for an intercom, public address, and master clock system. The bidder shall provide infrastructure, cable, hardware, and equipment, as defined, to provide a complete and operational communications system.
- 1.B Where applicable visit the site, verify all existing items shown on plans, or specified, and be familiar with the working conditions, hazards, and local requirements involved; submission of bids shall be deemed evidence of such visit. All proposals shall take these existing conditions into consideration before bidding.
- 1.C All materials, unless otherwise specified, shall be new, free from any defects, and of the best quality of their respective kinds. All like materials shall be of the same manufacture, model, and quality, unless otherwise specified.
- 1.D Contractor shall do all necessary cutting and drilling of present walls, floors, ceilings, etc., for the installation of new work; but no structural work shall be cut, unless specifically shown on drawings and/or approved by the Owner. All exposed building surfaces damaged by installation or removal of electrical work shall be patched and finished in the same materials and manner as adjacent areas by this Contractor.
- 1.E If, applicable, contractor shall co-ordinate his work with the Owner for times which changeover, removal of existing equipment, and new connections of existing systems can be completed.

2 Raceways and Cables

- 2.A Electrical work will conform to the National Electric Code and applicable local ordinances.
- 2.B All 125-volt electrical conductors shall be installed in galvanized electrical metallic tubing with compression type fittings and couplings, minimum 3/4" size conduit.
- 2.C All low-voltage wires and cables concealed in walls shall be run in EMT conduit from flush outlet boxes to above accessible ceilings. Provide conduit where cables penetrate firewalls above ceilings.
- 2.D All EMT entering boxes shall be served with insulating throat connectors and locknuts.
- 2.E No raceway shall be located in proximity of hot water lines or excessive heat.
- 2.F Where raceways cannot be run concealed in walls, use Wiremold Series surface raceway complete with all fittings, box extension rings, and required accessories. Co-ordinate routing of surface raceways with the Owner.
- 2.G Use Cast "C" clamps, "U" straps, or ring hangers attached to rods, and/or brackets fastened to structure.
- 2.H No perforated straps or tie wires permitted for supporting raceways.
- 2.I Use wire ties for supporting low voltage cables run concealed above ceilings. Do not run cables loose on ceiling tiles. Support from structure above. Group cables in bundles.
- 2.J Tie mounts, plates, and anchors shall be used.

- 2.K Ground all electrical apparatus in accordance with the National Electric Code.
- 2.L Provide plenum rated cabling when cable is run in plenum.

3 Quality Assurance

- 3.A Manufacturers must be regularly engaged in the manufacture of integrated communication systems, master clock systems, and ancillary equipment, of types and capacities required. Approved products shall have been in satisfactory use in similar service for not less than five years.
- 3.B Installer's Qualifications: Firms with at least five years of successful installation experience with projects utilizing integrated communications systems and equipment similar to that required for this project.
- 3.C All items of equipment including wire and cable shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.
- 3.D The Contractor shall be an established communications and electronics Contractor that has had and currently maintains a locally run and operated business for at least five years. The Contractor shall be a duly authorized distributor of the equipment supplied with full manufacturer's warranty privileges.
- 3.E The Contractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The Contractor shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.
- 3.F Except where specifically noted otherwise, all equipment supplied shall be the standard product of a single manufacturer of known reputation and experience in the industry. The Contractor shall have attended the manufacturer's installation and service school and upon request must show proof of attending such a school.
- 3.G Installing contractor must have a service office with qualified service and installation personnel within 75 miles of the site and be expected of providing service within a 24-hour period of time.

4 Scope of Work

- 4.A Furnish and install all materials, labor, equipment, permits, etc., to provide communications system as described herein and illustrated on the drawings for a complete operating system.
- 4.B All manufactured articles, material, and equipment shall be applied, installed connected, erected, used, cleaned, adjusted, and conditioned as recommended by the manufacturers, or as indicated in their published literature, unless specifically herein specified to the contrary.
- 4.C All work shall be performed by competent workmen and executed in a neat and workmanlike manner providing a thorough and complete installation. Work shall be properly protected during construction, including the shielding of soft or fragile materials. At completion, the installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of this portion of work shall be removed from the premises.
- 4.D Program the operational characteristics matching the operation described herein, adjusting for call routing, transfers, priorities, and volume levels.
- 4.E Remove all existing conduit, wire device, etc., being abandoned due to relocation.

- 4.F The Contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments, which will facilitate the training of individuals in the operation of this system. Operator Manuals and User Guides shall be provided at the time of this training.

5 Submittals

- 5.A Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.
- 5.B Shop Drawings: Composite wiring and/or schematic diagrams of the complete system as proposed to be installed. Drawing shall include relative position of all major components, typical connections, field components, accessories, and cable types.
- 5.C Product Data: Include catalog cut sheets, manufacturer's default specifications, Users operation guide, and bill of materials.

Quality control shall include the following:

1. Submit the Name, address, and telephone number of the nearest fully equipped service organization.
 2. Submit a certificate of completion of installation and service training from the system manufacturer.
- 5.D Program the operational characteristics matching the operation described herein, adjusting for call routing, transfers, priorities, and volume levels.
- 5.E Remove all existing conduit, wire device, etc., being abandoned due to relocation.
- 5.F The Contractor shall provide a minimum of eight hours of in-service training with this system. These sessions shall be broken into segments, which will facilitate the training of individuals in the operation of this system. Operator Manuals and User Guides shall be provided at the time of this training.

6 Acceptable Manufacturers

- 6.A The system shall be manufactured by Telecor to match existing, alternate manufacturer shall submit 10-days prior and show how their equipment works with the existing system.
- 6.B Manufacturer's names are listed herein to establish a standard. The products of other manufacturers will only be acceptable if approved by the specifying architect and the Owner 10-days prior to the bid. The substitute material must be of a quality as good or better than the material specified, and will serve with equal efficiency and dependability, the purpose for which the items specified were intended.
- 6.C Final approval of these alternates shall be determined at the time of completion. Failure to provide the "functional equivalent" shall result in the removal of the alternate system and installation of the specified system at the contractor's cost.
- 6.D The intent is to establish a standard of quality, function and features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds the intent of these specifications.
- 6.E The functions and features specified are vital to the operation of this facility and therefore inclusion in the list of acceptable manufacturers does not release the contractor from compliance with the requirements of this specification.

7 Product Overview

- 7.A Furnish and install all equipment, accessories, and materials in accordance with the specifications and drawings to provide a complete and operating Communication system as outlined below.
- 7.B Following is an outline of the basic functions required, set as a minimum standard. These functions must be included in the bid. Any exceptions to these functions must be listed and submitted as part of the bid. If several manufacturers are required to provide these functions proof must be provided that they will function as one integrated system to the user.
- 7.C Intercom Features/Public Address Features
1. Individual intercom circuit for every Classroom
 2. Urgent Call Placement
 3. Monitor Areas of the building during a crisis from the rescue team or on site security officer.
 4. All Call announcements
 5. Emergency Announcements
 6. Automatic Page
 7. Urgent Call-In Page
 8. 32 Zones of Audio Program Distribution
 9. 32 Zones of Paging
 10. Monitor Areas of the building during a crisis from the rescue team or on site security
 11. Page areas of the building during a crisis from the rescue team or on site security officer.
 12. Temporary Speaker Exclusion for Special Events
 13. Complete System Programming and diagnostics from LAN, WAN or Internet
- 7.D Time Control and Event Scheduler
1. 16 Schedules of Class Change Signals
 2. 32 Zones of Class Change Signals
 3. 1536 Class Change Signal Events
 4. Weekly System Event Scheduler
 5. Analog or Digital Clock Correction and synchronization
 6. Supports Electronic Message Displays for Timekeeping, Count Up-down timers and full alphanumeric messaging
 7. Automatic Daylight Savings Time Correction

8 Intercom/PA Features and Product Description

- 8.A Supply and install a complete microprocessor based Public Address, Intercom, and master clock system using 25-volt speakers and horns.
- 8.B The system shall consist of the Central Control Unit, Administrative Control Console(s), Integrated Master Clock and Rack Equipment. All other necessary devices that are required by this specification to create a complete and operational system such as Staff Phones, Call Buttons, Speakers, Horns, Amplifiers, Program Sources and Secondary Clocks must be supplied under this contract.
- 8.C The system shall be capable of multiple open voice intercom paths used for intercom, paging, program distribution, or emergency paging. The system shall be initially equipped with minimum of one intercom speech path.
- 8.D Provide a separate circuit for each classroom and administrative office so each room can be individually addressed.

- 8.E Corridor speakers, classrooms and outside horns shall be combined into groups of owner's preference. There must be 32 independent software paging zones that each circuit may be a part of. Each individually point must also have the ability to be paged independent of the software zones.
- 8.F The system will have the ability to utilize VOIP intercom stations in addition to industry standard 25 volt speakers. The VOIP stations will operate in the same manner as the conventional speakers. The system must be a hybrid system having the capability of using either or both types of stations wherever it is deemed necessary and practical by the owner. The VOIP stations must have the ability to incorporate a call switch and must be capable of operating on the existing school LAN/WAN network.
- 8.G The system specified is based on the Telecor XL system providing at least the following features and functions. It shall be installed and programmed by an authorized and certified Telecor dealer.

The central control unit shall have the capacity for expanding the system to 300 stations and 4 Administrative Consoles with the addition of plug in modules, as required.

- 8.H It shall be complete with circuitry for accomplishing all functions for signaling and communications to all stations, page zones, and administrative control consoles. The unit shall contain all required electronics on modular, plug-in type boards for ease of service and future expansion.
- 8.I All programmable functions shall be stored in a non-volatile EEPROM memory and shall not be lost in event of a power failure.
- 8.J Programming functions shall be accomplished through the use of a standard Internet web-browser interface. Any PC connected to the schools network and provided with the proper authorization shall have multi-level access to system programming. Any off-site PC shall have multi-level access to the system through the use of the public internet, provided they have been granted proper authorization by the school.

The intercom system shall be connected to a (school provided) Ethernet network port using the TCP/IP protocol for PC programming, performing diagnostics, or logging transactions either on or off-site.

The system shall support remote programming and support through a wide area network connection.

The programming interface shall support configurations for multiple sites and allow the user, after logon, to select which site to program from a list of all sites.

The user interface shall support user names and passwords. There shall be multiple levels of access allowed. Some users may only have view privileges only while others may only edit their site.

The program shall also serve as part of the documentation process. Page Zones and bell schedules shall support user-definable names and display as pick lists when editing the configuration.

Diagnostic functions shall be accomplished through any PC connected to the school network and provided with the proper authorization and diagnostic software. Any off-site PC shall have access to the system for diagnostics through the use of the public internet, provided that they have been granted proper authorization and have been provided diagnostic software.

Although the Intercom PA system is programmed through a PC interface, the system shall not have to rely upon a personal computer for day to day operation. All programming information is

loaded into the intercom system allowing independent operation of the system.

The final copy of the program and the configuration of data files shall be provided to the school in electronic format

8.K The audio channel(s) shall be priority driven allowing for the highest priority signal type access to a voice channel. The system shall be user programmable to allocate, upon demand, either of the channel(s) to facilitate simultaneous intercom conversations, pages, program distributions, or combination thereof.

8.L Call switches shall be provided and shall be programmable and capable of routing incoming calls from classrooms to a specific control console or specific group of consoles. Every point shall be individually programmed. Up to 16 different console groups can be assigned.

Calls may be answered from any annunciating control console, administrative telephone, attendant console, and Caller ID enabled single-line telephones. When calls are routed to multiple consoles or console display units simultaneously, once answered, the call shall be automatically cancelled from all other consoles or displays.

The system shall support both "normal calls" and "emergency calls" from a single call switch. Merely depressing the call switch repetitively 3 times or flashing the hook-switch of the room telephone 3 times shall initiate emergency calls. Call switches may also be programmed to initial an emergency call by pressing and holding the button for three seconds.

If an emergency call is not answered within a user programmable time, the call will automatically call all other Administrative Control Consoles in the system.

The system shall be capable of monitoring supervised call-in lines. Any supervised line shall alert the control console if the line is cut. The system can be checked daily from the control console for damaged lines.

All call switches shall be associated with a speaker assembly.

Every call switch point shall support an independent programmable priority level.

8.M Pre-announce tones will alert the classroom of incoming calls with distinct tones for each priority level.

To prevent unauthorized monitoring, the tone will sound whenever the classroom is being monitored, and will repeat at regular intervals. Facilities shall also be provided to defeat the tone repeat function from the administrative console if it is not desired.

8.N Provide automatic gain control on intercom speech to assure constant speech level.

8.O System shall have the capabilities of interfacing with a local Gym or Auditorium Sound System, providing automatic bridging of the local system, whenever it is accessed from the console. The system shall automatically track the local system, controlling the audio program as programmed from the control console.

8.P System will provide emergency and All Call paging and a minimum of 32 zones of group paging. The paging zones shall be independent of the time tone and audio program distribution zones. Systems sharing zones for both paging and time tone shall not be acceptable.

8.Q 32 different sections of the building can be monitored either on or off the premises from a control console or telephone.

- 8.R System shall support up to 5 low-impedance microphones, which can be individually programmed to announce in any individual room or assigned to any of the 32 paging zones. The microphone(s) shall be software programmable for control and distribution thus eliminating the need to go to the central electronics for set-up.
- 8.S Distribution of paging announcements can be made from any administrative control console, telephone, or dedicated microphone set-up.
- 8.T Emergency announcements shall have the highest priority over any other system function.
- 8.U System shall support general announcements made from a conventional microphone to facilitate reading a script and the participation of multiple announcers.
- Keying the microphone shall automatically mute all other audio programs at a lower priority in the system and transmit the microphone audio to All Rooms or specific speaker zones, as programmed into the system software.
- 8.V The system must have the capability of distributing audio program sources from any administrative control console, telephone system phone or intercom system DTMF phone. Program distribution shall be accomplished on an all rooms basis, selected rooms basis or an individual room.
- 8.W Classroom phones, if required, must have the ability to add or remove themselves from an ongoing program from their room phone.
- 8.X Inputs shall be provided from at least 3 different line level sources and 5 different low impedance sources. Available inputs include microphones, tuners, tape players, or auxiliary sources.
- The program source(s) can be located remotely from the central electronics so that the customer does not have to go to the communications closet to select the program.
- The control console shall be able to selectively monitor program sources being distributed.
- 8.Y Any area of the building shall be software programmable into 32 zones for easy selection of receiving audio programs. These zones shall be independent from the page and time tone zones. Individual rooms shall also be included or excluded independently from receiving audio programs.
- 8.Z Systems whose only method of distributing an audio program is by the use of mechanical switch banks shall not be accepted.
- 8.AA Systems, which cannot support the distribution of program material by at least two separate methods, will not be acceptable.
- 8.BB The Central Control Unit shall provide a 0 dB signal for connections to an external amplifier for distribution of program audio, time signals and paging announcements.
- 8.CC The system shall provide capability for multiple open voice intercom paths used for intercom, paging, program distribution, or emergency paging (Minimum of two). These paths shall be global, non-blocking circuitry. Systems offering multiple-speech paths, which are restricted to a single speech path per group of room stations or circuit card, due to hardware constraints, will not be accepted. The intercom channels shall be universal allocating channels on demand.
- 8.DD The system shall support the automatic distribution of user programmable, class change time signals (Bell Schedule) to all selected areas:
- The system shall support a minimum of 1536 events and 16 schedules.

Building time zones shall be used to select which areas receive the tone. They must be totally independent from page zones and program zones.

Ability to produce 8 different tone signals for classroom time changes or emergency signals selected from a combination of over 1500 tones.

All time signal programming shall be accomplished from a control console or a PC utilizing a standard web browser program.

Facilities for displaying console clock in 24-hour or 12-hour format, selectable at the control console.

The duration of the tone, as well as frequency, burst length and output level shall be software programmable from the console or a web browser.

The system shall support running all time schedules concurrently.

All system tones shall be user programmable for the following durations in seconds: 2, 3.5, 5, 6, 8, 10, 12.

The system shall provide the ability to have music on class change allowing any source to be distributed to specific program zones.

- 8.EE The intercom channel(s) must be equipped with an auto call back function allowing callers to simply request call back in the event that a channel is busy alleviating the need to repeatedly call the system.

9 Telephony Features and Product Description

- 9.A Room stations equipped with DTMF staff phones as described above shall be capable of:

1. Selectively calling intercom speakers and establishing open voice communications.
2. Selectively initiating Zone and All-Call paging announcements.

- 9.B Room stations equipped with DTMF staff phones as described above shall be capable of integrating with the school phone system providing the following:

1. Selectively initiate calls to the telephone system console, and establish duplex telephone communications.
2. Make and receive outside calls.
3. Ability to group hunt for available interface lines.
4. Phones can be restricted from any of above features.

- 9.C The system shall integrate to the facility phone system to allow any authorized telephone system extension to:

1. Place intercom calls to any classroom or work area
2. Make paging announcements to any of the 32 zones
3. Initiate system tones to any area of the facility
4. Distribute programs to any zones and zone monitor any area of the building

- 9.D The system shall allow the facility phone system to answer any calls from call switches or intercom handsets. When the phone system is equipped with standard Caller-ID support, all information about the caller such as room number and call priority will be available on the display of the telephone.
- 9.E The integration to the phone system will utilize unused CO ports from the KSU/PBX or VOIP Hybrid System. This system is described in another section of the project documents or to be provided by owner. Coordinate with the phone system vendor to ensure the availability of these ports. Up to 2 ports may be required.

10 Administrative Telephones

- 10.A The intercom/paging system control console shall be microcomputer based, desk top console, occupying no more than 75 sq. inches of desk space and weighing 2 lbs. It shall be manufactured of high impact, molded plastic with a standard 12 button keypad. It shall be Model MCC-300.
- 10.B The console shall provide selected, two-way voice communications and signaling between the console and room stations as well as between other control consoles in the system. The console shall be equipped with a telephone handset with a retractable cord to allow private conversations. A built-in microphone and speaker shall provide for push-to-talk intercom conversations.
- 10.C Incoming calls shall be annunciated on a two line 20-character LCD backlit digital display by room number and priority level. The display shall be angle adjustable to ensure the clearest viewing of console information.
- 10.D All incoming calls shall be held in memory and displayed sorted by priority and order received. Each of the six levels of priority shall be displayed by a unique priority prefix and call-in tone. The console shall also have facilities for reviewing all incoming calls stored in memory
- 10.E The distribution of program material shall be controlled from the administrative control console, room selector switch or DTMF intercom handset. System shall support distribution to any of 31 distribution zones, individual rooms or combination thereof.
- 10.F Paging announcements shall be distributed from the control console on an Emergency All Call, All Call, All-Call multiple zone, or individual basis to classroom speakers.

Any control console in the system shall have the ability to be designated as the "current console" and have the incoming calls from room stations, enunciate at that specific console. This function shall be programmed from the control console and shall allow for simple transfer of the "current console" assignment to any other console in the system.
- 10.G The console shall also provide the ability for the operator to place on hold, or clear any incoming calls registered in the system from the console keypad.
- 10.H Facilities for activating and controlling remote devices from the control console keypad. The system shall control the operation of external bells, utilizing the internal time clock within the system.
- 10.I Capabilities for user programming of alphanumeric architectural room numbers from the control console. The system shall be capable of using 2, 3, 4 digit number, or a letter (A = I) and a 3 digit number. The number for both the classroom speaker and the telephone shall be the same.
- 10.J The console shall retain the last room number dialed until another room number is dialed or previous call is cancelled.

- 10.K Ability to manually distribute tone signals on an all-call basis from the keypad of the Administrative Control Console cabinet.
- 10.L The console shall have the ability to program or change all of the operational characteristics of the Intercom/PA system.

