



MIDLANDS
TECHNICAL COLLEGE

GMC

Project Manual – Volume 02

MIDLANDS TECHNICAL COLLEGE
AMSC Expansion - Airport

AMSC Center Addition and Renovations

West Columbia, South Carolina

Architect's Project Number: ACOL240010

OSE Project Number: H59-N301-SB

Bid Documents

04/17/2026



SECTION 088000 - GLAZING

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. Glass for interior and exterior doors and borrowed lites.
 - 2. Glazing sealants and accessories.
- B. Related Requirements:
 - 1. Section 081113 "Hollow Metal Doors and Frames."
 - 2. Section 081416 "Flush Wood Doors."

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: 2021 International Building Code.
- D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; **12 inches (300 mm)** square.
- C. Glazing Accessory Samples: For sealants and colored spacers, in **12 inches (300 mm)** lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and sealant testing agency.
- B. Product Certificates: For glass.

- C. Product Test Reports: For coated glass, insulating glass and glazing sealants, for tests performed by a qualified testing agency.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than Four Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.11 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- 1. **Manufacturers:** Subject to compliance with requirements, provide glass units by [Guardian Industries Corp.](#); [SunGuard](#) or compatible products by one of the following:
 - a. [Oldcastle BuildingEnvelope™](#).
 - b. [Pilkington North America](#).
 - c. [PPG Industries, Inc.](#)
- B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
 - 1. Obtain glass from single source from single manufacturer.
- C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.
- C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.
 - 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
 - 2. Probability of Breakage for Sloped Glazing: For glass surfaces sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or **1 inch (25 mm)**, whichever is less.
- D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as **Btu/sq. ft. x h x deg F (W/sq. m x K)**.
 5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
 6. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 1. GANA Publications: "Glazing Manual."
 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
 1. Minimum Glass Thickness for Exterior Lites: **1/4 inch (6 mm)**.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 STANDARDS AND REFERENCES

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.
- C. Heat-Strengthened Float Glass: ASTM C 1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

2.5 MONOLITHIC GLASS

- A. Glass Type “G1”: Clear, annealed, fully tempered float glass.
 - 1. Basis of Design Product: [Guardian Clear](#) by [Guardian Glass](#).
 - 2. Minimum Thickness: **1/4 inch (6 mm)**.
 - 3. Safety glazing required (label all units).
- B. Glass Type “G2”: Gray-tinted, annealed, fully tempered float glass for insulating glass.
 - 1. Basis of Design Product: [Guardian Tinted Glass – Gray](#) by [Guardian Glass](#).
 - 2. Minimum Thickness: **1/4 inch (6 mm)**.
 - 3. Safety glazing required (label all units).
 - 4. Performance Data:
 - a. Visible light transmittance %: 45%
 - b. Reflectance Out %: 6%
 - c. Reflectance In %: 5%
 - d. U-Value: 1.025 / 0.929 Btu/hr-ft²-F
 - e. Shading Coefficient: 0.71
 - f. Solar Heat Gain Coefficient: 0.62
 - g. Light to Solar Gain: 0.73

2.6 INSULATING GLASS

- A. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
 - 1. Glass Type:
 - a. Outer Pane: **G2**, refer to monolithic glass types.
 - b. Interspace Content: **Air**
 - c. Inner Pane: **G1**, refer to monolithic glass types.
 - 2. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
 - 3. Spacer: Manufacturer's standard spacer material and construction.
 - 4. Safety glazing required (label all units).
 - a. Provide Tempered units as required by code and/or as noted in the drawings including at all doors, units adjacent to doors and units less than 24” a.f.f.

2.7 GLAZING SEALANTS

- A. General:

1. **Compatibility:** Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. **Suitability:** Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. **Field-applied sealants** shall have a VOC content of not more than 250 g/L.
 4. **Colors of Exposed Glazing Sealants:** As selected by Architect from manufacturer's full range.
- B. **Glazing Sealant:** Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. [Dow Corning Corporation.](#)
 - b. [Pecora Corporation.](#)
 - c. [Tremco Incorporated.](#)

2.8 GLAZING TAPES

- A. **Back-Bedding Mastic Glazing Tapes:** Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. **Expanded Cellular Glazing Tapes:** Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. **General:** Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. **Cleaners, Primers, and Sealers:** Types recommended by sealant or gasket manufacturer.
- C. **Setting Blocks:** Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. **Spacers:** Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.10 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
 - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - a. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Presence and functioning of weep systems.
 - 3. Minimum required face and edge clearances.
 - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than **50 inches (1270 mm)**.
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide **1/8-inch (3-mm)** minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 80 00

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior gypsum board assemblies.
 - 2. Suspension systems for interior gypsum ceilings, soffits, roof insulation system and grid systems.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 - b. Depth: As indicated on Drawings.
 2. Dimpled Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.025 inch (0.64 mm).
 - b. Depth: As indicated on Drawings.
- C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
- D. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: 1-1/2 inches (38 mm).
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 2. Depth: As indicated on Drawings.
- F. Cold-Rolled Furring Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: As indicated on Drawings.
 2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch (0.8 mm).
 3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