11 Program Sources

- 11.A Provide an AM/FM CD player, Telecor model T-CDP or approved equal. The unit shall be equipped with a LCD information display, front panel indicators and controls, clock, bass, treble, bass enhance, mute and digital signal processing. **It shall be located as shown on the plans in office area.** The unit shall automatically activate as a program source but shall be overridden by intercom calls.

1. The AM section shall be tuned over a range of 531 to 1602 KHz. The FM section shall be tuned over a range of 87.5 to 108.0 MHz. The unit shall be equipped to accommodate storage of up to 12 memory selections, six from each band. Storage can be manually accomplished or automatically performed by the unit based on the strongest signals.

2. The CD player shall provide utilize a sampling frequency of 44.1 KHz. The unit shall provide controls for play, stop, fast forward, rewind, track forward, track reverse, pause and eject. The unit shall provide a preview function, which will play the first 10 seconds of each track on the CD. The unit shall allow for random track play mode by the push of a single button

12 Amplifiers

- 12.A The power amplifiers shall be manufactured by Telecor. The system shall be sized at ½ watt per classroom, 1 watt per corridor speaker, and 3.5 watts per horn. The amplifier load shall not exceed 80% capacity.

The amplifiers shall be capable of producing an audio output of 60, 125 or 250 watts RMS at less than 1% distortion with a balanced output.

They shall be designed to operate on a line voltage of 115 AC. One amplifier shall be provided for each audio channel.

13 Equipment Racking

- 13.A The central electronics equipment shall be contained in an upright rack, Telecor model 242, 261 or 277 or approved equal. The rack must be sized by the contractor to house all components required by this specification plus 20% spare for additions.

The rack shall be 21.9" wide and 18.5" deep. It shall be constructed of CRS, using 16 gauge material for the top and bottom of the rack and 14 gauge material for the sides. The rack shall be equipped with both front & rear mounting rails, punched on standard EIA centers. The rack shall be complete with a hinged, locking rear door. The rack shall be finished in Black Baked Enamel.

- 13.B The rack must be supplied with locking castors to enable movement if necessary

14 Call Switches

- 14.A The Call Switch shall be a Telecor model CS-1 or approved equal. Furnish and install where indicated on the plans.

1. The switch shall be a momentary action, push-button switch mounted on a 1-gang brushed stainless steel plate suitable for flush or surface mounting on a standard single gang back box with 3 - 9/32" mounting centers.

2. The stainless steel plate shall be inscribed "Push to Call".

15 Speakers

- 15.A The loudspeaker/transformer/baffle assembly shall be a Telecor model STB-11 or approved equal. It shall be used for flush mounting on ceilings. Furnish and install as indicated on the plans.
1. The loudspeaker size shall be 8 inches in diameter and have a power handling capacity of 15 watts. The voice coil shall be of high-temperature bonded construction, be one inch in diameter and have an impedance of 8 ohms. The speaker shall have a frequency range of at least 50 Hz to 15,000 Hz and an axial sensitivity of 91dB at 4 ft, with a 1 watt input signal @ 1000Hz.
 2. The loudspeaker shall be equipped with a factory wired 25/70 volt line-matching transformer. The transformer shall have the primary taps at $\frac{1}{4}$, $\frac{1}{2}$, 1, 2, and 4 watts. The insertion loss shall be no greater than 1.0 dB. The transformer shall be mounted to the speaker with the secondary leads soldered to the speaker terminals.
 3. The assembly shall include a baffle constructed of 22 gauge, cold-rolled steel finished with a mar-resistant white, semi-gloss, epoxy coating. The baffle shall have a diameter of 13". The STB-11 shall mount to a T8 support bridge, used to attach the assembly to suspended ceilings. The support bridge will accept an enclosure, model H8, to provide a protective enclosure. The H8 enclosure shall attach to the support bridge with appropriate mounting screws.

16 Horn Loudspeakers

- 16.A The horn style loudspeaker shall be a Telecor model A-15T or approved equal. Furnish and install as indicated on the plans.
1. The horn shall be a double re-entrant type, with a flared bell and an integral compression driver rated for 15 watts of continuous audio power. The frequency response shall be 375 - 14,000Hz. Nominal sensitivity shall be such that a sound pressure level of 110 dB at 1000 Hz (on axis) at distance of one meter is produced with an input of one watt. Sound dispersion shall be no less than 100 degrees, regardless of the mounting position.
 2. The horn shall contain a weatherproof, built-in, 25/70 volt line matching transformer. Power taps shall be at 0.48, 0.94, 1.8, 7.5 or 15 watts for a 25V line and 1, 2, 3.8, 7.5 or 15 watts for a 70 V line. The power taps shall be screwdriver adjustable. Impedance selection shall be 5,000, 2500, 1300, 666, 333, 87, or 45 ohms.
 3. The unit shall include a die-cast universal mounting bracket, allowing the horn to be positioned both in the vertical and horizontal planes with a single adjustment. The wiring terminals and the screwdriver power tap shall be enclosed by a clear plastic cover for security and weather protection.
 4. The horn shall be finished in a grey epoxy. Dimensions shall be 9 1/4" deep with a diameter of 8"

END OF SECTION

SECTION 16570

AUTOMATED RIGGING SYSTEM

1.00 GENERAL

1.01 SCOPE

- A. This section describes an automated rigging system, which includes motorized hoists, control hardware/software, networking and automatic safety systems. A qualified specialist contractor, trained and authorized by the system manufacturer shall install, test and configure this system. The specialist contractor shall also provide owner training in system usage and safety procedures.
- B. Related work not included in this section:
 - 1. Any structural steel required to support the rigging system. Also, any catwalks, ladders or miscellaneous metals required to provide appropriate access to system components.
 - 2. Conduit, wire, distribution panels, terminations and other electrical work required to install the rigging system.
 - 3. Lighting control equipment, electrical distribution and fixtures.
 - 4. Loud speakers, video displays, amplifiers and other audio/visual equipment.
 - 5. Orchestra shells and portable staging.
 - 6. Stage drapery and track.

1.02 BIDDER QUALIFICATION & SUBMISSIONS

- A. Specified equipment performance is based on the products of J.R. Clancy Inc.. Where substantively equal manufacturers and products have been identified and approved, they are listed within this document by name.
- B. Bidder requests for approval that include products from other manufacturers are welcome. To be considered, all requests must:
 - 1. Be complete and submitted in writing, no less than 10 days prior to bid opening.
 - 2. Include a complete Bill of Materials, prepared by the equipment manufacturer.
 - 3. Include an engineered electrical riser diagram.
 - 4. Include a published manufacturer's warranty statement.
 - 5. Include a specific listing of any exceptions/deviations taken from the equipment specified.
- C. A complete submission of project specific engineering drawings shall be required and approved before equipment fabrication or installation may proceed. The submission shall be supported by appropriate cut sheets, schedules, operation guides and other materials required to document the form, function, fabrication, installation and use of all system components.

1.03 SYSTEM SAFETY AND WARRANTY

- A. The manufacturer of the motorized rigging system shall provide a three year warranty against defects in materials or workmanship that goes into effect on the date of system installation. The three-year warranty is contingent on inspection of the equipment and training on its use being provided annually by a factory authorized technician. It is the responsibility of the end user to make arrangements with factory for the annual inspection and training. Failure to obtain the inspection and training annually will void the three-year warranty. The warranty will not cover equipment that has become defective due to misuse, abuse, accident, act of God, alteration, vandalism, ordinary wear and tear, improper maintenance, or used not in a manner intended.

2.00 PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. Theatrical rigging systems involve moving loads overhead of people. Specialized engineering and manufacturing expertise are required to mitigate risk. Theatrical rigging manufacturers who do not meet all of the requirements of section 2.01B shall be prohibited from bidding or contracting for this work. Approval to bid does not release the manufacturer from meeting these requirements.
- B. Automated rigging system provided shall be from a single manufacturer who:
1. Engineers all products furnished as an integrated system. Accessory items such as wire rope, fittings, and curtain tracks may be the products of other specialized manufacturers.
 2. Has manufactured automated rigging systems for a minimum of ten years and references no less than 25 successful installations of comparable scope and complexity. Proof shall be provided as part of the contract document submittal.
 3. Has a quality management system certified to ISO 9001:2008. Provide proof of ISO certification as part of the contract document submittal.
 4. Carries primary product and general liability insurance of \$2,000,000 each, with excess liability coverage of \$10,000,000 and a Contractors Professional Liability policy with \$2,000,000 coverage. The theatrical manufacture shall provide proof of these insurances in force before a contract is issued.
 5. Control systems shall be Listed by a National Recognized Testing Laboratory (NRTL) as meeting UL 508A Standard for Industrial Control Panels. Hoists shall be Listed by a NRTL as meeting with UL 1340 Standard for Hoists. Proof of listing and compliance shall be provided as part of the contract document submittal.
- C. Automated rigging hoists, controls and networking equipment shall be manufactured and supported by:
- J.R. Clancy, Inc
or
The Classic Vortex Hoist

Alternate manufacturers shall submit for approval see Paragraph 1.02 for approval process.

2.02 DESIGN FOR SAFETY AND RELIABILITY

- A. All hardware and components shall be industrial grade, selected to provide long term reliability in environments where wide temperature variations, dirt and electromagnetic interference must be assumed. Critical components shall be the "off-the-shelf" products of major manufacturers and obtainable worldwide. This requirement exists to facilitate ongoing maintenance and prevent early system obsolescence.
- B. Control system hardware shall be based on Siemens Programmable Logic Controllers (PLCs) and sealed industrial grade computers. Home/office computers shall not be acceptable.
- C. Data communication between controllers, motor starters and drives shall be Profibus™, an open architecture, bi-directional industrial automation protocol.
- D. In the case of loss of data communication, hoists shall stop for safety. Individual hoist controllers shall retain cue and position data, even without power. Systems that lose data

when not powered may require time consuming reprogramming and loss of performances, and are not acceptable.

- E. "Hold to Run" (also known as "Deadman") operation shall be required. Systems that allow motion without an operator present at the console and holding down a button or joystick are not acceptable.
- F. Automatic service indicator lights shall be provided that signal when routine service and inspections of the automated rigging system are required.
- G. All motorized hoists shall be provided with two redundant safety brakes. The primary motor brake shall be spring applied and electrically released, so it will fail to the "brake" position. A secondary brake on the load side of the gearbox shall also be provided. It shall automatically trigger when excess speed, positioning mismatches or hardware failures are detected. Use of "drag" or "Weston" style motor brake is not acceptable, as these devices generate wear, heat and considerable noise.
- H. All motorized hoists shall be provided with separate normal and overtravel mechanically activated safety limit switches. Actuation of the normal end of travel limit switches shall only allow movement away from the limit switch. The redundant overtravel limit switches will remove power from the hoist using a UL580E Type 2, non-welding positive break contactor.
- I. For fire and electrical safety, all motor control systems shall conform to the National Electrical Code (NFPA 70) and be constructed in accordance with UL Standard 508, and be "touch safe" per IEC 204-1 "Protection against direct contact" rules.
- J. Variable speed hoists shall use closed loop vector drives, providing full torque at zero speed. Variable frequency or open loop drives are not acceptable.
- K. All motorized hoists shall provide electrical over-current, electrical over-load, and electrical phase-loss protection.
- L. All automated rigging systems shall provide emergency stop (E-Stop) systems:
 - 1. The E-Stop system shall conform to NFPA-79 (Electrical Standards for Industrial Machinery) and shall remove power, thru the use of UL580E Type 2, non-welding, positive break contactors.
 - 2. Resetting the E-Stop circuit shall not initiate motion.
 - 3. All hoists that run faster than 50 fpm shall be provided with Category 2 controlled E-stop, as described by NFPA-79. This protocol ramps the hoist to a quick stop to control shock to the load and building structure.

2.03 CONTROL SYSTEM

- A. General: The control system shall be specifically designed for the control of theatrical rigging, including operational and reliability needs. The system shall provide easily understandable and reliable position control of PowerLift hoists. The controller shall be available in compact wall or rack mounted configurations.
- B. Operation:
 - 1. A 6" color, industrial touch screen display will provide clear, easy to understand graphics for simplicity of operation. Movements will be set up using the touch screen. UP, DOWN, GO TARGET pushbuttons and a joystick are provided for initiation and control of movements.

2. Operation styles available shall range from direct position control using UP and DOWN buttons to composing presets with hoist speed, acceleration, deceleration, and target positions. Presets can be composed, stored, modified, and recalled to allow simple recording and re-creation of movements.
3. The SceneControl graphic user interface shall provide a hoist controller; preset creation and editing facilities; and a display of the current position and target position of each hoist. A complete display of hoist status and faults shall be provided for ease of troubleshooting and maintenance.
4. Actual pushbuttons and a joystick shall be provided for initiation and control of motion. For safety, no movement will be initiated from the touch screen. "Deadman" operation is required, so that the operator must be at the console and pressing a button for motion to continue.
5. The system shall include password-protected access, with separate levels for user, supervisor, and setup functions.
6. A mushroom head "EMERGENCY STOP" button wired to a failsafe circuit that conforms to NPFA 79 requirements shall be provided.
7. An "ON/OFF" key operated switch shall be provided that removes power to the console, motor starters and drives. Any control system that requires motors and drives energized while the system is not in use is not acceptable.
8. In systems with the load monitoring option, the SceneControl shall monitor the loads on PowerLift hoists, first learning the characteristics of a new load, then monitoring each move for changes in the load. Load information shall be obtained from solid state load cells on the PowerLift hoists. The load monitoring system shall be able to accommodate changing loads, such as the weight of borderlight cable which changes with elevation, without false tripping.

C. Reliability

1. The control system shall use an off the shelf industrial grade Programmable Logic Controller (PLC) selected for long term, reliable operation under the conditions and environment at the site. "Home" or "office" computers are not allowed, as they do not provide the level of reliability necessary for overhead lifting.
2. All hardware components shall be industrial grade equipment designed for use in a typical theatre environment. These components shall be widely available on an international basis to ensure ease of replacement and maintenance.
3. The system program shall be embedded in ROM (Read Only Memory) to prevent corruption or unauthorized changes.
4. Actual pushbuttons and a joystick shall be provided for initiation and control of motion. Systems that allow motion to be initiated from a touch screen are known to allow unintended movement and are not safe.
5. A "Service" indicator shall be provided to indicate when routine service and inspection of the rigging system is required.
6. Control systems shall be UL or ETL marked as meeting UL 508A Standard for industrial control panels.

2.04 AUTOMATED PACKAGED HOIST

A. PowerLift - General

1. The PowerLift hoist shall have an integral frame incorporating adjustable mounting clips for fast and simple mounting, horizontally or vertically.
2. The PowerLift hoist shall use a moving drum which minimizes wear of the wire rope lift lines. The drum slides along its axis while rotating and that keeps cable takeoff points consistently aligned. This zero fleet angle design shall be a requirement of this project.
3. Hoists shall be listed as meeting the UL Standard 1340 for Hoists.
4. UL 1340 compliant hoist covers shall be provided where specified or required.

- B. PowerLift - Gearmotor and Redundant Safety Brake Systems
1. The electric motor, primary brake, and gearbox shall be a single quiet and reliable assembly. A continuous shaft shall link the brake, motor armature, and the first stage pinion gear, with no internal couplings. The motor shall be a high-efficiency motor meeting IEC 60034-30.
 2. The gear reducer shall employ helical gearing. The gear case shall be constructed of cast iron to protect against shock damage and to minimize transmission of noise. The output shaft shall have triple lip oil seals to prevent gear oil leaks.
 3. The integral electro-magnetic primary safety brake shall be spring applied and electrically released. Loss of power shall cause the brake to set automatically.
 4. A second redundant safety brake system brake shall be installed between the gearbox output shaft and the drum. This safety device shall apply the brake automatically when over-speed or speed mismatch fault conditions are detected, or when stopped.
- C. PowerLift - Hoist Drum
1. The hoist drum shall be helically grooved and sized to accept a single cable layer of sufficient length to accommodate rated distance plus three dead wraps per cable. Random wind drum, conical wind drum, and pileup drum designs shall not be considered acceptable. All cause lift lines to wear excessively. Random wind and conical wind drums are specifically disallowed due to their tendency to cross-wind and jam. Both create significant safety hazards.
 2. Lift line cables shall be retained by a copper Nicopress® stop sleeve. The cable retention system shall allow replacement of lift lines in situ.
 3. Preloaded cable chase rollers shall be provided to keep lift lines inside their grooves.
 4. The drum shall be molybdenum disulphide filled nylon.
- D. PowerLift - Sheaves
- All sheaves shall have a minimum 26:1 D:d ratio, meeting wire rope manufacturer's recommendations. Depth of sheave grooves shall exceed the cable diameter to provide physical protection. Sheaves shall be equipped with a 12 mm diameter machined steel shaft and two sealed, precision ball bearings. Spacers shall positively retain the cable.
- E. PowerLift - Power & Control Wiring
1. One eight foot long SO power cable terminated by a NEMA connector shall be provided with each hoist. One eight foot long control cable terminated by a locking connector shall also be provided.
 2. Matching power and control distribution wireways (or outlet boxes) shall be provided
 3. A maintenance pendant shall be provided for direct hoist control. The pendant shall contain Up/Down pushbuttons, an Overtravel Bypass switch and a key operated On/Off switch. The pendant will run variable speed hoists at a fixed (slow) speed.
- F. Loft Blocks
1. Loft blocks shall have 12-gauge steel (minimum) side plates which enclose the sheave. Side plates shall be bolted to the base angles. Base angles shall be a minimum 1-1/2" x 1-1/2" x 3/16" angle punched with a universal hole pattern. There shall be a minimum of six 1/4" bolts with spacers between the side plates, four of which prevent a cable from escaping the sheave groove.
 2. The block and associated mounting hardware shall have a recommended working load of at least 500 lbs, and shall be designed for upright or underhung use.
 3. Loft blocks shall be provided with idlers to support ongoing lift lines with an individual groove for each lift line to prevent tangling. The use of un-grooved idler drums is known to cause cable tangling and jams. Un-grooved drums shall not be acceptable.
- G. Pipe Battens

1. Battens shall have the ability to accept standard lighting fixture clamps, scenery chains, and pipe clamps.
2. All battens shall be constructed of 1-1/2" nominal diameter, schedule 40 black steel pipe. All joints shall be spliced with 18" long sleeves and held by two 3/8" hex bolts and lock nuts on each side of the joint.
3. Each batten end shall be covered with a bright yellow, soft vinyl safety cap that indicates set capacity.
4. Lift line termination at the battens shall fully encompass the batten, and have a manufacturer's recommended working load rating of at least 500 lbs. Acceptable terminations include a 1/4" Grade 63, hardened alloy trim chain with a black finish to eliminate glare, meeting OSHA 1910.184(e)(5) with a forged shackle or a load rated full pipe clamp.

2.05 AUTOMATED RIGGING SYSTEM – EQUIPMENT BILL OF MATERIALS

- A. Provide hoists in the quantities, capacities and speeds listed:

Model	Speed	Capacity	Quantity
018-P0220VE	0 – 20 fpm	2,000 lbs	8
018-P1212VE	0 – 120 fpm	1,200 lbs	4
018-P1220VE	0 – 120 fpm	2,000 lbs	
018-P1812VE	0 – 180 fpm	1,200 lbs	
VARION	0-35 fpm	1,500 lbs	2

- B. Provide control system components as listed:

Model	Description	Accept
064-SC5300-CNSL	Scene Control 5300 w/rolling pedestal	1
064-SC5000P	SC5000 HC-100B Local Control	2
064-SC5100P	SC5100-P-4	1

- C. Provide battens, loft blocks and other related equipment as shown on the drawings and as required to produce a complete working system.

2.06 STAGE CURTAINS

CURTAIN FABRICS

- A. General: Provide fabrics inherently and permanently flame resistant comply with requirements indicated. Provide fabrics from the same dye lot. Colors, Textures and Patterns as selected by Architect from manufacturer's full range.
- B. Heavy weight woven Velour from Front Setting: Napped fabric of 100% Trevira CS, 54-inch minimum width
 1. Products: Subject to compliance with requirements,
 2. Provide one of the following:
 3. Heavy weight for Curtain Fabric weighing not less than 25 oz./linear, with pile height not less than 120 mils.
 - a. JB Martin Ltd.

- b. J.L. de Ball America
- c. KM Fabrics, Inc. (Prestige)
- d. Rose Brand, Inc.

- C. Heavy weight woven Velour for Intermediate and Cyclorama Setting: Napped fabric of 2/150/128 CS Poly, 54-inch minimum width
- 1. Products: Subject to compliance with requirements
 - 2. Provide one of the following:
 - 3. Heavy weight for Curtain Fabric weighing not less than 25oz./linear, with pile height not less than 120mils
 - a. JB Martin Ltd.
 - b. J.L. de Ball America
 - c. KM Fabrics, Inc. (Charisma)
 - d. Rose Brand, Inc.
 - e. Scrim Fabric 100% cotton Sharks tooth scrim
 - f. Cyclorama Sky Drop 100% cotton heavy weight seamless muslin

2.07 STAGE CURTAIN FABRICATION

- A. General: Affix permanent label, stating compliance with requirements of authorities having jurisdiction in accessible location on curtain not visible to audience. Provide vertical seams, unless otherwise indicated. Arrange vertical seams so they do not fall on faces of pleats. Do not use fabric cuts less than one-half width.
- 1. Vertical Hems: Provide vertical hems not less than 2 inches wide at borders, valance and tormentors, with not less than a 1-inch tuck and machine-sewn with no selvage material visible from front of curtain. Sew open ends of hems closed.
 - 2. Leading Edge Turnbacks: Provide turnbacks formed by folding not less than 12 inches of face fabric back with not less than a 1-inch tuck and secured by sewing turnbacks vertically. Trailing Edge not less than 6"
 - 3. Top Hems: Reinforce top hems by double-stitching 2 or 3 inch wide, heavy flameproof polypylene webbing to top serge edge of curtain.
 - 4. Pleats: Provide 50% fullness in curtains, exclusive of turnbacks and hems, by sewing additional material into 3-4 inch double-stitched box pleats spaced at 12 inches o.c. along top hem reinforcement Serge top edge of face fabric.
 - 5. Grommets: Brass, Black No.3, centered on each box pleat and 1 inch from corner of curtain equipped with S-hooks
 - 6. Bottom Hems:
 - A. For curtains that do not hang to the floor, provide hems not less than 2 inches deep
 - B. For floor length curtains, provide hems not less than 6 inches deep with separate, interior, 100% heavy cotton chain pocket equipped with jack chain. Stitch chain pockets so chain will ride 2 inches above finished bottom edge of curtain.
 - C. #10 Jack Chain zinc plated, ASTM A 413/A413M
 - 7. Velour Curtains: Fabricate with the fabric nap down

2.08 STAGE CURTAIN RIGGING

- A. Curtain Battens: Fabricate battens from 1 ½" sch 40 black pipe with a minimum number of joints. As necessary for required lengths, connect pipe with a drive-fit pipe sleeve not less than 18 inches long, and secure with four flush rivets, plug welds, threaded couplings or another equally secure method. Shop-paint completed pipe battens with black paint
- B. Steel Pipe: ASTM A53/A53M, Grade A, standard weight (Schedule 40), black, 1 ½ inch nominal diameter, unless otherwise indicated.
- C. S-Hooks: Track manufacturer's heavy-duty plated-wire hooks
- D. Supports, Clamps and Anchors: Sheet steel in manufacturer's standard thickness, galvanized after fabrication according to ASTM A153/A153M, Class B.
- E. Trim and Support Cable: ¼ inch diameter, 7 x 19 galvanized steel aircraft cable with a breaking strength of 7000lb. Also acceptable is ¼" grade 30 proof of coil chain. Provide fittings complying with the cable or chain manufacturer's written recommendations for size, number, and method of installation.
- F. Inserts, Bolts, rivets and Fasteners: Manufacturer's standard corrosion-resistant units
- G. Steel Track: Fabricated from roll-formed, galvanized, commercial-quality zinc-coated steel sheet; complying with ASTM A653/A653M, G60 (Z180) coating designation, with continuous bottom slot and with each half of track in one continuous piece.
 - 1. Products: Subject to compliance with requirements, provide one of the following or prior approved equal
 - a. H&H Specialties, Inc.
 - 2. Minimum Base-Metal Thickness: Not less than 0.0677 inch (1.7mm)

2.09 STEEL CURTAIN TRACK FABRICATION

- A. Heavy-Duty Track System: Equip track with heavy duty, live end, double-wheel pulley; heavy-duty, dead-end, single wheel pulley; and adjustable, heavy-duty floor block; each with not less than 5-inch molded nylon or glass-filled-nylon-tired ball-bearing wheels, enclosed. Provide single curtain carriers with a pair of nylon-tired ball-bearing wheels parallel to body. Provide one master carrier, for each leading curtain edge, with two pairs of nylon-tired ball-bearing wheels and with two line guides per carrier. Equip carriers with a neoprene or rubber bumper, to reduce noise, and heavy-duty,plated steel swivel eye, and manufacturer's standard trim chain for attaching curtain snap or S-hook. Provide end stops for track. Install adjustable floor block to maintain proper tension on operating line.
 - 1. Operating Line: Manufacturer's standard 3/8 inch (9mm) stretch resistant operating cord consisting of braided synthetic fiber jacket over solid, synthetic fiber, linear, center filaments.
 - a. Track Lap Clamp: Metal to match track channel for attaching double sectioned track at center overlap
 - b. Curtain Carriers: for track spaced at 12 inches (300mm) o/c.
- B. Medium-Duty Track System: Equip track with medium-duty wheels. Provide single curtain carriers with a pair of nylon-tired ball-bearing wheels parallel to

body. Provide a heavy-duty, plated steel swivel eye and manufacturer's standard trim chain for attaching curtain snap or S-hook. Provide end stops for track. Install adjustable floor block to maintain proper tension on operating line.

3.0 INSTALLATION

3.01 EQUIPMENT INSTALLATION

- A. Equipment installation and commissioning shall be performed by manufacturer authorized and trained specialty contractors. Installation shall be performed in a workman like manner.
- B. All blocks, rollers and guides shall be installed in a manner which provides proper alignment, specified fleet angles and prevents contact with other surfaces.
- C. Control system turn-on, and user instruction shall be performed by a factory authorized and trained technician. All wiring must be complete, limit switches set and all other predecessor activities required by the manufacturer completed before system turn on.
- D. Installation practices shall be in accordance with OSHA Safety and Health Standards and all local codes. All welding must be performed in full compliance with the latest edition of the Structural Welding Code (ANSI/AWS D1.1).

3.02 SYSTEM INSPECTION AND TESTING

- A. During system installation, the specialty contractor shall make his work available and accessible for regular inspection by owner representatives.
- B. When rough installation is completed, the specialty contractor shall conduct a complete pre-test of all components to ensure the system is safe and working properly. The specialty contractor must check that all normal and over travel limit switches have been correctly set and tested.
- C. Once finish installation is completed, the specialty contractor shall notify the specifier and a system inspection will be scheduled. As part of the inspection, the specialty contractor will operate all equipment and to perform such adjustments and tests as the specifier may require. Any equipment that fails inspection shall be repaired or replaced and a re-inspection will be scheduled.
- D. Each hoist shall be tested dynamically at 100% of its load rating. Each of the two brakes on every hoist shall be tested individually with a static load of 125% of the hoist's capacity for 5 minutes.

3.03 OWNER SAFETY AND USAGE INSTRUCTION

- A. The specialty contractor shall submit three copies of a manufacturer supplied Operations and Maintenance Manual which includes as built shop drawings, equipment descriptions, and parts lists.
- B. The specialty contractor shall also provide safety and usage instruction classes as the owner may require. The safety and usage classes shall be recorded and DVD copies provided to the owner.

- C. Appropriate permanent signage which provides operating instructions and warning information shall be posted within the venue. Signage shall be in conformance with ANSI-Z535.

3.04 FOLLOW-UP SAFETY INSPECTION

- A. One year after the project is completed, the specialty contractor shall return to the venue and provide the following services:
 1. Inspect the system as required by OSHA 29 CFR 1926.550(a)(6).
 2. Make all required adjustments.
 3. Correct all warranty repair items and provide a written report to owner and system manufacturer.
 4. List any non-warranty changes recommended. Provide a written report to system manufacturer.
 5. Conduct a one hour rigging safety and operations refresher class.
 6. Schedule the next year's maintenance and safety check.

3.05 TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central dimming controls. Laptop portable computer shall be used in training.
- B. Provide in the Base Bid an initial eight (8) hour training session with the owner with the factory-authorized service representative. Training to be videotaped and given to the owner.**
- C. In addition to the initial eight (8) hour training session, provide the owner two (2) four (4) hour training sessions at no additional cost. Training sessions to be scheduled by owner up to a year from the substantial completion date.**

SECTION 16571
THEATRICAL LIGHTING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes microprocessor-based central dimming controls with the following components:
 - 1. Master-control stations.
 - 2. Control Network
 - 3. Wall stations.
 - 4. Dimmer cabinets.
 - 5. Manual switches and plates for controlling dimmers.

1.3 DEFINITIONS

- A. Fade Override: The ability to temporarily set fade times to zero for all lighting scenes.
- B. Fade Rate: The time it takes each zone to arrive at the next scene, dependent on the degree of change in lighting level.
- C. Fade Time: The time it takes all zones to fade from one lighting scene to another, with all zones arriving at the next scene at the same time.
- D. Low Voltage: As defined in NFPA 70, term for circuits and equipment operating at less than 50 V or for remote-control, signaling, and power-limited circuits.
- E. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.
- F. SCR: Silicon-controlled rectifier.
- G. Zone: A fixture or group of fixtures controlled simultaneously as a single entity. Also known as a "channel."

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For central dimming controls; include elevation, features, characteristics, and labels.
 - 2. For dimmer panels; include dimensions, features, dimmer characteristics, ratings, and directories.

3. Device plates, plate color, and material.
 4. Ballasts and lamp combinations compatible with dimmer controls.
 5. Sound data including results of operational tests of central dimming controls.
 6. Operational documentation for software and firmware.
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on Project. Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
1. Include elevation views of front panels of control and indicating devices and control stations.
 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Samples for Initial Selection: For master-control stations, partitioned-space master-control stations, wall stations, dimmer cabinets, and faceplates with factory-applied color finishes and technical features.
- D. Samples for Verification: For master-control stations, partitioned-space master-control stations, wall stations, dimmer cabinets, and faceplates with factory-applied color finishes and technical features.
- E. Operation and Maintenance Data: For central dimming controls with remote-mounting dimmers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
1. Software manuals.
 2. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
 3. Operation of adjustable zone controls.
 4. Testing and adjusting of panic and emergency power features.
- F. Warranty: Special warranty specified in this Section.

1.5 **QUALITY ASSURANCE**

- A. Source Limitations: Obtain central dimming controls from a single source with total responsibility for compatibility of lighting control system components specified in this Section, in Division 13 Section "Lighting Controls," and in Division 16 Section "Lighting Control Devices."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with 47 CFR 15, Subparts A and B, for Class A digital devices.
- D. Comply with NFPA 70.

1.6 **COORDINATION**

- A. Coordinate features of devices specified in this Section with systems and components specified in other Sections to form an integrated system of compatible components. Match components and interconnections for optimum performance of specified functions.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of central dimming controls that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
 - 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
 - 3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

1.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
 - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Dimmers: Full-size units equal to 10 percent of amount installed for each size indicated, but no fewer than 3 units.
 - 2. Fuses: Equal to 10 percent of amount installed for each size installed, but no fewer than three.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Strand Lighting, Inc. is the basis of design for the dimming system

Alternate manufacturers shall submit for prior approval 10-days prior to bids.

2.2 CONTACT LIGHTING CONTROL PANEL

A. Overview.

1. The lighting control panel shall be fully digital, designed specifically for architectural and entertainment lighting control applications, and shall consist of 12, 24, 36 or 48 relays per panel. A secondary "slave" panel in each size will be available. Contact Lighting Control Panel systems shall be ETL and cETL listed.
2. Panel setup and preset data shall, as standard, be fully user programmable on a per panel or system wide basis.
3. Panels shall be available that support individual power feeds from standard circuit breaker panels or with integral breakers and 3 phase main lug only inputs.

B. Mechanical.

1. The relay panel shall be a wall-mount, dead-front switchboard, substantially framed and enclosed with 16-gauge, formed steel panels. All panel components shall be properly treated, primed and finished in fine texture, scratch resistant, silver powder coat paint.
2. The dimensions of the relay panels shall be as follows:
 - a. 12 Relay panel: 4 inches deep, 21 inches high and 15.8 inches wide.
 - b. 24 Relay panel: 4 inches deep, 21.9 inches high and 23.5 inches wide.
 - c. 36 Relay panel: 4 inches deep, 34.8 inches high and 23.5 inches wide.
 - d. 48 Relay panel: 4 inches deep, 34.8 inches high and 23.5 inches wide.
 - e. Slave panels shall be the same size as panels with processors.
3. Contact Relay panels shall be available to ship as a complete assembly or in two parts consisting of a wall mount enclosure and a relay panel insert with all electrical and electronic components preassembled.

C. Installation.

1. A wall mount enclosure shall be available to ship separately to permit wall mounting and conduit stub in. The relay sub panel shall be factory pre-wired and dressed. The contractor shall provide and terminate all feed, load and control wiring on screw terminals fitted within the panel.
2. Cable entry for all panels shall be on the top of the panel. Knockouts shall also be available on the sides of the panel to simplify wiring.
3. All terminations and internal wiring shall be accessible via a removable front cover panel. The Processor Module shall be accessible for programming at all times.

D. Electrical.

1. The power efficiency of the relay panel shall be greater than 95% at full load.
2. The panels shall be suitable for 50/60hz supplies and will accept power feeds from 120, 230 and 277 volt power supplies with the installation of a panel barrier included with each panel. A 347 volt power supply shall be available for Canada.

3. The relay panel shall have an internal power supply to support up to (16) 24vdc architectural control stations. A supplementary Power Supply shall also be available.
4. A "Panic" facility shall close selected relays if the Processor Module is removed or fails. Relays are selected from the panel processor. It shall also be possible to select "Panic" as follows:
 - a. The panel processor on the front of the panel selects "Panic" and "Normal" operation.
 - b. Remote maintained contact closure for Fire Alarm interface.
 - c. Two remote momentary contact closures for "Panic" and "Normal" respectively.
5. The system ground shall be made at a grounding lug in the panel.
6. The panel shall have a 14,000 AIC fault current rating at 277 volts.
7. The panel shall be a NEMA 1 enclosure and shall be ETL and cETL listed.
8. The panel shall be suitable for surface or recess mounting.
9. As an option the panel may be equipped for UL 924 emergency lighting applications.

E. Panel Electronics, Physical.

1. The main panel control electronics shall be housed in one Panel Processor Module (RPM). The panel control electronics shall be completely digital without employing any digital to analog demultiplexing schemes.
2. All panel setup and preset data shall be stored in a non-volatile manner and may be transferred to a replacement Panel Processor Module without losing data.
3. Each Panel Processor Module shall have a back-lit LCD display with a keypad for panel setup, preset control, testing, panel status, error and diagnostics.
4. LEDs shall indicate "DMX512 Port A", "DMX512 Port B" (ShowNet), Vision.net control and Power.
5. The Panel Processor Module shall be permanently mounted inside the panel. The RPM shall provide all necessary low voltage signal connections. The RPM shall provide the only point for contractor connection of signal cables and PANIC activation. The contractor connections shall be made with two-part plug in screw terminals (dedicated connector per input) for ease of installation.
6. All DMX512 & RS485 communication ports and remote contact input connections shall be optically isolated from all processor electronics by a minimum of 2,500V RMS isolation.
7. The Panel Processor shall have the provision to select any of the relay or outputs to be activated by the PANIC function. The PANIC function shall be activated or de-activated by one or more local or remote contact closures.

F. Panel Electronics, Control And Communications.

1. The control electronics shall provide the following control and communication inputs as standard:

- a. One optically isolated DMX512 control input.
 - b. An RS485 control input for Vision.net architectural control. Vision.net is a control system comprised of architectural style panels for recording and playback of presets in individual assigned "rooms".
 - c. There shall be two programmable panic inputs.
 - d. One RS232 Serial programming port for remote programming using PC based configuration software.
2. The system shall support an optional ShowNet Ethernet input to provide an additional input plus processor status monitoring and configuration.

G. Panel Electronics, Features.

1. The panel electronics shall provide two levels of operator interface:
 - a. A local standard interface that includes 6 menu keys and a bitmapped backlit LCD display to access standard system menus.
 - b. Remote configuration via personal computer using RS232 or ShowNet Ethernet data links.
2. The processor control electronics shall have an update rate better than 16 ms (60 Hz) or 20 ms (50 Hz).
3. The panel processor shall include a programmable astronomical time clock to permit programmed relay closures with a schedule of 128 events that may be programmed for days of the week, specific dates and offsets from sunrise or sunset. The system shall also support daylight savings time adjustments for all countries.
4. The RPM shall also have the capability to support single and double pole relays that may be mixed throughout the panel.
5. As a standard, Contact panel status reporting shall report the following conditions/data:
 - a. Processor active.
 - b. DMX512 Port A input fail.
6. The control electronics shall provide the following setup functions that shall be user programmable on a per panel or system wide basis:
 - a. DMX512 Port A patch.
 - b. ShowNet DMX512 patch.
 - c. Architectural patch for Vision.net control systems.
 - d. Record Vision.net presets for load pattern switching.
 - e. Occupancy sensor and photocell control inputs.

- f. Clock events.
- g. Set control input priority logic.

7. The DMX512 Port A and ShowNet patching shall support a panel start address and individual relay patch. The architectural patch shall define the panel circuit/room/room channel relationship for Vision.net control systems.

8. The control electronics shall provide a facility to disable the output of any individual relay by switching the relay off.

9. The processor shall provide an architectural Vision.net control system preset capability of 8 presets for each of up to 256 separate rooms.

10. It shall be possible to load new panel operating software via the Ethernet connection to the relay panel. There shall be no requirement to turn power to the panel off during the loading of panel software. It shall be possible to load new panel operating software into the processor, regardless of the state of the program storage.

H.) Mechanical.

1. Relays shall be snap in factory wired units in single or double pole configurations.
2. All relays shall be designed for repeat operation with mechanically operated contacts.
3. Relays may be operated locally with a manual over-ride.

I.) Electrical.

1. Power connections shall be made on compression screw terminals. Control signal connections shall be made via plug-in connectors at each module chassis.
2. Load connections shall be via compression screw terminals on a terminal block.
3. Relays shall be rated for 120/230/277/347 volts.
 - a. All relays shall be capable of continuous operation at full rated load. They shall be rated for tungsten, LED, cold cathode and HID loads.
 - b. Each assigned relay shall have a programmable switching threshold between 1 and 99%.
 - c. All relays shall have a local control switch to turn the relay on for testing and diagnostic purposes.
4. Relays shall be UL, ETL and cUL, cETL recognized.

J.) Accessories.

1. To supplement the internal Power Supply, a supplemental Power Supply shall be available to support up to 20 additional architectural control stations, and shall be supplied complete with an

enclosure for wall mounting in the dimmer/distribution room. It shall be suitable for 90 - 277 volts ac 60 or 50 Hz supplies. A 347 volt supply shall also be available.

K.) Documentation.