- C. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of **0.053 inch (1.34 mm)** and minimum **1/2-inch- (13-mm-)** wide flanges.
- D. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: **0.053-inch (1.34-mm)** uncoated-steel thickness, with minimum **1/2-inch- (13-mm-)** wide flanges, **3/4 inch (19 mm)** deep.
 - 2. Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: **0.033 inch (0.84 mm)**.
 - 3. Dimpled Steel Studs and Runners: ASTM C 645.
 - a. Minimum Base-Metal Thickness: **0.025 inch (0.64 mm)**.
 - 4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, **7/8 inch (22 mm)** deep.
 - a. Minimum Base-Metal Thickness: **0.018 inch (0.45 mm)**.
- E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 1. **Products:** Subject to compliance with requirements, provide one of the following:
 - a. [Armstrong World Industries, Inc.; Drywall Grid Systems.](#)
 - b. [Chicago Metallic Corporation; Drywall Grid System.](#)
 - c. [USG Corporation; Drywall Suspension System.](#)

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square and true to line, with connections securely fastened.

- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch (13-mm)** clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
 - 1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by faces of adjacent framing.

3.4 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

AMSC EXPANSION - AIRPORT
MIDLANDS TECHNICAL COLLEGE
WEST COLUMBIA, SOUTH CAROLINA

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- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within **1/8 inch in 12 feet** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

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. High-Impact Interior Gypsum Board.
- B. Related Requirements:
 - 1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
 - 2. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, thicknesses, finishes, joining, attachment devices, relationship of adjoining work and other components.
 - 1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement.
- C. Samples: For the following products:
 - 1. Aluminum Trim Accessories: Full-size Sample minimum 12-inch-long for each trim accessory indicated.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Lafarge North America Inc.
 - 2. National Gypsum Company.
 - 3. USG Corporation.
- B. Gypsum Board, Impact Resistant: ASTM C1658/C1658M. Locations: All locations U.N.O.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.
 - 3. Soft-Body Impact: ASTM C1629/C1629M; Level 3.
 - 4. Hard-Body Impact: ASTM C1629/C1629M; Level 2.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced galvanized steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.

- c. L-Bead: L-shaped; exposed long flange receives joint compound.
- d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
- e. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper or mesh
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
- D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.

- b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; AC-20 FTR, AIS-919.
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. USG Corporation; SHEETROCK Acoustical Sealant.
2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: Vertical surfaces unless otherwise indicated.
- B. Single-Layer Application:
 - 1. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 - 2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
 - 1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings.

- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use where indicated.
 - 4. U-Bead: Use where indicated.
- D. Aluminum Trim: Install in locations indicated on Drawings and per approved shop drawings.

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Not Used.
 - 3. Level 3: Not Used.
 - 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated, and at panel surfaces to receive wall coverings.
 - a. Primer and its application to surfaces are specified in other Section 099123 "Interior Painting."
 - 5. Level 5: Not Used.

3.6 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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END OF SECTION 09 29 00

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

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 base.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
- C. Samples for Initial Selection: For each type of product indicated.
- D. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
- E. Product Schedule: For resilient base and accessory products.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Furnish 1% of each type, color, pattern, and size of resilient product installed.

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 manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 RUBBER BASE, RB-1

- 1. Manufacturers: Subject to compliance with requirements, provide rubber base by Tarkett – Johnsonite Wall Base or, subject to compliance, products by one of the following:
 - 2. Armstrong
 - 3. Flexco.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Type TP in Toe: Provide in all floor areas as scheduled
- C. Thickness: 0.125 inch.
- D. Height: 4 inches
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Field-Made
- G. Inside Corners: Field-Made
- H. Colors: 40 Black B
 - 1. As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of 50 g/L or less.

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.
 - 1. 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Field-Made Corners:
 - 1. Outside Corners:
 - a. Stop application of adhesive to wall base approximately 18" (45cm) from the outside corner of the wall.
 - b. Position the wall base at the corner and pencil line the back of the wall base where the bend is required.
 - c. Lay the wall base on the floor with the backup. Utilizing a top-set or pull-type gouge tool, make a shallow notch along the pencil line.
 - d. Note: The notch depth should not exceed one-quarter the total thickness of the wall base.
 - e. Reposition the wall base corner on the wall. The corner of the wall should fit snugly into the notched recess on the back of the wall base.
 - f. Apply adhesive and roll firmly into place.
 - 2. Inside Corners:
 - a. Install wall base and terminate into the corner.
 - b. Position another piece of wall base on opposing wall, without adhesive, approximately 1" from the installed piece.
 - c. Utilize dividers; place one pin at the top of the installed piece and one pin at the top of the uninstalled piece. Carefully, move the dividers downward in a straight vertical motion, allowing the pin of the dividers to follow the profile of the installed piece. At the same time, place adequate pressure on the pin to transfer and/or scribe the profile onto the surface of the uninstalled piece.
 - d. Use a utility knife to cut the scribe line on the uninstalled wall base, apply adhesive, and position the trimmed section into place.