1. System riser and connection drawings shall be supplied as specified.
2. Installation Instructions and a Programming Guide shall be supplied with each Contact Lighting Control Panel.

L.) Standards.

1. The relay panel assembly shall be ETL and cETL listed.

M.) Environmental Specification.

1. Ambient temperature extremes: 15 - 140 degrees Fahrenheit (-10 - 60 degrees Celsius).
2. Recommended ambient temperature: 64 - 77 degrees Fahrenheit (18 - 25 degrees Celsius).
3. Relative humidity: 10 - 90% non-condensing.
4. General conditions: Office level cleanliness. Interior use only.

2.3 NEO MEMORY CONSOLE

A. General Description.

- 1.) The lighting control console shall be microprocessor based and specifically designed to provide complete control of stage, studio and entertainment lighting systems. An open architecture system using non-proprietary interfaces to permit upgradeability shall be used. The lighting control console shall be the NEO Lighting Control Console manufactured by Philips Strand Lighting or equal.
- 2.) The system shall provide control of up 100 Universes of DMX (51,200 output parameters) over 32,000 control channels. Output shall be distributed over a 10/100/1024 MB Ethernet network using Philips Strand Lighting ShowNet, E1.31 (sACN), Pathport, KiNet 1 & 2, ArtNet, simultaneously as well as E1.11 -2008 USITT DMX 512/1990-A outputs over four (4) DMX 5pin XLR outputs.
- 3.) The system shall support full bi-directional RDM communication with compatible RDM Network devices via the four (4) DMX connections on the Neo control console. RDM communication shall adhere to ANSI standard E1.20-2006 Entertainment Technology – RDM – Remote Device Management over DMX512 Networks.
Supported RDM features shall include:
 - a. Discovery and Identification of RDM capable devices
 - b. Setting of start addresses, operating modes and additional settings as exposed by connected devices and controllable via RDM
 - c. Remote viewing of data as provided by connected devices
 - d. Error reporting as provided by connected devices
- 4.) An infinite number of cues, cue lists, groups, presets, palettes, macros, effects, snapshots may be contained in non-volatile electronic memory and stored to an onboard solid-state hard drive and to any USB storage devices.

- 5.) Recorded cue lists (Unlimited) may be played back simultaneously on up to 95 faders (including future optional wing faders). Channels shall, by default, respond to cue information by last instruction, with timing control provided for all cues.
- 6.) The Neo control console may be programmed in Tracking, Hybrid Tracking or Cue Only mode by the user as a system default and overridden on individual record actions as required.
- 7.) A Master A/B motorized fader set shall be provided. The 60mm motorized fader set can execute move fades. Five (5) Additional 60mm motorized playback faders are also provided for multiple cue playback options over an unlimited number of fader pages.
- 8.) Ten (10) 60mm motorized multifunction faders are also provided in addition to the above. These multifunction faders give the end user additional playback faders, additive, inhibitive or effect submasters. Two (2) dedicated, addressable motorized grand masters and one rate master are provided as well.
- 9.) A rate master shall be provided. The 60mm motorized fader can be set to execute all master timing across the console functionality allowing for "on the fly" busking timing.
- 10.) A set of four (4) push button soft touch encoders and companion LCD play back screens shall be included for control of multichannel luminaires. Each LCD playback screen will give the user feed back on the rotary encoders state, value, and graphic. Encoders may be operated in coarse or fine mode. Tactile feedback for full frame operations shall be provided. .
- 11.) A high-resolution level wheel shall be provided to control intensity for selected channels and scrolling/zoom for some displays.
- 12.) An integrated track ball and alpha-numeric keyboard shall be included for screen navigation, software interaction, cue labeling, patch labeling, or non -numeric command line functions using the Alpha numeric text call up function feature.
- 13.) Each Control Console shall support up to three (3) HD multi-touch monitors (sold separately) and support HDMI, DVI, and Display port device outputs. Each display is user definable.
- 14.) Control surface buttons shall be backlit. The backlighting shall provide indication of functional states through both color change and intensity. Back lit buttons shall also indicate "follow me" programming which will allow the novice user to follow the next key press sequences needed when command line programming.
- 15.) Control and programming features for intelligent lighting fixtures shall also include: a standard library of fixture profiles, the ability to copy and edit existing profiles and create new profiles and patch displays.
- 16.) User-definable, interactive displays may be created – magic sheet view. These displays, which can be used in live and blind operating modes, allow graphical layout of channels and system shortcuts such as Palettes and Groups.
- 17.) Software upgrades shall be made by the user via USB flash drive; changing internal components shall not be required.
- 18.) Show data may be created and modified on a personal computer, using either Windows 7, or Windows 8 operating systems, with a free offline editing application. The program shall also allow output to visualization software supporting the same protocols as the lighting system.

- 19.) FTB (full tracking back up) Synchronized backup shall be provided via another full console on the network or by use of a remote processor unit. The backup console or Rack mount controller shall maintain synchronized playback with the master and shall take over control of the lighting system upon loss of communication with the master, either automatically or upon user confirmation.
- 20.) Multiple users may access show data from the main control console. Each user shall have an individual workspace. User identification may be assigned to more than one control device, allowing users to work in tandem, or allowing a remote access user to mirror the current display format and mode.
- 21.) Show files are simultaneously saved across the system to each mapped integral hard drive, flash drives and external network drives.
- 22.) The control console shall provide a pull out drawer housing an external alpha-numeric keypad and USB Charging and Data Port .
- 23.) The lighting control console shall feature a flexible hardware and software design. Control channel counts, automated lighting support, help files, and additional control hardware shall be easily upgradeable.
- 24.) Minor revisions of operating software and an off-line editor shall be available to the user via download from the manufacturer's web site at no additional cost. Console software shall be upgradeable in the field via Internet download.
- 25.) The lighting control console software shall feature a familiar and easy-to use Windows graphical user interface (GUI) based on the Windows operating system. Software features shall include Off-line Editor, Remote Video, Media Player, Web Browser, and PDF Reader.
- 26.) The dedicated Windows processor architecture shall deny access to operating system, but shall allow access to an open hard drive for show files. Processor back up shall be supported by the use of any Windows 7, or later, computer running the PC version of the lighting control console software.

B. Capacities

- 1) The Neo control console shall provide direct control (4 output ports and one input port of DMX 5 Pin XLR) of up to 2048 DMX/RDM512 devices (51,200 via network, 100 universes) via the DMX network output capacity of the console. This output capacity of the console can be upgraded at any time and purchased in single DMX universe packets
- 2.) A show file may contain virtually unlimited cues, groups, submasters, submaster pages, effects, macros and one fully proportional patch that can be stored on an internal solid state hard drive and archived to standard USB memory key drives.
- 3.) Multiple show files and backups shall be stored on the system hard drive and shall have the ability to backup to multiple read/write storage devices simultaneously.
- 4.) The control console shall utilize a mission critical Firebird SQL sequel server data base for secure show file storage. Users do not need to ever "save" their show. The Neo Control console is always backing up and saving show file key presses to ensure that a key stroke, key press is never lost. Any system not utilizing this technology will not be accepted.

- 5.) Boot time shall be reduced to a maximum of 30 seconds from a cold boot to system up and outputting DMX/Network.
- 6.) The control console shall host two (2) individually isolated 1 Gigabit network ports located on the back of the console. Each LAN can be individually addressed via network settings to allow for both outside Web access to the console as well as networked Lighting system control.
- 7.) Philips Advantage DMX, shall allow use of “unregistered outputs” when Philips Selecon, Philips Varilite, Philips Showline, or Philips Color Kinetics luminaries are patched to the unregistered universes of the console. Advantage DMX will allow for use of any Philips Entertainment Luminaires in the Patch with-out encumbering any of the registered universe channels. Manufacturers that charge for registered outputs to run their manufactured multichannel luminaries shall not be acceptable.

A. Control

Control Interface.

- 1.) The programming keyboard shall be grouped by function. Major groupings shall be record target functions, numeric keys, level assignment functions, display navigation functions and controls, as well as non-intensity parameter controls. The key board shall be grouped in six (6) distinct areas and grouped as:
 - a. Playback
 - b. Action
 - c. Command
 - d. Selection/Attributes
 - e. Shortcuts
 - f. Advanced
 - g. Effects
 - h. Display
- 2.) Playback Section:
 - a. The playback faders shall consist of a motorized 60mm Master Fader pair with associated Select, Go and Stop/Back buttons.
 - b. Five (5) Additional 60mm motorized playback faders are also provided for multiple cue playback options with associated Select, Go, and Stop/Back Buttons, over an unlimited number of fader pages.
 - c. It shall be possible to instantaneously halt an active cue, back to the previous cue, manually override the intensity fade or manually override the entire fade.
- 3.) Submasters:
 - a. Ten (10) proportional fully overlapping additive, effect or inhibitive submasters may be defined over infinite pages. Submaster’s bump buttons shall have multi-colored LEDs to indicate submaster status. Each submaster may have fade up, dwell and down fade times. Each has a bump and assert/channel select button.
 - b. Submasters may be set to independent.
 - c. Submasters may be set to HTP or LTP intensity.
 - d. Exclusive mode for a submaster shall prohibit the live contribution of that submaster from storing to cues or other submasters.

- e. Motorized faders shall set submasters to required positions as fader pages are changed.
 - f. It shall be possible to set submaster values directly from the command line.
- 4.) Grand Master Faders- Two (2)
- a. The grand master shall have associated blackout and blackout enable buttons.
 - b. Blackout shall send all associated intensity outputs to zero. Non-intensity outputs shall not be affected.
 - c. Motorized faders shall set grand masters to required positions as fader pages are changed.
- 5.) Track Ball – Pointing Device. Shall be integrated into the control console infrastructure and shall work in and outside of the console operating software.
- 6.) Encoders- Neo shall include four (4) independent rotary encoders including an integrated push button as well as four (4) LCD feed back screens for encoder assignments and positioning. Encoder Screens shall display but not be limited to:
- a. Position in Degrees
 - b. Color Mix in Percentage
 - c. Gobo Position
 - d. Gobo Image
 - e. Gobo Rotation
 - f. FX control Parameters
 - g. Lens Percentage

B. Physical

Console Physical & Electrical.

- 1.) The console controls and electronics shall be a desktop configuration and shall use a high density multicore Intel microprocessor.
- 2.) The console shall be constructed of steel with an aluminum face panel. All internal control components shall be fully modular to permit simple removal and exchange. The top panel shall be easily removed via thumb screws to allow for easy access to the internal components of the console.
- 3.) The central processor shall be fully integrated into the main console in a separate removable enclosure for rapid removal and exchange. The processor shall include a 120GB solid state hard drive (minimum), standard computer I/O and an integrated USB hub for connection of all console control electronics to the system processor.
- 4.) The Control Console shall be universal in power requirements and shall support from 90-240 volt 50-60Hz power systems. The integrated power supply shall also support the power requirements of additional future accessories.
- 5.) The Measure of the control console shall not exceed 20" (508 mm) x 31" (787.4mm) x 5" (127mm)

C. Environmental

Operational Environment.

- 1.) The acceptable ambient operating temperature shall be 0 degrees to 50 degrees Celsius (32 degrees to 122 degrees Fahrenheit) and the ambient storage temperature shall be -40 degrees to 70 degrees Celsius (-40 degrees to 158 degrees Fahrenheit).
- 2.) The acceptable operation location shall be the equivalent of a good office environment, without excessive dust.
- 3.) Acceptable humidity levels for operation shall be 5% - 95%, non-condensing.

Standards Compliance.

- 1.) The console shall be CE marked and ETL, cETL, and cTick listed.

D. NEO Operating Software

Channel Control.

- 1.) Selection: Channel control lists shall be composed of any combination of control channels, cues, looks or groups using the +, -, Thru & Thru-on syntax. Any one selection shall be capable of being manipulated for level, intelligent light control without the need to re-select. Mouse and touch screen selection via the Graphical User Interface shall be available on all supported touch screen monitors.
- 2.) Intensity Control: Intensity levels shall be set using the '@' key and inputting a numerical level or adjusted using the level wheel. Context sensitive soft keys with labels available on the system monitor or hard keys shall be provided for Full, DMX512 level, +%, -%, Off, Copy and Move. Level change shall also be available via the main level wheel when the fixture is selected.
- 3.) An "On" key with user definable levels shall be provided.
- 4.) Commands: Command entry shall be user selectable between command line (RECORD CUE 1 [enter]) and direct entry (CUE 1 RECORD). Additional Record Dialogue boxes shall be user accessible when Holding Record and Cue simultaneously. Consoles that do not provide both methods shall not be acceptable.

Cues.

- 1.) The console shall set to tracking cue recording, hybrid tracking cue recording, or cue only recording based on operational preference. This shall be set during the initial configuration of the system when the system is started for the first time and can be changed at any time.
- 2.) Each cue may have split fade & delay times, a follow time, link & loop parameters, calls for macros & effects, a text label and may be assigned to any cue or cue list.
- 3.) Cue zero shall always be a blackout cue by default.

- 4.) Unlimited cue lists can be created to split up a show into manageable units. Each cue list supports up to millions cues with 3 decimal places of point cues. (Cues 0.000 through to 9999999.999)
 - a) Each cue:
 - a. can contain an unlimited number of channels
 - b. can contain an unlimited number of effects, groups and shortcuts
 - c. can be Full tracking or hybrid tracking modes
 - d. can be Auto follow and part cues.
 - e. can wait for user interaction or continue automatically.
 - f. can be completely flexible, run order allows cues to be rearranged into any order.
 - g. can have its own delayed start, fade in, dwell, fade out, and effects delay start.
 - h. Each channel within a cue can be assigned a delayed start and override fade time
 - i. can have a different attribute fade time for complex timing.
 - j. With an effect can be assigned a delayed start, override length and whether the effect will loop until the cue ends.
 - k. has "Auto Mark" functionality and can be used to automatically setup intelligent fixtures.
 - l. List can include Scene breaks with text editing.
- 5.) Cues, groups, submasters, palettes, macros, & effects shall be recorded or updated from the keypad.

Playbacks.

- 1.) Playbacks shall be provided (one (1) main dual, five (5) individual playback and unlimited virtual playbacks), each with a Go button, dedicated stop/back, and select keys. Interaction between each playback shall be user programmable as highest level or latest action takes precedence operating from separate cue list. Each playback shall operate in automatic, manual fade or manual time modes executing fades while following links, loops and macros.
- 2.) The playback faders shall be motorized and provide rate override of fades.
- 3.) Cue Only, Hybrid Tracking, and Tracking modes of operation shall be supported.

Effects.

- 1.) Dynamic, fading and tracking FX parameters shall be supported.
- 2.) Chase and build effect types shall be supported as shall forward, reverse, bounce and random directions.

- 3.) Levels and attributes shall be recorded or shall be randomly generated or inverted or alternatively normal and inverted every cycle.
- 4.) Modifications to running effects may be returned back to the effects memory for re-recording.

Cue, Submaster and Effect Previews & Cross Reference Screen.

- 1.) Cue and submaster preview modes shall be supported to permit blind changes to be made to these entities using channel control syntax.
- 2.) A Cross Reference screen shall provide an alternative view of cues by showing levels recorded in a range of cues.
- 3.) Changes may be tracked or restricted to one cue using the Cue Only option.

Submasters.

- 1.) Unlimited pages of fully overlapping submasters shall each be provided each with a fader, virtual fader, bump button and status LED's.
- 2.) Each submaster shall be individually programmable as normal, last takes precedence, inhibitive or exclusive, recordable per page.
- 3.) Bump buttons may be individually enabled, disabled, latching or trigger macros.
- 4.) Submasters shall be loadable with the contents of cues, groups, other submasters or channel lists.

Groups.

- 1.) Groups may be recorded for fast recall of commonly used stage looks. Groups can be independently recorded or directly recorded from the stage output. Cues recorded using preset focus groups may be easily edited and changed by simply updating the focus groups.
- 1.) Each group may be assigned a text label.

Display Formats.

- 1.) User programmable channel display formats shall be provided to show channel levels, colors, and attribute information. User programmable channel formats shall be provided to show channels in show, defined channels or active channels. Screens shall be fully adjustable using the systems fully graphical user interface.
- 2.) On screen controls shall be provided for programming moving light attributes using the supplied system input device.

Patch.

- 1.) A proportional soft patch shall be provided.
- 2.) Dimmers may be profiled, set with a non-dim trigger value, or un-patched at a level.

- 3.) A library of luminaires to simplify patching shall be provided.
- 4.) Patch displays shall be ordered by channel or by output.

Profiles.

- 1.) Profiles may be applied to dimmers or up/down fades in cues or parts.

Set-up.

- 1.) Simple to use set-up screens shall be provided to configure external communications and operation of the console,

Macros.

- 1.) Macros may be activated by, submaster's bump button, from a cue, external switch contact, remote control, console power-up or at pre-programmed times.

Archive.

- 1.) Automated Show archive shall be supported to the systems internal solid state hard drive, a USB key drive, or optional file server.
- 2.) The File control drop down menu shall provide a means to select the current show from the system disk or file server and to copy a show (or any part of a show) to or from a USB key drive, or the file server.
- 3.) Shows shall have text labels and a time and date stamp.
- 4.) The system software shall support the loading and saving of database files formatted in the Strand NEO FireBird database Format (*.FDB), data structure.

Printing.

- 1.) The system shall support Portable Document Format (*.PDF) printing.
- 2.) The following printouts may be requested: Patch, Cues, Groups, Subs, Profiles, Macros, Fixtures, Channels in Use, and Channels Not In Use.

E. System Control Software

Channel Capacity Software Upgrades.

- 1.) Channel and attribute capacity shall be upgradeable via software to the maximum capacity of the console in DMX universe increments (up to 100 total per console).

Automated Luminaire Control.

- 1.) The system shall provide intelligent control of any DMX512 automated luminaire. The console shall display automated luminaire attributes as true attribute definitions not as channels or DMX512 values. An automated luminaire shall be addressed to a single fixture control channel not a series of consecutive control channels. Consoles that use consecutive control channels or DMX512 percentage values to operate automated fixtures shall not be acceptable.

- 2.) The Fixture Attributes display shall show fixture number, model, mode, and attribute settings displayed in values of colors, degrees, percentages, hertz, and RPMs, not in DMX512 percentages or channel levels.
- 3.) All attributes of an automated luminaire (intensity, color, gobo, focus, X-Y position, effects, CMY, RGB, etc.) shall be accessed by typing one channel number.
- 4.) The system shall use an integrated fixture library for patching and control of automated luminaires.
- 5.) Neo control allows for all parameters to be controlled in a user-friendly format. Pan and Tilt shall be adjusted in degrees. Color shall be adjusted using Color Space Control. Gobo parameters like rotation shall be adjusted in RPM speed. Zoom shall be adjusted in degrees. Other parameters shall have similar and consistent parameter control. Console software not using this format shall not be acceptable.
- 6.) Color Frame Control: Full color frames shall be selected using palettes. Part frames may be adjusted using the rotary control wheels. Preset focus groups shall be available to permit the recall of specific colors from scrollers.
- 7.) Color Space Control: For control of color mixing units, it shall be possible to use CMY, RGB, HSL or HSV color mixing methods to select colors. An on screen, user selectable, color picker shall be provided. Consoles that do not provide CMY, RGB, HSL and HSV color mixing shall not be acceptable.
- 8.) Individual attributes shall also be selected from soft keys and the scrolling wheel in conjunction with on screen controls showing attribute names as well as full touch screen support and selection of the individual attributes.
- 9.) Displays shall be provided which show all attributes of a fixture.
- 10.) Attributes shall be excluded from inappropriate masters and normally operate in latest action takes precedence fashion within submasters, playbacks and effects.
- 11.) When attributes and levels are recorded in a submaster the levels shall be mastered by the fader but the attributes shall go to their recorded value in a latest takes precedence basis to ensure that scenes played back on submasters can be faded in and out with recorded colors and positions. Attributes shall have the option of moving when the fader is moved off of zero, when the fader reaches full or manually.
- 12.) Cue tracking shall be supported for attribute channels.
- 13.) A channel and attribute cross-reference screen shall be provided for blind viewing.
- 14.) Auto Mark shall provide an optional automatic means of moving fixtures to the next required position (pan, tilt, color, gobo, etc.) after the previous fade has completed and when the fixture intensity is zero without the need to record extra cues.
- 15.) A library of over 8,000 intelligent and automated luminaires with text labels shall be provided to facilitate fast patching. An off line and built in profile builder is included for easy set up of new luminaires or attribute editing.
- 16.) Unlimited preset focus groups shall be provided to simplify the programming of automated luminaires.

Remote Communication.

The console software shall also support communication with other computer programs running on other computer systems including WYSIWYG, Capture Polar and many other visualization programs.

Ethernet Network Operation.

- 1.) The system shall support full Ethernet connectivity to system dimmer racks and remote peripherals using the built in Ethernet port on the console. Protocols that shall be available are ShowNet, CKNet, ArtNet, Pathport and ANSI E1.31. This is in addition to direct DMX512 connectivity.
- 2.) The system shall support industry standard 10/100/1000Base-T cables, Ethernet hubs and switches.

Wireless Remotes.

- 1.) Multiple wireless handheld devices may be connected to the system using a Wireless access point.
- 2.) Multiple access points may be provided to supply adequate coverage throughout a facility.

Tracking Backup.

- 1.) Two consoles may be configured and operated as main and tracking backup.

Remote Console.

- 1.) Additional consoles or PCs running Windows 7, or later, shall be able to connect to the Main console as a Remote Console over an Ethernet network.

Off-Line Editor Software.

- 1.) A Windows hosted off-line editor shall be available which shall enable show files to be edited and simulated in real time on any Windows 7 or later PC.
- 2.) All facilities of the console, including patching, channel control, playbacks, submasters, effects & set-up shall be supported on the off-line editor.

Showfile Compatibility.

The control console shall utilize a mission critical firebird SQL sequel server data base for secure show file storage. Users do not need to ever "save" their show. The Neo Control console is always backing up and saving show file key presses to ensure that a key stroke, key press is never lost. Any system not utilizing this technology will not be accepted.

Provide 91001 Neo Control Console

- 91002 One Universe of DMX (up to 100 may be ordered per console)
- 91021 21" HD Multi-touch Monitor
- 91022 23" HD Multi-touch Monitor
- 91001-DC – Neo control console replacement dust cover

2.4 VISION.NET CONTROL SYSTEM

System shall be a fully integrated digital lighting control system, utilizing digital communications between stations, and the control devices (dimmers, relays, and DMX-512 controlled equipment) in the system as required.

A.) Capacities.

- 1.) The lighting system shall be fully scalable to meet the needs of complexes of any size. Each complex can consist of up to 1000 areas.
- 2.) Each area shall support up to 255 rooms with a maximum of 127 control channels per room, which can be connected to an unlimited number of dimmers, relays, or DMX512 controlled equipment. The control connection between stations and to C21, A21 and R21 dimming systems shall be via standard Cat 5e cable using the Vision.net control protocol. For DMX512 applications an optional Vision.net to DMX512 module shall be available.
- 3.) Star wiring shall be supported using any number of available 4 port Vision.net data hubs.
- 4.) Large-scale systems consisting of multiple Vision.net networks may be linked using a Strand Lighting ShowNet Ethernet network.
- 5.) No central processor shall be required. Systems requiring a separate processor shall not be acceptable.
- 6.) Connections to BMS systems shall be supported through the use of
 - a. Simple contact closures from the BMS system to a standard Vision.net AV interface card. Any number of cards may be used with 8 contact closure inputs per card. Each closure may be defined as a system room preset command, toggle command or Smart button command.
 - b. RS 232 serial interface modules shall also be available permitting simple ASCII text commands and acknowledgements between the BMS system and the Vision.net lighting control system. Commands may access any room or preset or through the use of Smart button commands multiple rooms and presets system wide.

B.) Interconnection.

- 1.) Each station shall be connected as an RS485 serial "daisy chain" using Belden 1583A Cat 5e cable.
- 2.) It shall be possible to change standard control stations at any location on the data network without requiring additional wiring or alterations to the wiring specification. Touchscreen stations shall require a separate power feed to operate the station electronics.

C.) Vision.net 4 Configuration Interface.

- 1.) The system shall support a digital communications link for station configuration and set up.
- 2.) An RS232 programming station shall be used for connecting a Windows PC operating Vision.net 4 Designer software to the Vision.net data network.
- 3.) A Windows PC can communicate either via an RS232 port or via the available network interface card.

VISION.NET 4 DESIGNER CONFIGURATION SOFTWARE

A.) General.

- 1.) Vision.net 4 Designer software shall be a graphical set up and configuration programmed designed to operate under Windows XP (or later) operating systems.
- 2.) An astronomical clock shall be available on any system touchscreen capable of being programmed to any geographical location in the world. The clock shall be able to execute any number of daily, weekly or date specific events at fixed times, or offset relative to sunset and sunrise.
- 3.) Each system area shall support 127 control channels per room with up to 255 rooms per system. Any number of dimmers may be assigned to a room.
- 4.) Each room shall be capable of having any combination or quantity of control stations.
- 5.) It shall be possible to change stations at any location by replacing it with a different station type, and modifying the systems configuration file accordingly.
- 6.) Each room shall have 32 presets available, regardless of the number of rooms or number of channels within each room. Presets shall be selected from control stations, or shall be "played back" automatically by time clock events. Each preset shall have its own programmable fade, delay and hold time and may be linked for sequential playback in a single sequence, or using system macros if a continuous loop is required.
- 7.) Programmable delay, fade and hold times shall be available in the following increments; instant, 1 sec., 2 sec., 3 sec., 5 sec., 7 sec., 10 sec., 15 sec., 30 sec., 1 min., 5 min., 15 min., 60 min.
- 8.) It shall be possible to allocate a name or label to every room, panel, station, preset and group in the system.
- 9.) It shall be possible during system configuration to create macros using a "Smart" button. Smart buttons shall carry out a sequence of standard system commands. It shall be possible to program Smart buttons from any control station pushbutton, remote input or, automatically using the astronomical time clock. It shall be possible to assign any of the system commands to any station pushbutton, external device input, time clock event, or Macro step.
- 10.) In cases where an area is to be divisible for separate or combined control, it shall be possible to combine the constituent rooms either manually or with automatic partition switches. Rooms are combined using a "Room Link" touchscreen button. Rooms that are not linked shall maintain their own presets, levels and channels. "Room Link" coordinates the selection of presets within the combined rooms from any control station within those rooms.
- 11.) The following commands shall be programmable to any system button:
 - a.) Preset.
 - b.) Preset/Off.
 - c.) Toggle.
 - d.) Smart.

- e.) Raise.
- f.) Lower.
- g.) State / Mode.
- h.) Room Link.
- i.) Console button.
- j.) Share Button.
- k.) CK Show.
- l.) Set Clock.
- m.) Suspend Clock.
- n.) Toggle Master.
- o.) Screen Saver.

12.) The system shall include an output simulation mode allowing the system designer to test all configurations prior to system installation.

13.) Touchscreen configuration shall be supported with simple drag and drop tab, button, slider, sliders, and text entities.

14.) Tabbed touchscreen pages may be created for:

- a.) Buttons and Sliders.
- b.) PaletteOS Monitor.
- c.) Web Browser.
- d.) Real Time Clock.

15.) Touchscreens may optionally be connected to a Strand Lighting ShowNet Ethernet network to connect to PaletteOS series control consoles or Network control devices. In this mode of operation, it shall be possible to view console pages that display information on Cues, Submasters, Macros, Lamp Check and Channels.

VISION.NET TOUCHSCREEN STATIONS

A.) Specific Features.

- 1.) All Vision.net touchscreens shall be full color displays. Systems that do not support color displays shall not be acceptable.
- 2.) Users may choose from a variety of touchscreen sizes.
- 3.) Each display shall support multiple tabs to allow users to organize their displays to meet a wide range of applications. Tabs shall support the following applications:

a.) Programmable Sliders that can be scaled and programmed as both channel controls and submasters. Flexible fader sizes are available allowing system programmers to optimize the number of faders displayed on screen for maximum flexibility. Users may also select from a range of fader styles to suit their application.

b.) Touchscreen buttons shall be available in a variety of sizes and shapes permitting system designers the flexibility to allow buttons to define their function through size, shape and color.

c.) Buttons shall support both text labeling and icons. A broad character set shall be supported including Chinese and Arabic characters.

d.) All displays, faders, buttons and tabs shall have text labels in a choice of fonts, sizes and colors.

e.) Real Time clock display with full system programming.

4.) Systems with network connections shall also support tabs with:

a.) Web Browser capability allowing access to Strand ShowNet network devices.

b.) Remote control and monitoring access to Strand Lighting PaletteOS control consoles.

c.) Any screen can have a color graphic background to permit a wide range of custom graphic options for system designers. Backgrounds may be any bit-mapped image. Alternately backgrounds may be assigned a wide range of colors. A standard set of graphical backgrounds shall be available.

d.) Any screen with an internet connection can support access to any webpage.

VISION.NET CONTROL STATIONS

A.) Mechanical.

1.) The control station faceplates shall be free of visible fasteners and shall be of a pleasing aesthetic appearance.

2.) Control stations shall be supplied standard with a white finish, optional custom colors shall be available on request.

3.) On control stations with sliders, the sliders shall have 1.75" (45mm) travel with matching slider knobs.

4.) Control station push buttons shall have matching button caps with long life programmable LED backlighting. The backlight intensity shall be fully adjustable to allow for ambient lighting conditions. Backlighting shall be user definable with a choice of Blue, Amber or White. Different backlighting colors may be programmed to indicate the state of each button.

5.) Key caps shall be available with optional custom engraving.

6.) Each station shall inputs for up to 8 photo cells or occupancy sensors or any combination of these devices. The function of the sensors shall be programmable using the system design software and may be updated at any time.

B.) Operation.

1.) All control stations shall have a unique address between 1 and 255 configured at the initial system start up.

2.) A Vision.net control station may consist of sliders and button keypads with a maximum of 5 gangs per station.

C.) Installation.

1.) 2 gang and larger control stations require flush mounted masonry ("ears-in") back boxes, with a minimum depth of 3.5" (90mm). Back boxes must be grounded / earthed in accordance with local wiring practices to provide a discharge path to ground for static electricity.

2.) Control stations shall be supplied complete with a sub-plate, which is screwed to the flush mounting back box with the screws provided. The sub-plate allows the control station to be hinged into position and secured with hexagonal setscrews on the bottom edge of the trim ring.

3.) Touchscreen stations shall be available with surface and flush mount enclosures designed to simplify station mounting.

4.) Vision.net data line terminations shall be via a screw-terminal plug and socket to facilitate removing a control station while maintaining the continuity of the data network.

VISION.NET SLIDER WITH PUSHBUTTON STATIONS

A.) Specific Features.

1.) Each station shall have a MANUAL (Take Control) button, which shall give control to the manually operated channel sliders.

2.) Stations shall be available with 3, 6, or 9 sliders plus a proportional master. It shall be possible to allocate several channels within a room to a single slider. Expansion stations shall be available to accommodate rooms requiring more sliders.

3.) Channels not allocated to a slider shall either go out or remain at the previously selected pre-set level when MANUAL is selected according to the configuration software.

4.) Sliders may also be configured in submaster mode allowing them to operate as group masters.

5.) All buttons may be programmed to overwrite their default settings. Each button may be assigned any of the following functions:

a.) Preset.

b.) Preset/Off.

c.) Toggle.

d.) Smart.

e.) Raise.

f.) Lower.

- g.) State / Mode.
- h.) Room Link.
- i.) Console button.
- j.) Share Button.
- k.) CK Show.
- l.) Set Clock.
- m.) Suspend Clock.
- n.) Toggle Master.
- o.) Screen Saver.

6.) Smart button commands including room combine, cross room commands and commands to Strand Lighting PaletteOS controller consoles.

7.) If enabled pressing and holding any preset button shall enable recording, which will allow the current slider settings to be recorded into one of the presets available from the local pushbuttons. Fade times for these presets will remain unchanged by this record action.

8.) Within each room, MANUAL buttons can be configured to operate on a "last action takes precedence basis" where recalling a preset or pressing another MANUAL or TAKE CONTROL button will cancel the current selection. During the configuration procedure it shall be possible to select "Override" mode for each room. In this mode an active MANUAL button can be canceled by toggle action. It shall be possible to define whether channels fade to the OFF preset or return to the previously selected preset when TAKE CONTROL is canceled.

VISION.NET PUSHBUTTON STATIONS

A.) Specific Features.

- 1.) All button stations shall be fully configurable.
- 2.) Each button may be assigned any of the following functions:
 - a.) Preset.
 - b.) Preset/Off.
 - c.) Toggle.
 - d.) Smart.
 - e.) Raise.
 - f.) Lower.
 - g.) State / Mode.
 - h.) Room Link.

- i.) Console button.
- j.) Share Button.
- k.) CK Show.
- l.) Set Clock.
- m.) Suspend Clock.
- n.) Toggle Master.
- o.) Screen Saver.

3.) Smart button commands including room combine, cross room commands and commands to Strand Lighting PaletteOS controller consoles.

4.) Each station shall store all active control information at all times. No central processor shall be required.

AV INPUT / OCCUPANCY SENSOR INTERFACE

A.) Specific Features.

- 1.) Each Interface shall accept up to 8 momentary or maintained contact closures at their inputs.
- 2.) The Interface shall simultaneously support the Vision.net family of occupancy sensors, photo-cell sensors, contact closures and 0-10v analog configurations.
- 3.) In addition to Vision.net data input, the Interfaces shall require an additional 24-volt dc power supply.

AV INPUT / OCCUPANCY SENSOR INTERFACE WITH CONTACT CLOSURE OUTPUTS

A.) Specific Features.

- 1.) Each Interface shall accept up to 8 momentary or maintained contact closures at their inputs and either 4 or 8 contact closer outputs (depending on model).
- 2.) The Interface shall simultaneously support the Vision.net family of occupancy and photocell sensors.
- 3.) In addition to Vision.net data input, the Interfaces shall require an additional 24-volt dc power supply.

WALL POWER AND DATA PORTS

A.) Specific Features.

- 1.) Wall Jacks featuring both power and data are available for portable station connectivity in two modes.
 - a. Dumb Jack – the data port provides access to the Vision.net system and allows all configuration programming to reside in the portable station.

- b. Smart Jack – the data port provides access to the Vision.net system and stores all configuration programming within the jack allowing the connected portable station to access and control the data ports programmed data.

RS232 SERIAL INTERFACE PORT

A.) Specific Features.

- 1.) The RS232 Serial Interface port allows a programming PC to connect to the Vision.net system for system configuration and operation.

PORTABLE ENCLOSURE KITS

A.) Specific Features.

- 2.) Portable Enclosure Kits shall enable standard stations to be converted to portable units. Kits shall be supplied complete with 25ft (8m) cable and mating connectors.
- 3.) Portable Enclosure kits are available as either smart stations (where the programming resides in the station) or as dumb stations (where the programming resides in the Smart Jack).

DATA CABLE SPECIFICATION

A.) Specific Features.

- 1.) Vision.net stations Belden 1583A Cat 5 cable.
- 2.) DMX512 Belden 9829.

DOCUMENTATION

A.) Specific Features.

- 1.) An Operations Manual and Installation Instructions are supplied with each system. Project installation & connection drawings shall be supplied as specified.

ENVIRONMENTAL

A.) Specific Features.

- 1.) For all control stations and associated equipment, the following recommendations shall apply:
 - a.) Ambient temperature extremes: 32° - 104° F (0° - 40° C).
 - b.) Recommended ambient temperature: 64° - 77° F (18° - 25° C).
 - c.) Relative humidity: 10% - 90% non-condensing.
 - d.) General conditions: Office level cleanliness - Interior use only.

2.5 WALL BOXES

- A. This assembly shall consist of a 16 gauge, galvanized housing designed for recessed mounting in the wall. The unit shall be provided with a 16 gauge steel wall plate with hinged door.
- B. The box may have up to six flush receptacles mounted on a 16 gauge galvanized steel angled receptacle plate.
- C. The box shall be completely pre-wired at the factory, with ground lugs installed.
- A. The entire assembly shall be listed and labeled by Underwriters Laboratories.

2.6 CABLE MANAGEMENT SYSTEM

- A. The CMS Pantograph assembly shall consist of an extruded aluminum wireway.
 1. CMS-I 6.605" wide by 1.450 " high in cross section containing five cable compartments.
 2. CMS-II 2.882" wide by 1.450" high in cross section containing two cable compartments.
- B. The length of each section to be specified based on the distance between rigging pick up cables and maximum actual travel.
- C. The CMS shall raise and lower the enclosed electrical cable as it travels with the battens.
- D. The CMS shall provide a permanent electrical connection for the lighting system circuits.
- E. The CMS shall be installed between rigging lift lines and in such as a way as to prevent electrical cables from fouling with other hoisting components or mechanism.
- F. The CMS unit housing shall have an electrostatic paint finish in black.
- G. CMS aluminum wireway shall have a uniform minimum wall thickness of .094.
- H. CMS housing shall be inherently rustproof.
- I. Festoon cable shall be 12 or 10 AWG annealed stranded bare copper insulated with flame-retardant Polyvinyl Chloride (PVC) and provided in the specified number of conductors.
- J. CMS units shall contain electrically insulated, adjustable pressure pad strain relief devices to hold all cable securely in place.
- K. CMS unit shall be provided with two (2) PMB1 pipe clamp mounting devices for attachment to 1-1/2" pipe (2"O.D.)
- L. Each CMS hinge section to be provided with a pair of 7 gauge hinge arms and grade 8 attachment hardware.
- M. Unistrut P1001 horizontal stabilization track to be supplied in the specified length.

- N. One (1) P2950 trolley and PTB1 mounting bracket shall be provided with unit to attach extruded aluminum wireway to P1001.
- O. One (1) P2949 trolley and PCB1 bracket shall be provided with unit to manage excess cable.
- P. Two (2) P1001 end stop plates to be provided to prevent the P2950 trolley from exiting the P1001 track.

2.7 CONNECTOR STRIPS

- A. This assembly shall consist of an extruded aluminum wireway, 3.375" x 4.75" in cross section, and in the lengths specified containing terminal strips for feed conduit and wire extending to outlets (flush mount or pigtail), as specified.
- B. Connector strip housing shall be fabricated of black extruded aluminum wireway with interlocking cover sections to exceed UL 1573 standards. Housing shall be inherently rustproof.
- C. Connector strip shall have an electrostatic paint finish in black, with outlets identified by 2" high die-cut circuit identification numbers on the vertical surface of the strip.
- D. The strip shall contain 125°C XLP wiring of the proper sizes and quantities to connect the individual outlets to the terminal blocks in circuits of capacity as specified.
- E. The terminal blocks shall be molded barrier type with screw lugs suitable for connecting multiconductor feed cable or incoming wire. These shall be located in an extended terminal box of appropriate length when the strip contains more than twenty-20 AMP circuits. Terminal blocks can accept up to #8 gauge wire.
- F. Units available with 20, 30, 50, 60 and 100 Amp devices in either flush mount or pigtail.
- G. Connector strips shall be supplied with .125" thick by 1.5" steel C-channel mounting brackets. Brackets shall be suitable for single or double pipe battens, as specified, and shall extend above and below the strip. Brackets shall be 60" on centers. U-bolts shall be supplied to grip up to 2" O.D. standard steel pipe.
- H. The entire assembly shall be listed and labeled by UL.