3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting 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 horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.

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- 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. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

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SECTION 096723 - RESINOUS FLOORING

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. Resinous flooring.
- B. Related Sections:
 - 1. Section 033000 "Cast In Place Concrete" for newly installed concrete floor slab.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.
- B. Samples: For each resinous floor system required and for each color and texture specified, **6 inches (150 mm)** square in size, applied to a rigid backing by Installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For each resinous flooring component.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
 - 1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Apply full-thickness mockups on **96-inch- (2400-mm-)** square floor area selected by Architect.
 - a. Include **96-inch (2400-mm)** length of integral cove base with inside corner.
 - 2. Simulate finished lighting conditions for Architect's review of mockups.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 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.

1.8 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 installation.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- C. Close spaces to traffic during resinous flooring installation and for 24 hours after installation unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Flammability: Self-extinguishing in accordance with ASTM D635.

2.2 RESINOUS FLOORING-RFS

- A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, resin-based monolithic floor surfacing designed to produce a seamless floor.

Manufactures: Subject to compliance with requirements, provide [DEX-O-TEX Tek-Crete SL-B](#) or, subject to compliance, products by the following:

1. Sherwin-Williams POLY-CRETE SLB

- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

- C. System Characteristics:

1. Color and Pattern: **Light Grey** as selected by Owner from manufacturer's full range
2. Wearing Surface: **Textured for slip resistance**, as selected by Owner from manufacturer's full range.
3. Overall System Thickness: **3/16 inch (4.8 mm) to 1/4 inch (6.4 mm)**

- D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested in accordance with test methods indicated:

1. Compressive Strength: **6,100 psi (42.0 MPa)** minimum in accordance with ASTM C579.
2. Tensile Strength: **1,000 psi (6.89 MPa)** minimum in accordance with ASTM C307.
3. Flexural Modulus of Elasticity: **2,000 psi (13.8 MPa)** minimum in accordance with ASTM C580.
4. Water Absorption: **0.64%** maximum in accordance with MIL-D-3134.
5. Shrinkage: **1.4×10^{-5} in/in/°F** maximum in accordance with ASTM C531.
6. Impact Resistance: No chipping, cracking, or delamination and not more than **1/16-inch (1.6-mm)** permanent indentation in accordance with MIL-D-3134J.
7. Resistance to Elevated Temperature: No slip or flow of more than **1/16 inch (1.6 mm)** in accordance with MIL-D-3134J.
8. Abrasion Resistance: **33 mg** maximum weight loss in accordance with ASTM D1044.
9. Hardness: **85-90** Durometer, Shore D in accordance with ASTM D2240.
10. Flammability-Critical Radiant Flux (ASTM E648): **1.07 watts/sq.cm.**

- E. Body Coat: **3/16 to 1/4 inch (5 to 6 mm)**, with sand broadcast to rejection.

Top Coat: Tek-Crete Sealer CP. UV and abrasion resistant High Build Polyaspartic Topcoat, typically applied in two, (2), coats.

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.
 - 1. 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 resinous flooring systems.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare and clean substrates in accordance with resinous flooring manufacturer's written instructions for substrate indicated to ensure adhesion..
- 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 requirements in SSPC-SP 13/NACE No. 6, with a Concrete Surface Profile of 3 or greater in accordance with ICRI Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete in accordance with resinous flooring manufacturer's written instructions.
 - 3. Moisture Testing: Perform tests so that each test area does not exceed **1000 sq. ft. (304.8 sq. m)**, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of **5 lb of water/1000 sq. ft. (2.27 kg of water/92.9 sq. m)** in 24 hours.
 - b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum **75** percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Perform tests recommended in writing by resinous flooring manufacturer. Proceed with installation only after substrate alkalinity is not less than **6** or more than **8** pH unless otherwise recommended in writing by flooring manufacturer,
- C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates in accordance with manufacturer's written instructions.
 1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring in accordance with manufacturer's written instructions.
- D. Resinous Materials: Mix components and prepare materials in accordance with resinous flooring manufacturer's written instructions.

3.3 INSTALLATION

- A. Apply components of resinous flooring system in accordance with manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness specified.
 1. Coordinate installation of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components in accordance with manufacturer's written instructions. Prevent contamination during installation and curing processes.
 3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Primer: Apply primer over prepared substrate at spreading rate recommended in writing by manufacturer.
- C. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness specified for flooring system.
 1. Aggregates: Broadcast aggregates at rate recommended in writing by manufacturer. After resin is cured, remove excess aggregates to provide surface texture indicated.
- D. Grout Coat: Apply grout coat to fill voids in surface of final body coat.
- E. Topcoats: Apply topcoats in number indicated for flooring system specified, at spreading rates recommended in writing by manufacturer, and to produce wearing surface specified.