2.8 EMERGENCY TRANSFER CABINET

- A. The Emergency Lighting Transfer Cabinet shall provide automatic transfer of the line and neutral conductors of each branch circuit from normal to emergency power when normal power fails. The cabinet shall automatically reconnect circuits to normal power when normal power has been restored.

- B. The transfer cabinet contacts shall be electrically operated and mechanically held. The entire assembly shall be UL1008 listed and labeled. This equipment must comply with the regulations in NFPA 110 for Emergency and Standby Power Systems.
- C. The Emergency Lighting Transfer Cabinet must also satisfy the requirements of NFPA 70 (National Electrical Code).
 - Article 701-Legally Required Standby Systems
 - Article 700-Emergency Systems
 - Article 540-11c-Motion Picture Houses
 - Article 520-7-Theatres and Similar Locations
 - Article 518-3c-Places of Public Assembly
- D. The Emergency Lighting Transfer Cabinet shall be a wall-mounted, NEMA 4 enclosure constructed of 14-gauge steel finished in matte black powder coat paint. All terminations and wiring shall be accessible via a hinged lockable door. The cabinet shall be pre-wired and tested at the factory with clearly marked terminals for contractor wiring of normal feed, emergency feed, lighting loads and sensing feeds.
- E. Standard transfer relays shall be available at 20A and 50A current ratings.
- F. The Emergency Lighting Transfer Cabinet shall accommodate circuits of two wire, dimmed incandescent or fluorescent lighting as well as three wire, dimmed, fluorescent lighting.
- G. Emergency Lighting Transfer Cabinets with Type 1 emergency power feeds shall accept one, two-wire, emergency power feed for each emergency power circuit.
- H. The front panel of the Emergency Lighting Transfer Cabinet shall contain a key-switch to simulate power failure for testing purposes as well as indicator lights to visually signal the presence of normal or emergency power.
- I. Voltage sensing of the Normal source shall cause automatic transfer when the voltage of one or more phases drops below 55% of 120VAC.
- J. Factory default settings for time delay of transfer are as follows: Normal to Emergency-0 Seconds, Emergency back to Normal-3 Seconds. These settings shall be field adjustable.
- K. Provisions for optional remote signal, fire alarm and other input signals shall be incorporated into the control circuit.
- L. Provide Emergency Lighting Transfer Cabinets as manufactured by Stagecraft Industries, Inc. or approved equal.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method:
 - 1. Comply with requirements in Division 16 Section "Conductors and Cables."
 - 2. Install unshielded, twisted-pair cable for control and signal transmission conductors, complying with Division 16 Section "Voice and Data Communication Cabling."

3. Minimum conduit size shall be 1/2 inch (13 mm).
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- F. Install dimmer cabinets for each zone.

3.2 IDENTIFICATION

- A. Comply with requirements in Division 16 Section "Electrical Identification" for identifying components and power and control wiring.
- B. Label each dimmer module with a unique designation.
- C. Label each scene control button with approved scene description.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
 1. Continuity tests of circuits.
 2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- D. Remove and replace malfunctioning dimming control components and retest as specified above.
- E. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

- F. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.4 TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central dimming controls. Laptop portable computer shall be used in training.
- B. Provide in the Base Bid an initial eight (8) hour training session with the owner with the factory-authorized service representative. Training to be videotaped and given to the owner.**
- C. In addition to the initial eight (8) hour training session, provide the owner two (2) four (4) hour training sessions at no additional cost. Training sessions to be scheduled by owner up to a year from the substantial completion date.**
- D. FACTORY CERTIFIED TECHNICIAN (FCT) SHALL BE LOCATED WITHIN 125 MILES OF JOBSITE.**

END OF SECTION 16571

SECTION 16715

STRUCTURED CABLING SYSTEM

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. General Requirements/Provisions shall be considered a part of this section and shall have the same force as if printed herein full. In addition, all information related to communications infrastructure that is documented in the architectural, structural, mechanical, and electrical drawings/documents shall be considered as part of the communications documents.

1.02 QUALITY ASSURANCE

- A. Specifications, Standards and Codes: All work shall be in accordance with the following:
 - 1. The current edition of the National Electrical Code (NFPA 70)
 - 2. American National Standards Institute (ANSI)
 - 3. National Electrical Manufacturers Association (NEMA)
 - 4. Telecommunications Industries Association (TIA)
 - 5. Electronic Industries Association (EIA)
 - 6. Institute of Electrical & Electronics Engineers (IEEE)
 - 7. Underwriters Laboratories (UL)
 - 8. American Standards Association (ASA)
 - 9. Federal Communications Commission (FCC)
 - 10. Occupational Safety and Health Administration (OSHA)
 - 11. American Society of Testing Material (ASTM)
 - 12. Americans with Disabilities Act (ADA)
 - 13. Local city and county ordinances governing electrical work
 - 14. In the event of conflicts, the more stringent provisions shall apply.

1.03 SCOPE

- A. The work under this section of the specifications shall include furnishing labor, material and equipment required to provide a complete installation of the work indicated on the drawings or as specified herein.
- B. All material required to provide a fully operational system but not specifically mentioned or shown on the drawings, shall be furnished and installed without any additional charge.
- C. The drawings and specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the drawings and specifications, the more stringent shall be included, and the engineer shall be notified of the discrepancy.
- D. **All structured cabling that is routed thru underground conduits shall be outside plant rated.**

1.04 WORK INCLUDED

The Communications Infrastructure installed and work performed under this Division of the Specifications shall include but are not limited to the following:

- A. Data Cabling Infrastructure
- B. Wireless Access System Cabling
- C. Communications raceways, cable tray, ladder rack, racks and equipment mounting backboards

D. Grounding and Bonding

1.05 DEFINITIONS

- A. Terms: The following definitions of terms supplement those of the General Requirements and are applicable to Division 27 - Communications:
- B. Provide: As used herein shall mean "furnish, install and test (if applicable) complete."
- C. Infrastructure: As used herein shall mean cable, conduit, raceway, cable tray or j-hooks with all required boxes, fittings, connectors, and accessories; completely installed.
- D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.

1.06 DRAWINGS

- A. Drawings are diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. The contractor shall carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, the contractor shall advise the engineer in writing for approval before proceeding with such work.
- B. Materials, equipment or labor not specifically indicated but required to form a complete system shall be provided. Drawings and Specifications do not indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- C. The right is reserved to make reasonable changes in locations of equipment indicated on drawings prior to rough-in without increase in contract cost.
- D. The contractor shall not reduce the size or number of conduit runs indicated on the drawings without the written approval of the Engineer.
- E. Any work installed contrary to contract drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.
- F. The location of equipment, support structures, outlets, and similar devices shown on the drawings are approximate only. Do not scale drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on communications plans.
- G. Verify the ceiling type, ceiling suspension systems, and clearance above ceilings prior to ordering cabling and associated hardware. Notify the engineer of any discrepancies.
- H. Review all architectural drawings for modular furniture layouts.

1.07 SUBMITTALS

- A. Submit for approval, manufacture specifications of all materials, equipment and systems to be furnished. Work shall not proceed without the Engineer's approval of the submitted items. Three (3) copies of the following shall be submitted:
 - 1. Submittal specification sheets for individual items for equipment assemblies that consist of more than one item or component shall be submitted. Each specification sheet shall be reviewed and sealed by contractors RCDD. Partial or incomplete submittals will not be considered, reviewed or stored, and such submittals will not be returned except at the request and expense of the contractor.
 - 2. Contractor shall generate shop drawings. Modify reviewed and accepted shop drawings to include revisions based upon completion of work. Submit shop drawings with record drawings on hard copy. Additionally, provide one electronic copy of shop drawings in both AutoCad format (.dwg file) and Visio format(.vsdx file). Failure to submit electronic file with drawings will be grounds for immediate rejection.

3. Shop drawings shall include equipment racks, patch panels, termination blocks, connection details, rack mounting details and any other details not included in the construction drawings. All Submittal drawings shall be prepared and sealed by the contractors RCDD for approval.
- B. Any materials and equipment listed that are not in accordance with specification requirements may be rejected.
- C. The approval of material, equipment, systems and shop drawings is a general approval subject to the drawings, specifications and verification of all measurements at the job. Approval does not relieve the Contractor from the responsibility of shop drawing errors. The contractor shall carefully check and correct all shop drawings prior to submission for approval.

1.08 QUALITY ASSURANCE

- A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.
- B. Equipment shall bear labels attesting to Underwriters Laboratories, where subject to label service. Manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

1.09 CONTRACTOR QUALIFICATIONS

- A. The contractor shall have total responsibility for the coordination and installation of the work shown and described in the drawings and specifications. The contractor shall be a company specializing in the design, fabrication and installation of integrated communications systems.
- B. Communication systems specified shall be installed under the direction of a qualified Contractor. Qualification requirements shall include submittal by the contractor to the engineer of the following:
 1. List of five [5] previous projects of this scope, size and nature; including names and sizes of projects, description of work, time of completion and names of contact persons for reference.
 2. Certification of contractor's manufacturer-authorization to provide material, perform installation and provide a minimum 25 year manufactures warranty for work to be performed under this contract. This must be provided with submittals for approval.
- C. Contractor must have a Registered Communications Distribution Designer (RCDD) on staff. This individual must be a W-2 employee of data contractor. Various types RCDD contractors are not allowed for this project.
- D. Submit copy of contractor's RCDD Certificate and resume for verification and approval at time of submittal.
- E. All submittal documentation shall be prepared, sealed and signed by the contractors RCDD for approval.
- F. Contractor shall have a certified BICSI Technician present at all times during the installation and/or testing of the entire Structured Cabling System.
- G. Contractor must have an office regularly staffed on a daily basis with certified service and installation technicians within a 75 mile radius of the project site.

1.10 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate communications work with that of other sections as required ensuring that the entire communications work will be carried out in an orderly, complete and coordinated fashion.

1.11 PERMITS

- A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

PART 2 - PRODUCTS

2.01 SUBSTITUTIONS

- A. Where equipment is identified by manufacturer and catalog number, it shall be as the base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Contractor may submit for approval, similar equipment of other manufacturers as substitution. The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.
- B. All changes necessary to accommodate the substituted equipment shall be made at the contractor's expense and shall be as approved by the Engineer. Detailed drawings indicating the required changes shall be submitted for approval at the time the substitution is requested.
- C. If substitutions are made in lieu of devices specified; form, dimension, design and profile shall be submitted to the Engineer for approval.
- D. Submit request for approval of substitute materials in writing to the Engineer at least ten (10) days prior to bid opening for review.

2.02 MATERIALS

- A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.
- B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.
- C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.
- E. Components shall be compatible with each other and with the total assembly for the intended service.

PART 3 - EXECUTION

3.01 EXAMINATION OF CONDITIONS

- A. Prior to the start of work, the Contractor shall carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.

- B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
- C. In the event of a discrepancy, immediately notify the engineer in writing.
- D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

3.02 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.
- B. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.
- C. As determined by the engineer, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the contract documents.
- D. Damaged paint on any equipment or material shall be repainted to the same quality of paint, color, finish and workmanship as used by the manufacturer.

3.03 ACCESS TO EQUIPMENT

- A. Equipment shall be installed in a location and manner that will allow convenient access for maintenance and inspection.
- B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.
- C. Where the engineer determines that the contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the engineer, at no additional cost to the Owner. "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 duct work.

3.04 CLEANING

- A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of all packing material and debris caused by communications work.
- B. Remove dust and debris from interiors and exteriors of all communications equipment.

3.05 COMPLETION

- A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.
- C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this specification shall be delivered to the Owner.

PART 4 – HORIZONTAL CABLING

4.01 APPROVED PRODUCTS

- A. Approved Horizontal Copper Cable Manufacturer(s)
 - 1. Berk-Tek

2. Systimax
3. Hitachi

4.02 HORIZONTAL COPPER CABLE

- A. 100 OHM Category 6 Balanced Twisted Pair Cable
 1. The horizontal balanced twisted pair cable shall meet or exceed the Category 6 transmission characteristics per issue of ANSI/TIA-568-C.2.
 2. Cable jacket shall be CMR or CMP rated (according to the space it occupies).
 3. All Category 6 cabling shall be equal to Berk-Tek LANmark-2000 Enhanced Category 6 cabling
 4. Jacket color shall be:
 - A. Blue Category 6 cabling for Data.
 1. Berk-Tek Part #10136226
 2. Systimax Part #8773614/10
 3. Hitachi Part #30237-8-BLY
 - B. Green Category 6 cabling for Wireless Access Points.
 1. Berk-Tek Part #10136748
 2. Systimax Part #8774114/10
 3. Hitachi Part #30237-8-GRY

4.03 HORIZONTAL CABLES

- A. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
- B. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- C. Cable raceways shall not be filled greater than the ANSI/TIA-569-B maximum fill for the particular raceway type.
- D. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
- E. Riser rated cable shall be installed in metallic conduit when installed in a plenum space.
- F. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in an enclosure intended and suitable for the purpose.
- G. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.
- H. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of 48 to 60 inch (1.2 to 1.5 meter) intervals. At no point shall cable(s) rest on acoustic ceiling grids, conduit, pipes, duct work or panels.
- I. Horizontal distribution cables shall be bundled in groups of no more than 50 cables. Cable bundle quantities in excess of 50 cables may cause deformation of the bottom cables within the bundle and degrade cable performance.
- J. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes or other control devices.
- K. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, the Contractor shall install appropriate carriers from the building structure to support the cabling.
- L. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the Contractor prior to final acceptance at no cost to the Owner.
- M. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/TIA-568-C.2 document, manufacturer's recommendations and best industry

- practices.
- N. Leave a minimum of 12" of slack for twisted pair cables at the outlet. Cables shall be coiled in the outlet box, surface-mount box or modular furniture raceway if adequate space is present to house the cable coil without exceeding the manufacturers bend radius. Excess slack shall be loosely coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
 - O. Cables shall be neatly bundled and dressed to their respective termination device. Each terminating device shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
 - P. Each cable shall be clearly labeled on the cable jacket behind the termination device at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

PART 5 – BACKBONE FIBER OPTIC CABLING

5.01 APPROVED PRODUCTS

- A. Approved Optical Fiber Backbone Cable (Inside Plant) Manufacturer(s)
 - 1. Berk-Tek 12 Strand OM3 Interlocked Armored Plenum Rated.
 - 2. Systimax 12 Strand OM3 Interlocked Armored Plenum Rated.
 - 3. Hitachi 12 Strand OM3 Interlocked Armored Plenum Rated.
- B. Approved Optical Fiber Backbone Cable (Outside Plant) Manufacturer(s)
 - 1. Berk-Tek 12 Strand OM3 Loose Tube Outside Plant
 - 2. Systimax 12 Strand OM3 Loose Tube Outside Plant
 - 3. Hitachi 12 Strand OM3 Loose Tube Outside Plant

5.02 OPTICAL FIBER BACKBONE CABLE (INSIDE PLANT)

- A. Indoor Distribution 50/125 Multimode Optical Fiber Conductive Plenum (OFCP) Tight Buffer Cable (OM3)
 - 1. Generic Characteristics
 - A. The indoor optical fiber cable shall be available with up to twelve 900-micron fibers placed with aramid strength elements.
 - B. The indoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
 - C. The indoor optical fiber cable shall have sequential length marking printed on the cable jacket.

5.03 OPTICAL FIBER BACKBONE CABLE (OUTSIDE PLANT)

- A. Outdoor 50/125 Multimode Optical Fiber Non Conductive (OFNR) Loose Tube Cable (OM3)
 - 1. Generic Characteristics
 - A. The indoor/outdoor optical fiber cable with up to twelve 250-micron coated fibers placed in a color-coded sub-unit bundle with moisture-blocking gel.
 - B. The indoor/outdoor optical fiber cable shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
 - C. The indoor/outdoor optical fiber cable shall have sequential length markings printed on the cable jacket.

5.04 OPTICAL FIBER CONNECTOR ASSEMBLIES

A. Multimode Fiber Connectivity

1. The optical fiber connectors shall be factory terminated LC for installation onto multimode 50/125-micron fiber.
2. The optical fiber connectors shall meet or exceed the performance criteria found in ANSI/TIA-568-C.3.
3. The optical fiber connectors shall be compatible with 900-micron buffered fibers or 250-micron loose-tube fibers.
4. All multimode fiber pigtail assemblies shall be installed by fusion splicing method only (No Exceptions).
5. All fiber enclosures shall be equipped with slack storage trays or slack management spools.
6. The loss of each connector shall not exceed 0.75 dB.
7. The fiber adapter panels shall be type LC.
8. The optical fiber adapter module that occupies the fiber patch panel shall be equipped with zirconia ceramic sleeve.
9. Multimode fiber connector boot color shall be Beige.

5.05 APPROVED OPTICAL FIBER CONNECTORS

A. Optical Fiber Connectors

1. Provide LC type

B. Optical Fiber Adapter Panels

1. Provide LC type.

5.06 BACKBONE FIBER OPTIC CABLES (INSIDE PLANT)

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.
- B. Backbone cables shall be installed separately from horizontal distribution cables
- C. A plastic or nylon pull cord with a minimum test rating of 90 Kg (200 lb.) shall be co-installed with all cable installed in any conduit.
- D. Where cables are housed in conduits, the backbone and horizontal cables shall be installed in separate conduits
- E. Exposed cables must be OFCP rated if installed in an air return plenum. Riser rated cables shall be installed in metallic conduit if installed in an air return plenum.
- F. Where backbone cables and distribution cables are installed in a cable tray or wire way, backbone cables shall be installed first and bundled separately from the horizontal distribution cables.
- G. Leave 10' of slack on each end of fiber backbone cable.
- H. Backbone cables spanning more than three floors shall be securely attached at the top of the cable run with a wire mesh grip and on alternating floors or as required by local codes.
- I. Vertical runs of cable shall be supported to messenger strand, cable ladder, or other method to provide proper support for the weight of the cable.
- J. Large bundles of cables and/or heavy cables shall be attached using metal clamps and/or metal banding to support the cables.
- K. The cable's minimum bend radius and maximum pulling tension shall not be exceeded. Refer to manufacturer's requirements.

- L. Each optical fiber cable shall be individually attached to the respective enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- M. Each optical fiber cable shall be clearly labeled at the entrance to the enclosure. Cables labeled within the bundle shall not be acceptable.
- N. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- O. A maximum of 24 strands of fiber shall be spliced in each tray
- P. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

5.07 BACKBONE FIBER OPTIC CABLES (OUTSIDE PLANT)

- A. All OSP cables brought to the Entrance Facilities shall have 15ft of slack coiled and secured to the wall in the proximity of the fiber enclosure.
- B. All cables shall be tagged and identified within each hand-hole/maintenance hole.
- C. Place initial cables in bottom conduits to facilitate easy subsequent cable placement.
- D. Place leader guard in the duct before placing cable to prevent damaging the cable sheath on the sharp edge of the duct.
- E. Ventilate maintenance where gas has been detected before entering the maintenance hole.
- F. To ensure that the optical fiber cable's qualities and characteristics are not degraded during installation, excessive pulling tensions and short bending radii will not be allowed. The maximum pulling tension is 600 lbs. The minimum bending radius for cable under tension is 20 times the outside diameter of the cable and for cable at rest is 10 times the outside diameter of the cable.
- G. A 600 lb. break-away swivel, along with a slip clutch capstan winch that shows the dynamometer (pulling tension) reading, shall be used at all times during pulling.
- H. Reels shall be continuously manned during cable installation.
- I. Cable coils shall have at least two points of support on the optical fiber racking system.
- J. When mounting the optical fiber slack coils, the minimum bend radius shall not be exceeded; this radius is equal to 10 times the outside diameter of the cable in a static application and 20 times the outside diameter in a dynamic application. At any time during the entire handling process of the optical fiber cable, as much care as possible should be maintained and all the manufacturer's recommendations should be followed.