3.4 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may, at any time and any number of times during resinous flooring installation, require material samples for testing for compliance with requirements.

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1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reinstall flooring materials to comply with requirements.
- B. Core Sampling: At Owner's direction and at locations designated by Owner, take one core sample per 1000 sq. ft. (92.9 sq. m) of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

3.5 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 096723

SECTION 09 91 13 - EXTERIOR PAINTING

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 surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Galvanized metal and steel.
 - 2. Aluminum Plate
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Label each Sample for location and application area.

- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by Sherwin-Williams Company (The) or, subject to compliance, products by one of the following:
1. Benjamin Moore & Co.
 2. PPG Architectural Finishes, Inc.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.
- D. Colors: As selected by Architect from manufacturer's full range and as indicated on drawings.
- a. **PNT-3**
- 1) Color: **Fortitude**
 - 2) Code: **SW 9562**

2.3 BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior: MPI #4.
1. Sherwin Williams LX01W0200 Loxon Acrylic Block Surfacer

2.4 METAL PRIMERS

- A. Primer, Metal, Steel and Galvanized, Water Based: MPI #134.
1. Sherwin Williams B66W310 Pro-Industrial Pro-Cryl Universal Acrylic Primer.

2.5 WATER-BASED PAINTS

- A. Light Industrial Coating, Exterior, Water Based, Semi-Gloss (Gloss **Level 5**): MPI #153.
1. Sherwin Williams B66W01151 Pro Industrial DTM Acrylic Semi-Gloss

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[,] but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed to view as determined by architect:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 - 1. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based, gloss (Gloss Level 5), MPI #153.
- B. Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - a. Prime Coat: Primer, galvanized, water based, MPI #134.
 - b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, exterior, water based, gloss (Gloss Level 5), MPI #153.

END OF SECTION 09 91 13

SECTION 09 91 23 - INTERIOR PAINTING

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 surface preparation and the application of paint systems on the following interior substrates:
 - 1. Brick Veneer.
 - 2. Fiber Cement Panel.
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Gypsum board.
 - 6. Wood
- B. Related Requirements:
 - 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
 - 2. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches square.
 - 2. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by Sherwin-Williams Company (The) or, subject to compliance, products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Architectural Finishes, Inc.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Floor Coatings: 100 g/L.

D. Colors: As selected by Architect from manufacturer's full range and as indicated on drawings.

a. PNT-1

- 1) Color: **Pure White**
- 2) Code: **SW 7005**

b. PNT-2

- 1) Color: **Unusual Gray**
- 2) Code: **SW 7059**

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: **MPI #4.**

1. Sherwin Williams B25W25 PrepRite Block Filler Interior / Exterior Latex Block Filler

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: **MPI #50.**

1. Sherwin Williams B28W2600 ProMar 200 Zero VOC Interior Latex Primer

2.5 METAL PRIMERS

A. Primer, Metal, Steel and Galvanized, Water Based: **MPI #134.**

1. Sherwin Williams B66W310 Pro-Industrial Pro-Cryl Universal Acrylic Primer.

2.6 WATER-BASED PAINTS

A. Latex, Interior, Eg-Shel (Gloss Level 3): **MPI #52**

1. Sherwin Williams B20W12651 ProMar 200 Zero VOC Interior Latex Eg-Shel

B. Light Industrial Coating, Interior, Water Based, Eg-Shel (Gloss Level 3): **MPI #145.**

1. Sherwin Williams B66W01661 Pro Industrial Acrylic Eg-Shel

C. Pro Industrial Pre-catalyzed, Interior, Water Based Epoxy, Eg-Shel (Gloss Level 3): **MPI #151.**

1. Sherwin Williams K45W01151 Pro Industrial Pre-Catalyzed WB Eg-Shel Epoxy

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (CMU): 12 percent.
 - 3. Brick Veneer: 12 percent.
 - 4. Fiber Cement Panel: 12 percent.
 - 5. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry, Brick Veneer and Fiber Cement Panel Substrates: Remove efflorescence and chalk, repatch damaged existing surface. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer. but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.

2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Brick Veneer Substrates:
 1. Latex System:
 - a. Prime Coat: Block filler, latex, interior/exterior, MPI #4.
 - b. Intermediate Coat: Latex, interior, Water Based, matching topcoat.
 - c. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.
- B. CMU Substrates:
 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
 - a. Intermediate Coat: Pro Industrial Pre-catalyzed, Water Based Epoxy, matching topcoat.
 - b. (2) Topcoats: Pro Industrial Pre-catalyzed, Water Based Epoxy, MPI #151
- C. Fiber Cement Substrates:
 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
 - b. Intermediate Coat: Latex, interior, Water Based, matching topcoat.
 - c. Topcoat: Latex, interior, Eg-Shel (Gloss Level 3), MPI #52.

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D. Steel Substrates:

1. Pro Industrial Coating System:

- a. Prime Coat: Pro-Industrial Pro-Cryl Universal Acrylic Primer, water based, MPI #134.
- b. Intermediate Coat: Pro Industrial Acrylic Eg-Shel, water based, matching topcoat.
- c. Topcoat: Pro Industrial Acrylic Eg-Shel, water based, MPI #145

E. Gypsum Board and Wood Substrates:

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
- b. Intermediate: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, Eg-Shel (Gloss Level 3), MPI #52

END OF SECTION 09 91 23

SECTION 101100 - VISUAL DISPLAY SURFACES

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. Markerboards.

1.3 DEFINITIONS

- A. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes markerboards
- B. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of markerboards and tackboards.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show locations of panel joints.
 - 2. Show locations of special-purpose graphics for visual display surfaces.
 - 3. Include sections of typical trim members.
 - 4. **Include routing of surface mounted wire-mold around marker board installation locations.**
- C. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of available wall space and construction contiguous with visual display surfaces by field measurements before fabrication.

1.10 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: Life of the building.

PART 2 - PRODUCTS

2.1 MARKERBOARD MATERIALS, GENERAL, EF15

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
 - 1. Gloss Finish: Matte; dry-erase markers wipe clean with dry cloth or standard eraser.
- B. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish.
- C. Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.
- D. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and porcelain-enamel face sheet with Matte finish.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Basis of Design: Claridge Products and Equipment, Inc. LCS Deluxe
 - b. Marsh Industries, Inc.; Visual Products Group.
 - c. Platinum Visual Systems; a division of ABC School Equipment, Inc.
 - d. PolyVision Corporation; a Steelcase company.
 - 2. Particleboard Core: 1/2 inch thick; with 0.015-inch-thick, aluminum sheet backing.
 - a. Magnetic: Core material shall have magnet connectivity.
 - 3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 MARKERBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; slim size and standard shape.
 - 1. Factory-Applied Trim: Manufacturer's standard.
- B. Tack Strip: Manufacturer's standard 2" high tack strip.
- C. Chalktray: Manufacturer's standard, continuous.
 - 1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.
- D. Flag Holder: 2" Aluminum hook clip flag holder mounted to tack strip rail, provide (1) one per marker board.
- E. Hook with Clip: 2" Aluminum Hook with Clip mounted to tack strip, provide (2) two per marker board.

2.4 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
 - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
 - 2. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.
 - 3. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
 - 1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

2.7 MARKERBOARD SCHEDULE

- A. Visual Display Board, **EF 15**: Factory assembled.
 - 1. Markerboard: Porcelain-enamel markerboard assembly.
 - a. Color: White.
 - 2. Corners: Square.
 - 3. Width: As indicated on Drawings or 6'-0" minimum if not noted in the drawings.
 - 4. Height: As indicated on Drawings or 4'-0" minimum if not noted in the drawings.

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5. Mounting: Wall.
6. Mounting Height: As indicated on Drawings or at height directed by the Architect.
7. Factory-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
8. Accessories:
 - a. Marker tray: Solid type.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.
- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.

3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
 1. Mounting Height: 28" inches above finished floor to top of marker tray or as directed by the Architect, and coordinating with the owner regarding the height before installation.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 10 11 00

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

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. Room-identification signs that are directly attached at the interior and exterior of the building.
 - 2. Exterior Vinyl Number Signs

1.3 ALLOWANCES

- A. Allowances for signage are specified in Section 012100 "Allowances."

1.4 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.5 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

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- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: Full-size Sample.
 - 2. Variable Component Materials: Full-size Sample of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - 3. Exposed Accessories: Full-size Sample of each accessory type.
 - 4. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

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

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. [Advance Corporation.](#)
 - b. [Best Sign Systems, Inc.](#)
 - c. Fastsigns
 - d. Signarama
 - 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: **0.125 inch (3.18 mm)** and / or **0.25 inch (6.35 mm)**.
 - b. Subsurface Graphics: Reverse halftone or dot-screen image.
 - c. Color(s): As selected by Architect from manufacturer's full range.
 - 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: TBD
 - b. Corner Condition in Elevation: TBD
 - 4. Mounting: Surface mounted to wall with adhesive.
 - 5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled.