5.08 OPTICAL FIBER CONNECTIVITY / SPLICING

- A. Optical fiber connectors shall be installed as per the requirements specified by the manufacturer's installation guidelines.
- B. All splicing shall be of the fusion type made under Light Injection and Detection Mode. The Contractor shall provide certified and experienced personnel for splicing.
- C. Contractor's tools and equipment shall be in excellent working order. Any worn or improperly working tools shall be discarded and not used on this project. All fusion splicers shall be calibrated and labeled according to the manufacturer's specifications. Contractor shall submit certification of calibration for the fusion splicers to the Engineer.

PART 6 – FACEPLATES AND CONNECTORS

6.01 APPROVED PRODUCTS

- A. Approved Copper Connectivity Manufacturer(s)
 - 1. Leviton
 - a) Cat 6 8P8C Connector Blue-Data Part #61110-RL6
 - b) Cat 6 8P8C Connector Green-WAP Part #61110-RV6

2. Systemax
 - a) Cat 6 8P8C Connector Blue-Data Part #2291216-6
 - b) Cat 6 8P8C Connector Green-WAP Part #2291216-9
3. Hubbell
 - a) Cat 6 8P8C Connector Blue-Data Part #HXJ6B
 - b) Cat 6 8P8C Connector Green-WAP Part #HXJ6GN

B. Approved Faceplate Manufacturer(s)

1. Leviton
 - a) 4 Port Stainless Steel Faceplate Part #43080-1L4
2. Systemax
 - a) 4 Port Stainless Steel Faceplate Part #M14SP-L
3. Hubbell
 - a) 4 Port Stainless Steel Faceplate Part #SSFL14

C. Approved Surface Mount Box Manufacturer(s)

1. Leviton 2 Port Surface Mount Housing Part #41089-2WP
2. Systemax 2 Port Surface Mount Housing Part #M102SMB-B-262
3. Hubbell 2 Port Surface Mount Housing Part #ISB2W

6.03 COPPER CONNECTIVITY

A. Voice/Data Jacks

1. Category 6, 8-Position, 8-Contact (8P8C) Modular Jack
 - A. The connector module shall meet or exceed the Category 6 performance criteria per ANSI/TIA-568-C.2.
 - B. The eight-position connector module shall accommodate six-position modular plug modular cords without damage to either the cord or the module.
 - C. The connector module shall be designed for use at the work area (WA), communications room (TR) and/or equipment room (ER) without modification.
 - D. The connector module shall be available in both the T568A and T568B wiring configurations within the same module.
 - E. The connector module shall have an insulation displacement connection featuring insulation slicing of 22 to 24 AWG plastic-insulated solid copper conductors forming a gas-tight connection.
 - F. Jack/Icon colors shall be:
 1. Blue for Data
 2. Green for Wireless Access Points

6.04 FACEPLATES

A. Faceplates

1. The faceplate housing the connector modules shall have no visible mounting screws.
2. The faceplate shall have a labeling capability using built-in labeling windows, to facilitate outlet identification and ease network management.
3. The faceplate shall provide flexibility in configuring multimedia workstation outlets that respond to present or future network application needs.
4. Each faceplate shall have a minimum of (4) ports per each outlet location. Each unpopulated port shall have a blank module installed that matches the color of

the faceplate.

5. Faceplates shall be stainless steel unless noted otherwise. All faceplates shall match electrical outlet covers. Verify color and size of each faceplate prior to ordering.

6.05 SURFACE MOUNT BOXES

- A. The surface mount box shall be sized to accommodate the quantity of outlets per each location as required.
- B. A surface mount box shall be provided at each of the following locations: Projector, Wireless Access Point and/or any outlet location serving a ceiling mounted device.
- C. Provide a minimum of 15ft of slack at each ceiling mounted outlet location. Slack loop shall be coiled up neatly and placed on a j-hook to support cable.
- D. Verify location with owner prior to mounting.

6.06 COPPER CONNECTIVITY

- A. 8-position, 8-contact (8P8C) modular jacks shall be installed in accordance with manufacturer's recommendations and installation guides, and best industry practices.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. All outlet locations shall have color-coded 8P8C modular jacks installed. No cable shall be left unterminated.

6.07 FACEPLATES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.
- C. Faceplates shall be installed straight and level.
- D. Faceplates shall be installed at the same heights as electrical outlets.

6.08 SURFACE MOUNT BOXES

- A. Blank inserts shall be installed where ports are not used.
- B. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation.
- C. Surface mount boxes shall be installed straight and level.
- D. Surface mount boxes shall be installed in an accessible area.

PART 7 – PATCH PANELS AND FIBER OPTIC ENCLOSURES

7.01 APPROVED PRODUCTS

- A. Approved Patch Panel Manufacturer(s)
 1. Leviton
 - a) 24 Port Patch Panel Part #49255-L24
 - b) 48 Port Patch Panel Part #49255-L48
 2. Systemax
 - a) 24 Port Patch Panel Part #M2000-1U
 - b) 48 Port Patch Panel Part #M2000-2U
 3. Hubbell
 - a) 24 Port Patch Panel Part #UDX24E
 - b) 48 Port Patch Panel Part #UDX48E
- B. Approved Optical Fiber Enclosure Manufacturer(s)

1. Leviton
 - a) 1RU Rack Mount Fiber Enclosure Part #5R1UM-S03
 - b) 2RU Rack Mount Fiber Enclosure Part #5R1UM-S06
 - c) 4RU Rack Mount Fiber Enclosure Part #5R1UM-F15
 2. Systimax
 - a) 1RU Rack Mount Fiber Enclosure Part #760147439
 - b) 2RU Rack Mount Fiber Enclosure Part #760147447
 - c) 4RU Rack Mount Fiber Enclosure Part #760147454
 3. Hubbell
 - a) 1RU Rack Mount Fiber Enclosure Part #FCR1U3SP
 - b) 2RU Rack Mount Fiber Enclosure Part #FCR2U6SP
 - c) 4RU Rack Mount Fiber Enclosure Part #FCR4U15SP
- C. Approved Termination Block Manufacturer(s)
1. Leviton
 2. Systimax
 3. Hubbell
- D. Category 6 Patch Panel
1. The Category 6 patch panel shall be compatible with 19" equipment racks, cabinets or wall mount brackets.
 2. The Category 6 patch panels shall be 24 or 48 port unloaded patch panels.
 3. The Category 6 patch panels shall be sized to accommodate one port for each cable installed plus 25% spare capacity for future growth. All ports shall be filled with a removable 8-position color coded modular jacks for each system. No port shall be left empty or blank.
 4. The Category 6 patch panel shall be equipped with removable 8-position modular jacks color coded for each system and shall allow for termination of both T568A and T568B wiring schemes.
 5. Data and WAP cabling shall not occupy the same patch panel. All cabling for each system shall be installed in separate patch panels with color coded modular jacks to match as specified.
 6. The Category 6 patch panel shall be equipped with front labeling windows to facilitate port identification.
 7. The connector module shall meet or exceed the Category 6 performance criteria per ANSI/TIA-568-C.2.

7.02 OPTICAL FIBER PANELS/ENCLOSURES

- A. Rack Mount Optical Fiber Enclosure
1. The rack mount optical fiber enclosure shall be equipped with a sliding drawer to access fibers.
 2. The rack mount optical fiber enclosure shall be capable of terminating tight-buffered or loose tube optical fiber cable.
 3. The rack mount optical fiber enclosure shall provide for bend radius control throughout the panel as well as storage space for slack cabling.
 4. The panel/enclosure shall meet or exceed the performance criteria per ANSI/TIA-568-C.3.
 5. The rack mount optical fiber panel/enclosure shall be equipped with optical fiber cassettes.
 - A. The optical fiber adapter panels shall accommodate multimode terminated optical fiber.

- B. The optical fiber adapter panels shall be compatible with ST OM1 connectors.
- C. Multimode adaptors shall be beige in color and equipped with zirconia ceramic sleeves.

7.03 PATCH PANELS

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practice.
- B. Pair untwist at the termination shall not exceed 13 mm (0.5 inch).
- C. Bend radius of the cable in the termination area shall not exceed 4 times the outside diameter of the cable.
- D. Cables shall be neatly bundled and dressed to their respective patch panel. Each patch panel shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
- E. Each cable shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support ties. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.

7.04 OPTICAL FIBER PANELS/ENCLOSURES

- A. Cables shall be dressed and terminated in accordance with the recommendations made in ANSI/TIA-568-C.0 and/or ANSI/TIA-568-C.1, manufacturer's recommendations and best industry practices.
- B. Each cable shall be individually attached to the respective splice enclosure by mechanical means. The cables strength member shall be securely attached the cable strain relief bracket in the enclosure.
- C. Bend radius of the optic fiber cable in the enclosure shall not exceed 10 times the outside diameter of the cable.
- D. Each fiber bundle shall be stripped upon entering the splice tray and the individual fibers routed in the splice tray.
- E. Each cable shall be clearly labeled at the entrance to the splice enclosure. Cables labeled within the bundle shall not be acceptable.
- F. A maximum of 24 strands of fiber shall be spliced in each tray
- G. Fiber slack shall be neatly coiled within the fiber splice tray or enclosure. No slack loops shall be allowed external to the fiber panel.

PART 8 – PATCH CORDS

8.01 APPROVED PRODUCTS

- A. Approved Copper Patch Cord Manufacturer(s)
 - 1. Leviton
 - a) Cat 6 Patch Cord Blue-Data Part #62460-XXL
 - b) Cat 6 Patch Cord Green-WAP Part #62460-XXG
 - 2. Systimax
 - a) Cat 6 Patch Cord Blue-Data Part #UNC6-BL
 - b) Cat 6 Patch Cord Green-WAP Part #UNC6-GR
 - 3. Hubbell
 - a) Cat 6 Patch Cord Blue-Data Part #HC6BXX
 - b) Cat 6 Patch Cord Green-WAP Part #HC6GNXX
- B. Approved Fiber Patch Cord Manufacturer(s)

1. Leviton
 - a) ST to LC OM1 Fiber Patch Cord Part #62STL-MXX
2. Systemax
 - a) ST to LC OM1 Fiber Patch Cord Part #FEMSTLC32BXM1X
3. Hubbell
 - a) ST to LC OM1 Fiber Patch Cord Part #DFRCLCSTCXMM

8.02 COPPER PATCH CORDS

A. Category 6 Patch Cords

1. Copper patch cords shall be installed as per the requirements specified by the manufacturer's installation guidelines.
2. The Category 6 patch cord shall be 4-pair, with 24 AWG solid or stranded copper conductors and 8-position modular plug.
3. The Category 6 modular cord cable shall be UL Listed as Type CMR.
4. The Category 6 patch cord shall meet or exceed the requirements of ANSI/TIA-568-C.2.
5. Lengths shall be 3', 5', 7' and/or 10' as required by the Owner.
6. Provide one patch cord for every cable installed that will be utilized for patching between patch panel and switches. Verify length and color with Owner prior to ordering.
7. Provide one patch cord for every cable installed at each work area outlet. Verify length and color with Owner prior to ordering.
 - A. The Category 6 patch cord color for Data shall be: Blue
 - B. The Category 6 patch cord color for Wireless Access Points shall be: Green

8.03 FIBER PATCH CORDS

- ### A. 62.5/125-Micron 850nm Multimode Fiber Patch Cord (OM1)
- A. Fiber patch cords shall be installed as per the requirements specified by the manufacturer's installation guidelines.
 - B. The 62.5/125-micron fiber used in the multimode fiber patch cord shall have a maximum attenuation of 3.0dB/km@ 850 nm and 1.0 dB/km @1300 nm.
 - C. The 62.5/125-micron 850nm laser optimized multimode fiber patch cord shall meet or exceed the requirements of ANSI/TIA-568-C.3.
 - D. The optical fiber cord connector shall be ST to LC duplex.
 - E. The multimode fiber cord assembly shall be dual zip jacketed.
 - F. Lengths shall be 1m, 2m, and/or 3m as required by the application.
 - G. Provide a minimum of (6) OM1 ST to LC fiber optic patch cords per each IDF and a minimum of (72) OM1 ST to LC fiber optic patch cords in the MDF. Verify length with Owner prior to ordering.

PART 9 – EQUIPMNET RACKS AND ENCLOSURES

9.01 APPROVED PRODUCTS

A. Approved Equipment Rack/Cabinet Manufacturer(s)

1. Chatsworth Products, Inc.
 - a) 2-Post Floor Mounted Equipment Rack Part #48353-703
 - b) 4-Post Adjustable Server Rack Part #15213-703
2. Hoffman

- a) 2-Post Floor Mounted Equipment Rack Part #EDR19FM45U
 - b) 4-Post Floor Mounted Server Rack Part #E4DRS19FM45U
 - c) Wall Mount Equipment Rack Part #E19SWM25U24
3. Middle Atlantic

9.02 EQUIPMENT RACKS/CABINETS

A. Equipment Racks

- 1. The equipment rack shall be constructed of high strength, lightweight aluminum.
- 2. The vertical rails of the equipment rack shall be equipped with the EIA hole pattern.
- 3. 2 Post rack shall be: 7'H x 19"W floor mounted. Vertical channels shall be drilled and taped.
- 4. 4 Post rack shall be: 7'H with adjustable depth of 26-inches to 38-inches. Vertical channels shall have square punched mounting holes. Provide additional equipment mounting hardware, per each rack installed, to owner upon completion of the installation.
- 5. Provide a minimum of (50) 12X24 cage nuts with (50) 12X24 rack screws per each 4-Post rack and a minimum of (50) 12X24 rack screws per each 2-Post or wall mount rack provided/installed.
- 6. Rack color shall be black.

9.03 EQUIPMENT RACKS/CABINETS

- A. Equipment racks shall be securely attached to the concrete floor using minimum 3/8" hardware or as required by local codes.
- B. Equipment racks shall be installed as per the requirements specified by the manufacturer's installation guidelines.
- C. Equipment racks shall be placed with a minimum of 36-inch clearance from each of the corresponding walls: front, rear and one side of the rack or as indicated on Drawings.
- D. All equipment racks shall be grounded to the telecommunications ground bus bar.
- E. Mounting screws not used for installing patch panels and other hardware shall be bagged and left with the rack or turned over to the owner upon completion of the installation.

9.04 BACKBOARDS

- A. Backboards shall be 3/4" void free plywood. Size of backboard shall be 4' x 8' mounted vertically 18" A.F.F. unless otherwise noted differently on Drawings. Backboards shall be painted with two (2) coats of gray fire-retardant paint.

PART 10 – CABLE MANAGEMENT AND LADDER RACK

10.01 APPROVED PRODUCTS

A. Approved Horizontal Cable Management Manufacturer(s)

- 1. Chatsworth Products, Inc.
 - a) 2RU Horizontal Cable Manager Part #35441-702
- 2. Leviton
 - a) 2RU Horizontal Cable Manager Part #492RU-HFR
- 3. Systimax Equal
- 4. Hubbell Equal

B. Approved Vertical Cable Management Manufacturer(s)

1. Chatsworth Products, Inc.
 - a) 6" Vertical Cable Manager Part #35521-703
 - b) 8" Vertical Cable Manager Part #35522-703
2. Leviton
 - a) 6" Vertical Cable Manager Part #4980L-VFR
 - b) 8" Vertical Cable Manager Part #8980L-VFR
3. Systimax Equivalent
4. Hubbell Equivalent

C. Approved Ladder Rack System Manufacturer(s)

1. Chatsworth Products, Inc.
 - a) 12" Ladder Rack Part #11275-712
 - b) 18" Ladder Rack Part #11275-718
2. Hoffman
 - a) 12" Ladder Rack Part #LSS12BLK
 - b) 18" Ladder Rack Part #LSS18BLK
3. Middle Atlantic

D. Approved Tie Wrap/Velcro Strap Manufacturer(s)

1. Leviton
2. Or Approved Equal

10.02 CABLE MANAGEMENT - HORIZONTAL

A. Horizontal Cable Management

1. The horizontal wire manager shall be compatible with 19-inch equipment racks, cabinets or wall mount brackets.
2. The horizontal cable manager shall be double-sided to provide support/management for patch cords at the front of the panel and support/management of cables at the rear of the panel.
3. The horizontal cable manager shall be equipped with removable front and covers
4. The horizontal cable manager shall be 2 rack-units in height, installed above and below each patch panel and each switch as indicated on drawings.
5. Horizontal cable managers shall be black.

10.03 CABLE MANAGEMENT - VERTICAL

A. Vertical Cable Management

1. The vertical cable manger shall be 80" high double-sided, installed on both sides of all racks.
2. The vertical cable manager shall provide support/management for patch cords at the front of the rack and support/management of cables at the rear of the rack.
3. Vertical cable managers shall be installed on both sides of a single equipment rack. Where two (2) or more racks are positioned in a row, vertical cable managers shall be installed between each rack and each end of the row.
4. The vertical cable manager shall be a minimum width of 6".
5. Vertical cable manager color shall be black.

10.04 LADDER RACK

A. Ladder Rack System

1. See Drawings for ladder rack system details.
2. The ladder rack system shall be securely mounted with hardware (triangle brackets, top mounting plates, junction splice kits, butt splice kits, end caps, radius drop kits, etc.) designed for use with ladder rack systems per manufactures recommendations.
3. Ladder rack shall be 12" or 18" wide as indicated on drawings.
4. End caps shall be installed on the exposed ends of the ladder racks and channel supports. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
5. All sections of ladder rack shall be properly grounded to the corresponding telecommunications ground bus bar in each communications room.
6. Ladder Rack System color shall be black.

10.05 TIE WRAPS AND VELCRO STRAPS

A. Tie Wraps and Velcro Straps

1. Tie wraps/Velcro straps installed in air handling spaces must be plenum rated.
2. Backbone cables shall be fastened to support structures with tie wraps/Velcro straps.
3. Horizontal cables shall be fastened to support structures with Velcro straps.
 - A. Tie Wraps shall be plenum rated red in color.
 - B. Velcro Strap color shall be black.
4. Tie wraps/Velcro straps shall be installed around cables at intervals of 12" minimum.
5. Tie wraps shall secure cables to ladder racks using an "X" pattern.
6. Do not over-cinch cables.

10.06 D-RINGS

A. D-rings

1. D-Rings shall be used on backboards to support cables, patch cords and cross-connect wire.
2. D-Rings shall be made of high-strength, fire-retardant material with rounded edges to prevent damage to cable and wire insulation.
3. Provide D-Rings of appropriate size and quantity for proper cable management and support as required.
4. D-Rings shall be installed on 3/4" backboard, straight and level.

10.07 LADDER RACKS

- A. Ladder rack system shall be installed straight, level and perpendicular to walls and ceiling slabs.
- B. Ladder racks shall be supported at 4' intervals maximum.
- C. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete ladder rack system.
- D. Provide ladder rack system at minimum on (2) adjacent walls in each communications room or as indicated on drawings.
- E. See Drawings for ladder rack system details.

PART 11 – PATHWAYS

11.01 APPROVED PRODUCTS

- A. Approved Cable Tray System Manufacturer(s)
 - 1. Hoffman Quick Tray Pro Part #QTP4X18
 - 2. Wire Basket Tray Part #WBT4X18
 - 3. Or Approved Equal

- B. Approved Cable Hanger Manufacturer(s)
 - 1. Erico Products – Caddy HP Series
 - 2. Hoffman
 - 3. Or Approved Equal

11.02 COMMUNICATIONS OUTLET BOXES

- A. Outlet boxes and device covers shall be galvanized steel not less than 1/16" thick.
- B. The dimensions of the outlet box shall be 4" x 4" square with a minimum depth of 2-1/8".
- C. Outlet boxes shall be equipped with single gang device covers. Where installed in plaster, gypsum board, etc., covers shall be raised to compensate for the thickness of the wall finish.
- D. Where outlet boxes are to be empty for future use, blank cover plates shall be used.