2.3 EXTERIOR VINYL NUMBER SIGNS

- A. Locations: All exterior doors as indicated on Sheet A1.00 - Overall Reference Plan
- B. Start number sequence from existing main building entrance door to all other existing exterior doors in a plan-clockwise array at each door; with numerical characters.
 - 1. Label all exterior door openings that lead into the building with vinyl graphic to designate numbered entry system for first responders.
 - a. Mounting: At doors without lites, surface mounted to exterior side of door with adhesive.
 - b. Size: 10" tall

2. Label all exterior door openings that lead into the building with vinyl graphic to designate numbered entry system for first responders
 - a. Mounting: At doors without lites, surface mounted to interior side of door with adhesive.
 - b. Size: 10" tall

2.4 SIGN MATERIALS

- A. Aluminum Sheet and Plate: **ASTM B 209 (ASTM B 209M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.
- E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.5 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish nonferrous-metal devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - b. Fastener Heads: Use oval countersunk screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
 4. Room Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.6 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly

mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

2.7 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.
- B. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls according to the accessibility standard.

C. Mounting Methods:

1. **Concealed Studs:** Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. **Masonry Substrates:** Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. **Thin or Hollow Surfaces:** Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. **Through Fasteners:** Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. **Adhesive:** Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. **Two-Face Tape:** Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.3 SIGNAGE SCHEDULE

- A. The Manufacturer shall be responsible for developing the room signage schedule with the Owner / Architect.
 1. Signage shall be provided for all new spaces and all existing rooms within the scope.
 2. All codes required signs to be provided for exit doors.

END OF SECTION 10 14 23.16

SECTION 10 41 90 - DIMENSIONAL LETTER SIGNAGE

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. Cast dimensional characters.

1.3 DEFINITIONS

- A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For dimensional letter signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, tpestyles, graphic elements, and layout for each sign at least half size.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available tpestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Dimensional Characters: Full-size Sample of each type of dimensional character.
 - 2. Exposed Accessories: Full-size Sample of each accessory type.
- E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DIMENSIONAL LETTER SIGNS, GENERAL

- A. The Dimensional letter signs associated with this section are including the full scope of work described herein. The base bid shall include the construction of the exterior wall at the signage locations with no additional work.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Impact Architectural Signs
 - 2. Gemini Incorporated
 - 3. ASI Signage
 - 4. Signarama
 - 5. Or approved equal.

- B. Cast Characters: Characters with uniform faces, sharp corners, and precisely formed lines and profiles, as follows:
 - 1. Character Material: Flat Cut Aluminum.
 - 2. Character Height: 24" High Letters
 - 3. Thickness: 3/4" thick letters
 - 4. Finishes:
 - a. Painted Finish: Manufacturer's standard stock paint finish in color as selected by Architect from manufacturer's full range.
 - 5. Mounting: Standoffs studs.
 - 6. Typeface: To verified by the Owner
 - a. from custom colors.
 - 7. Mounting: Concealed mounting

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant spanner-head slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Standoffs Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Adhesives: As recommended by sign manufacturer and with a VOC content of 70g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Adhesives: As recommended by sign manufacturer and that 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."
- D. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - 6. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Stainless-Steel Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils (0.04 mm)**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color as selected by the architect from the full range available from the manufacturer.

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 signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 - 3. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 - 4. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
 - 5. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support

weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 DIMENSIONAL LETTERING SCHEDULE

- A. Refer to the exterior elevations for dimensional lettering requirements
 - 1. The Owner shall confirm the exact verbiage of all exterior dimensional lettering and signage.
 - 2. The contractor shall provide a signage schedule for review and approval of the Owner and Architect

END OF SECTION 10 41 90

AMSC EXPANSION - AIRPORT

↑ MIDLANDS TECHNICAL COLLEGE
/ WEST COLUMBIA, SOUTH CAROLINA
\\

State Project Number: H59-N301-SB | GMC Project Number: ACOL240010 | Date: 04/17/2026

SECTION 10 52 20 - FIRE EXTINGUISHERS, CABINETS, AND ACCESSORIES

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 this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fire extinguishers.
 - 3. Mounting brackets.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data for each type of product specified. For fire extinguisher cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.
 - 2. Where color selections by Architect are required, include color charts showing full range of manufacturer's standard colors and designs available.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain fire extinguishers, cabinets, and brackets from one source from a single manufacturer.
- B. UL-Listed Products: Provide new portable fire extinguishers which are UL-listed and bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. J.L. Industries.
 - 2. Larsen's

2.2 FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers for each extinguisher cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, which comply with requirements of governing authorities.
 - 1. Abbreviations indicated below identify extinguisher types related to UL classification and rating system and not necessarily to type and amount of extinguishing material contained in extinguisher.
- B. Extinguishers: Provide equivalent to the following, from one of the above manufacturers.
 - 1. Multi-purpose Dry Chemical Type: Rechargeable, UL-rated **2-A:40-B:C**, in enameled steel container.
 - 2. Mounted on wall bracket, unless otherwise indicated on the Drawings.
- C. Provide tag for each fire extinguisher, which identifies the unit, indicates date charged, and other pertinent data required by authorities having jurisdiction.

2.3 MOUNTING BRACKETS

- A. Provide brackets designed to prevent accidental dislodgement of extinguishers, of sizes required for type and capacity of extinguisher indicated, in manufacturer's standard plated finish: Provide brackets for extinguishers not located in cabinets.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
- B. 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.
- C. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions, and mounting heights as follows:
 - 1. Fire Extinguisher Mounting Brackets: 44" A.F.F. to horizontal centerline of bracket release mechanism.
 - a. Comply with ICC A117.1-2017 for mounting height for accessibility.
- D. Where exact location of cabinets and bracket-mounted fire extinguishers is not indicated, locate as directed by Architect.
- E. Install one fire extinguisher on each bracket.

END OF SECTION 10 52 20

SECTION 123661.16 - SOLID SURFACING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid surface material wall covering.

B. Related Requirements:

1. Section 079200 "Joint Sealants"
2. Section 092216 "Non-structural Metal Framing"
3. Section 092900 "Gypsum Board"

C. Definitions:

1. Solid Surface: Non-porous, homogeneous material maintaining the same composition throughout the part with a composition of acrylic polymer, aluminum trihydrate filler and pigment.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Arrange preinstallation conference 1 week prior to commencing work with all parties associated with trade as designated in Contract Documents or as requested by Architect. Presided over by Contractor, include Architect who may attend, Subcontractor performing work of this trade, Owner's representative, testing company's representative and consultants of applicable discipline. Review Contract Documents for work included under this trade and determine complete understanding of requirements and responsibilities relative to work included, storage and handling of materials, materials to be used, installation of materials, sequence and quality control, Project staffing, restrictions on areas of work and other matters affecting construction, to permit compliance with intent of work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For vertical wall with solid surface. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.

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2. Show direction of directional pattern, if any.
- C. Samples for Initial Selection: For each type of material exposed to view.
 1. Provide hard copy of manufacturer's catalog or material/ color selection charts in Adobe PDF format. Owner will review and return with written selection of finishes for sample submittals. Refer to Section 013300 "Submittal Procedures", 1.5 Submittal Administrative Requirements for submittals' requirements.
- D. Samples for Verification: Provide samples for the following products:
 1. Solid surface material, **6 inches (150 mm)** square.
 2. Wood trim, **8 inches (200 mm)** long.
 3. One full-size solid surface material countertop, with front edge and backsplash, **8 by 10 inches (200 by 250 mm)**, of construction and in configuration specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricators/installers.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in Project closeout documents.

1.6 QUALITY ASSURANCE

- A. Fabricator/Installer Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
 1. The fabricator is to have a minimum of **five (5)** consecutive years of experience in the type and quality of casework shown on the drawings and specified herein.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver no components to Project site until areas are ready for installation.
- B. Storage and Handling Requirements:
 1. Store components indoors prior to installation.
 2. Handle materials to prevent damage to finished surfaces.

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1.8 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.9 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE MATERIAL WALL COVERING

- A. **Manufacturers:** Products of following manufacturers are acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
 - 1. Corian® by DuPont;
 - 2. Wilsonart Engineered Surfaces.
- B. Quality Standard: Comply with AWI Section requirements for Custom Grade for Countertops.
- C. Type: Provide Standard type unless Special Purpose type is indicated.
- D. Flammability: Class 1 and A when tested to UL 723.
- E. Colors and Patterns: **To be selected by Owner.**
 - 1. To be selected by owner from the full range of manufacturers' standard colors.
- F. Provide and install 3-inch diameter grommets above each electrical and data outlets. Color of grommets shall match finish of adjacent surface of countertop. Surfaces of grommet shall be smooth and rounded to prevent wear and damage to cable and wire.
 - 1. Locate all grommets in submittals for review by the Architect.

2.2 FABRICATION

- A. Wall Covering:
 - 1. 1/4-inch- (6-mm-) thick, solid surface material.
- B. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- C. Joints:
 - 1. Fabricate wall covering without joints.

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D. Cutouts and Holes:

1. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting **3/16 inch (5 mm)** into fixture opening.
2. Wall-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

E. Fabrication Tolerances:

1. Variation in Component Size: $\pm 1/8"$.
2. Location of Openings: $\pm 1/8"$ from indicated location.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."
- C. Screws: Product recommended by L-profile bracket manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Verify actual site dimensions and location of adjacent materials prior to commencing work.
- C. Examine cabinets upon which counter tops are to be installed. Verify cabinets are level to within $1/8"$ in $10' - 0"$.
- D. Notify Architect in writing of any conditions which would be detrimental to installation.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.
- F. Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2 INSTALLATION

- A. Install vertical level to a tolerance of **1/8 inch in 8 feet (3 mm in 2.4 m)**, **1/4 inch (6 mm)** maximum. Do not exceed **1/64-inch (0.4-mm)** difference between planes of adjacent units.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Secure solid surface material to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- D. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. **Exposed joints/seams are not permitted.** Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.
 1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- F. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

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SECTION 21 05 00 - GENERAL FIRE SUPPRESSION REQUIREMENTS

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.
- B. Section 078413 Penetration Firestopping.
- C. All sections of Division 21 specifications apply to this section.