11.03 CABLE TRAY

- A. Cable Tray System
 - 1. Cable tray shall be aluminum construction.
 - 2. Cable tray cross members shall be factory welded at 12" intervals maximum.
 - 3. Cable tray shall be equipped with one (1) or two (2) support rails that run the length of each segment.
 - 4. End caps shall be installed on the exposed ends of the cable tray, channel supports and bolts. Protective covers shall be installed on threaded rods that come in contact with cabling plant.
 - 5. Wall mount cable tray used in limited clearance areas shall be hook style and constructed of aluminum.
 - 6. Provide all cable tray hardware accessory assemblies required to properly install cable tray system per manufactures requirements.
 - 7. See Drawings for cable tray dimensions.

11.04 CABLE HANGERS

- A. J-Hooks
 - 1. J-hooks shall provide sufficient width to comply with required bend radii of high-performance cables. J-hook shall be cULus Listed.
 - 2. J-hooks shall have flared edges to prevent damage while installing cables.
 - 3. J-hooks sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.

11.05 CABLE TRAY SYSTEM

- A. Install trays in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of the NEC.
- B. All open trays shall be installed a minimum of six (6) inches away from any light fixture.
- C. Provide external grounding strap at expansion joints, sleeves, crossover and other locations where tray continuity is interrupted.
- D. Support all pathways from building structure. Do not support pathways from ductwork, piping or equipment hangers.
- E. Install cable tray level and straight.
- F. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete cable tray system.
- G. Cable trays shall not be used to house both low voltage and power cables unless cables are separated by a grounded physical barrier.
- H. Cable tray system shall be grounded in accordance with ANSI/TIA-607-B.

11.06 CABLE HANGERS

- A. Installation and configuration shall conform to the requirements of ANSI/TIA-568-C.0, ANSI/TIA-568-C.1 & ANSI/TIA-569-B, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- B. Install cables using techniques, practices, and methods that are consistent with Category 6 or higher requirements and that supports Category 6 or higher performance of completed and linked signal paths, end to end.
- C. Install cables without damaging conductors, shield, or jacket.
- D. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- E. Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.
- F. Do not exceed load ratings specified by manufacturer.
- G. Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- H. To avoid electromagnetic interference (EMI), pathways shall provide minimum clearances of four feet from motors or transformers, one foot from conduit and cables used for electrical power distribution, and five inches from fluorescent lighting. Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.

PART 12 – GROUNDING AND BONDING

12.01 APPROVED PRODUCTS

- A. Approved Grounding Lug Manufacturer(s)
 - 1. Harger
 - a) 2 Hole Compression Lugs Part #GECLB62A
 - 2. Hoffman
 - a) 2 Hole Compression Lugs Part #DGCL61
 - 3. Or Approved Equal

- B. Approved Grounding Busbar Manufactures(s)
 - 1. Harger
 - a) Wall Mount TMGB Ground Bar Part #GB14412TMGB
 - b) Wall Mount TGB Ground Bar Part #GB14212TGB
 - c) Rack Mount Ground Bar Part #RGBHKIT14119.25
 - 2. Hoffman
 - 3. Or Approved Equal

- C. Approved OSP Cable Shield Bond Connector Manufacturer(s)

1. 3M
 - a) Shield Bond Connector Part #4460-S
2. Or Approved Equal

12.02 GROUNDING CONDUCTORS

A. Grounding Conductor

1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL listed jacket is applied.
2. Jacket color shall be green.

12.03 GROUNDING LUGS

A. Grounding Lugs and Hardware

1. Grounding lugs shall be 2-hole compression type irreversible. Stainless steel bolts and washers shall be used to install lugs to equipment and grounding bus bars.

12.04 GROUNDING BUSBARS

A. Grounding Busbar

1. The grounding busbar shall be made of 1/4" thick solid copper.
2. The grounding busbar shall be installed with minimum clearance, 1" offsets and 1-1/2" insulators.
3. The grounding busbar shall accommodate 2-hole compression lugs.
4. The grounding busbar shall meet or exceed ANSI/TIA-607-B requirements.

12.05 GROUNDING

- A. The facility shall be equipped with a Telecommunications Bonding Backbone (TBB). This backbone shall be used to ground all communications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has the potential to act as a current carrying conductor. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA-607-B Telecommunications Bonding and Ground Standard.
- B. The main entrance facility/equipment room (EF/ER or MDF) in each building shall be equipped with a telecommunications main grounding busbar (TMGB). Each telecommunications room (TR or IDF) shall be provided with a telecommunications ground busbar (TGB). The TMGB shall be connected to the building electrical entrance grounding facility.
- C. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the EF, ER, or TR shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.
- D. All wires used for communications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA-606-A.

PART 13 - LABELING

13.01 LABELING REQUIREMENTS

- A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA-606-A document, manufacturer's recommendations and best industry practices.
- B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.
- C. All labels shall be clear with black text.
- D. All cables shall be labeled with machine generated, wrap around labels. Handwritten labels will not be accepted.
- E. A total of three (3) labels per horizontal cable are required at the following intervals: 6" from outlet; 18" from outlet' 12" from termination block/patch panel.
- F. Labeling scheme shall be alphanumeric. Verify labeling scheme requirements with Owner prior to installation.

PART 14 - TESTING

14.01 TESTING REQUIREMENTS

- A. General
 - 1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA-568-C.0, ANSI/TIA-568-C.1 and/or ANSI/TIA-1152. All conductors/strands of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors/strands in all cables installed.
- B. Copper Testing
 - 1. All twisted-pair copper cable links shall be tested for continuity, pair reversals, shorts, opens and performance as indicated below. Additional testing is required to verify Category 6 performance. Horizontal balanced twisted pair cabling shall be tested using a level IIe, III, or IV test unit for category 6 performance compliance.
 - 2. Continuity - Each pair of each installed cable shall be tested using a test unit that shows opens, shorts, polarity and pair-reversals, crossed pairs and split pairs. The test shall be recorded as pass/fail as indicated by the test unit and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
 - 3. Length - Each installed cable link shall be tested for installed length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the ANSI/TIA-568-C.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number. For multi-pair cables, the shortest pair length shall be recorded as the length for the cable.
- C. Fiber Testing
 - 1. All fiber testing shall be performed on all fibers in the completed end-to-end system. There shall be no splices unless clearly defined in the RFP and/or Drawings. These tests also include continuity checking of each fiber.

2. Multimode

- A. Test the optical fiber cable bi-directionally with an OTDR and uni-directionally with a power meter/light source. Fiber must be tested at both 850nm and 1300nm. Maximum attenuation dB/Km @ 850nm/1300nm shall be 3.5/1.5. Maximum attenuation per connector pair shall be .75 dB. Attenuation testing shall be performed with a stable launch condition using a one-meter or two-meter jumper, equipped with an built in Encircled Flux module provided by the test equipment manufacture, to attach the light source to the cable plant. The Encircled Flux jumper assembly shall remain connected to the light source after calibration and during all test measurements. Test set-up and performance shall be conducted in accordance with ANSI/TIA-568-C.3, TIA-TSB-4979 and to the manufacturer's application guides.
- B. All fiber optic stands shall be tested utilizing the "Method B" one jumper reference.

D. Coaxial Testing

- 1. Sweep testing of each reel of coaxial cable shall be performed over the 5 MHz through 1 GHz range by the cable manufacturer for transmission and structural return loss and be so certified in writing by the cable manufacturer.
- 2. Verification testing with a verification field test instrument will determine shorts, continuity, termination location and length of cable.
- 3. Approved testers are as follows:
 - 1. Fluke DTX
- 4. Signal strength measurement shall be performed with a field strength meter.
- 5. Signal level at each outlet will be +5 dBmv, + 3 dB.
- 6. Approved signal strength meters are as follows:
 - 1. Acterna
 - 2. Sadelco
 - 3. Promax

E. Test Results

- 1. Test documentation shall be provided on disk as part of the as-built package. The disk shall be clearly marked on the outside front cover with the words "Project Test Documentation," the project name, and the date of completion (month and year). The results shall include a record of test frequencies, cable type, conductor pair (or strand) and cable (or outlet) I.D., measurement direction, reference setup, and crew member name(s). The test equipment name, manufacturer, model number, serial number, software version and last calibration date will also be provided at the end of the document. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle will be required on all test equipment used for this installation. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
- 2. The field test equipment shall meet the requirements of ANSI/TIA-568-C.2, ANSI/TIA-568-C.3, and/or ANSI/TIA-1152.
- 3. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the Contractor may furnish this information in electronic form (CD). These CDs shall contain the electronic equivalent of the test results as defined by the Specification and be of a format readable from Microsoft Word.
- 4. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be

documented.

PART 15 – DOCUMENTATION, AS-BUILTS, TRAINING AND RECORDS

15.01 DOCUMENTATION & AS-BUILTS

- A. As-Built record documentation for communications work shall include:
 - 1. Cable routing and identification
 - 2. System function diagrams
 - 3. Manufacturers' description literature for equipment
 - 4. Connection and programming schedules as appropriate
 - 5. Equipment material list including quantities
 - 6. Spare parts list with quantities if required.
 - 7. Details not on original Contract Documents
 - 8. Test results
 - 9. Warranties
 - 10. Release of liens
- B. The Contractor shall provide and maintain at the site a set of prints which shall accurately show the actual installation of all work under this section, indicating any variation from contract drawings, including changes in pathways, sizes, locations and dimensions. All changes shall be clearly and completely indicated as the work progresses.
- C. Progress prints shall be available for inspection by the Owner or any of his representatives and may be used to determine the progress of communications infrastructure work.
- D. At the completion of the work, prepare a new set of as-built drawings, of the work as actually noted on the marked-up prints, including the dimensioned location of all pathways.
- E. Furnish as-built drawings and documentation to the Project Manager. As-built drawings shall be generated in AutoCad 2006 or later and Visio formats. Submit as-built drawings electronically on C.D. and hard copy.

15.02 OPERATIONS AND MAINTENANCE MANUAL

- A. After completion of the work, the Contractor shall furnish and deliver to the Engineer three (3) copies of a complete Operations & Maintenance Manual. A system wiring diagram shall be furnished for each separate system.
- B. The manual shall be subdivided into separate sections with tab dividers to identify subsystems of the integrated system. Reference appropriate Specification sections.
- C. Provide the following additional information for each electronic system. Information shall be edited for this project where applicable.
 - 1. Point-to-point diagrams, cabling diagrams, construction details and cabling labeling details

15.03 TRAINING

- A. The Contractor shall be responsible for training of facility personnel. Training shall take place after occupancy and before acceptance and shall include programs for on-site operations and maintenance of technology and communications systems. Training shall be held at the Owner's site and shall be of sufficient duration and depth to ensure that the trained personnel can operate the installed systems and can perform usual and customary maintenance actions.

15.04 WARRANTY

A. General

1. All equipment is to be new and warranted free of faulty workmanship and damage.
2. Replacement of defective equipment and materials and repair of faulty workmanship within 24 hours of notification, except emergency conditions (system failures), which must be placed back in service within eight (8) hours of notification, all at no cost to the Owner.
3. The minimum warranty provisions specified shall not diminish the terms of individual equipment manufacturer's warranties.

B. Voice & Data Structured Cabling

1. Manufacturer(s) shall provide a minimum 25-year warranty for components used in the installed Structured Cabling System. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.
2. Contractor shall provide a 1-year material, labor and workmanship warranty on all products installed under this contract against any defects. Defective and/or improperly installed products shall be replaced and/or correctly installed at no cost to the Owner.

END OF SECTION

SECTION 16851

SECURITY SURVEILLANCE VIDEO SYSTEMS

PART 1 GENERAL

1.1 The intent of this document is to specify the minimum criteria for the design, supply, installation, and commissioning of a digital surveillance system.

1.2 SCOPE OF WORK

All proposed equipment shall meet the minimum specifications detailed herein and shall consist of at least the following...

- A. The indoor and outdoor domes shall be of the same manufacture and shall have identical housing for aesthetical values. All domes shall use the same wall mount that orient the dome in a downward facing position. These cameras shall be powered with centralized multiple camera power supplied that provide isolated outputs.
- B. Digital Video Recorders is existing in main school and shall be expanded to add to recorder and new cameras via a fiber optic connection.

1.3 SUBMITTALS

- A. Submittals shall include manufacturer data sheets for all major system components.
- B. Submittals shall include a certificate provided by the manufacturer of proposed system proving that the installing company is an authorized dealer and installer for proposed system.
- C. Submittal shall include a certificate of factory training for installing technician(s) for proposed system.

1.4 MANUFACTURERS

- A. Alternate manufacturer's must submit 10-days prior to bids for approval and must show how they can successfully integrate new cameras into the existing DVR system.

1.5 QUALITY ASSURANCE

- A. The video system manufacturer shall be certified as being compliant with ISO9001.

1.6 CONTRACTOR QUALIFICATIONS

- A. The contractor for the security system specified shall have the following qualifications and shall submit documentary evidence of same with bid submittals:
 1. Contractor shall have a staff of factory trained technicians who are qualified to provide instructions, routine and emergency maintenance and repairs on all portions of systems. Staff shall be assigned on an all-call basis.
 2. A track record of successful completion of like projects for a minimum of 5 years. The contractor shall provide evidence of experience in successful design, installation and operation of integrated video systems.
 3. Documented evidence that the contractor is a certified installer and distributor of the products specified in this specification. A letter stating this on manufacturer's letterhead must accompany submittals.
 4. Contractor shall hold a current AESBL certificate. A copy of current AESBL certificate shall be included in bid submittal.
 5. Contractor shall maintain an office with factory trained service and installation personnel within 75 miles of project location.

PART 2 PRODUCTS

2.1 Inside Color rugged dome camera

- A. The Rugged Dome UVD-EVRDNR-VA2 or UVD-EVRDNR-VA9 shall be as manufactured by GE Security or an approved equal. The camera shall produce high-resolution color images and be contained in a heavy-duty, weatherproof dome housing.
- B. The camera shall meet or exceed the following specifications:
 1. The camera shall have the form factor as typical of a CCTV dome video camera.
 2. The image capturing device shall be a 1/3-inch interline transfer super HAD CCD image sensor.
 3. The camera shall have digital signal processing.
 4. The camera shall have automatic backlight compensation.
 5. The camera shall have a variable high-speed electronic shutter.
 - a. The electronic shutter shall have automatic adjustment.
 - b. The electronic shutter shall operate from 1/60 NTSC or 1/50 PAL to 1/100,000 sec.
 6. The signal system shall be NTSC, with PAL optional.
 7. The resolution that the camera provides shall be 480 television lines.
 8. The camera shall have 811 horizontal and 508 vertical picture elements NTSC or 795 horizontal and 596 vertical picture elements PAL.
 9. The scanning system shall be 525/60 lines NTSC or 625/50 lines PAL.

10. The synchronizing system shall be internal / line-lock.
 - a. The synchronizing system shall be phase adjustable.
 11. The sensitivity shall be 1.0 lux at f1.4.
 12. The sensitivity shall be 0.1 lux at the faceplate.
 13. The signal-to-noise ratio shall be greater than 50 dB.
 14. The camera shall have automatic tracking white balance.
 15. The camera shall have a composite video output.
 - a. The video output shall be 1.0 V p-p at 75-ohm load.
 16. Several lens options shall be available for the camera: **(Appropriate lens shall be selected for each camera location and shall be varifocal auto iris lens selection f. or g. below)**
 - a. Lens pack that includes 2.5 mm, 4 mm, and 6 mm lenses
 - b. 8 mm lens
 - c. 12 mm lens
 - d. 16 mm lens
 - e. 25 mm lens
 - f. 3 to 8 mm varifocal autoiris lens
 - g. 9 to 22 mm varifocal autoiris lens
- C. The housing shall meet or exceed the following specifications:
1. The dome and base shall be circular in construction.
 2. The housing shall be impact resistant Lexan.
 3. The housing shall have a hinged lid to allow access to the camera inside
 4. The housing shall be weatherproof for indoor or outdoor use.
 5. The housing shall have a built-in rubber gasket on its base for weather sealing.
 6. The housing shall have tamperproof screws to resist vandals.
 7. The housing shall have a conduit entry on its side and base.
 8. The housing shall be constructed to comply with IP66 rating.
 9. The dome shall be available with a wall mount bracket, pendant mount bracket, and extendable pendant mount. **(Appropriate mounting bracket shall be selected for each location.)**
 10. The dome shall be available with either coaxial or UTP transmission types.
 - a. The UTP shall be swappable in the field using a modular board.
- D. The electrical specifications for the dome shall be as follows:
1. Power source shall be universal, 10 to 40 VDC or 18 to 30 VAC.
 2. Power consumption shall be 3.8 W.
- E. The environmental specifications for the dome shall be as follows:

1. Operating temperature shall be 14 to 122 degrees Fahrenheit or -10 to 50 degrees Celsius.
- F. The physical specifications for the dome shall be as follows:
1. Net weight shall be 1.8 pounds or 820 grams.
 2. Dimensions shall be 5.32 in. W by 4.00 in. H or 135 mm by 101 mm.
- G. The dome shall conform to these internationally recognized compliance standards:
1. FCC

PART 3 EXECUTION

3.1 EXAMINATION

- A. Submission of a proposal confirms that the contract documents and site conditions are accepted without qualifications unless exceptions are specifically noted.
- B. The site shall be visited on a regular basis to appraise ongoing progress of other trades and contractors, make allowances for all ongoing work, and coordinate the requirements of this contract in a timely manner.
- C. All system components must be inspected before installation, and shall be free of any cosmetic defects or damage.

3.2 PREPARATION

- A. Prior to installation all system components shall be configured and tested in accordance with the manufacturer's instructions.

3.3 INSTALLATION

- A. The security cameras must be installed, programmed, and tested in accordance with the manufacturer's instructions.
 1. In order to ensure a complete system for bidding purposes, where information is not available from the Owner upon request, the worst-case condition shall be assumed.
 2. Interfaces shall be coordinated with the Owner's representative, where appropriate.
 3. All necessary back boxes, racks, connectors, supports, conduit, cable, and wire must be furnished and installed to provide a complete GE Video System. Exact location of all boxes, conduit, and wiring runs shall be presented to the Owner for approval in advance of any installation.
 4. All conduit, cable, and wire shall be installed parallel and square with building lines, including raised floor areas. Conduit fill shall not exceed forty percent

(40%). All wires shall be gathered and tied up to create an orderly installation.

3.4 TESTING AND CERTIFICATION

- A. The Contractor shall demonstrate the functionality of the Video System upon completion of installation, documenting the result of all tests and providing these results to the Owner. The Video System shall be tested in accordance with the following:
 - 1. The Contractor shall conduct a complete inspection and test of all installed equipment. This includes testing and verifying operation with connected equipment.
 - 2. The Contractor shall provide staff to test all devices and all operational features of the system for witness by the Owner's representative and the Authority Having Jurisdiction. All testing must be witnessed by the Owner's representative, prior to acceptance.
 - 3. The testing and certification shall take place as follows:
 - A. The Video System shall be tested in conjunction with the manufacturer's representative.
 - B. All deficiencies noted in the above test shall be corrected.
 - C. Test results shall be submitted to the consultant or Owner's representative.
 - D. The test and correction of any deficiencies shall be witnessed by the owner's representative, and noted.
 - E. The Owner's representative shall accept the system.
 - F. The system test shall be witnessed by the Authority Having Jurisdiction. Any deficiencies noted during the testing must be corrected.
 - G. A letter of certification shall be provided to indicate that the tests have been performed, and all devices are operational.