1.2 SUMMARY

- A. The Fire Protection Work shall include, but not be limited to, the following:
 - 1. Connection to the above ground existing dry and wet sprinkler piping located in the existing fire pump room.
 - 2. Alarm valves and risers.
 - 3. Drain connections.
 - 4. Pipe hangers and supports.
 - 5. Seismic supports.
 - 6. Water piping, sprinkler heads, and valves.
 - 7. Submittals.
 - 8. All other work and materials specified herein or shown on drawings.
 - 9. Design, installation, and testing of the automatic sprinkler system to provide coverage as indicated on the contract documents. The installation of the sprinkler system shall conform to NFPA 13 (2019 edition). The system shall be hydraulically calculated by the Contractor.
 - 10. Securing permits and inspections.

1.3 DELINEATION OF WORK

- A. Provide all necessary supervision and coordination of information to installers who are performing work to accommodate Division 21 installations.
- B. Where the Division 21 installer is required to install items that they do not purchase, they shall include such items:
 - 1. The coordination of their delivery.
 - 2. Their unloading from delivery trucks driven into any designated point on the property line at grade level.
 - 3. Their safe handling and field storage up to the time of permanent placement in the project.
 - 4. The correction of any damage, defacement, or corrosion to which they may have been subjected.
 - 5. Their field assembly and internal connection as necessary for their proper operation.

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6. Their mounting in place includes the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
 7. Their connection to building systems includes the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- C. Items that are to be installed by the Division 21 installer but not purchased as part of the work of Division 21 shall be carefully examined upon delivery to the project. The Division 21 installer shall provide all work necessary to properly install these items.
- D. If any items have been received in such condition that their installation will require additional work beyond the project scope of the work, the Architect/Engineer shall be notified in writing within 10 working days of the date of delivery of the items. Any claims beyond 10 days will not be considered by the Architect/Engineer.

1.4 QUALITY CONTROL

A. Qualifications of Installer:

1. The systems shall be installed by a licensed fire protection contractor or contracting firm regularly engaged in the installation of fire protection systems. The Architect/Engineer may require evidence to support the above requirements and may reject any proposed contractor who cannot show suitable experience.
2. The Contractor must be certified as a NICET Level III for fire sprinkler systems and shall submit data showing the same.
3. The Contractor shall furnish evidence that there is an experienced and effective service organization that carries a stock of repair parts for the system to be furnished. Should the Contractor fail to comply with the service requirements of this Section, the Owner or his Representative will then have the option to make the necessary repairs and back-charge the Contractor without any loss of warranty as provided by the Contract Documents.

B. Equipment and Materials:

1. All equipment and materials required for installation under these specifications shall be new and unused, of the best grade and quality, shall be of the latest design of the manufacturer, and shall be listed as approved by U.L. All components shall be suitable for the pressures to be encountered.
2. All manufacturers of equipment and materials pertinent to these items shall have been engaged in the manufacture of said equipment for a minimum of three (3) years and, if so directed by the Engineer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.
3. All equipment, materials, and work is intended to be installed in a manner conforming to the best engineering practice and all equipment is intended to be complete in every respect to satisfy the job requirements and/or this specification.
4. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
5. All materials with a manufacturer's listed shelf life shall be used at least six months before the expiration of the materials' shelf life.

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C. Criteria:

1. Installation of the systems and all the work covered by these specifications shall conform in strict accordance to all codes, ordinances, and regulations of the City, County, State, National Fire Protection Association (NFPA), and/or all other authorities having jurisdiction. Also, the work covered by these specifications shall be provided in strict accordance with all requirements and recommendations of the National Fire Protection Association, and the insurance underwriter. All material and work necessary to meet these requirements shall be so indicated on the shop drawings and shall be installed at no extra cost to the Owner.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

- A. Submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.
- B. All work shall conform to the following Building Codes (latest edition unless noted otherwise):
 1. International Building Codes
 2. National Fire Protection Association
- C. All work shall conform to all federal, state, and local ordinances.
- D. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:
 1. Factory Mutual Laboratories (FM)
 2. Underwriters Laboratories, Inc. (UL)

1.6 APPROVAL OF SUBSTITUTIONS

- A. Specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor in such cases may, at his option, use any article, device, product, material, fixture, form, or type of construction which, in the judgment of the Architect/Engineer expressed in writing, is equal to that named. Where quality and other characteristics are very nearly the same, the question of determining equal materials and readily available service sometimes resolves itself to a matter of personal opinion and judgment and in these and all other cases involving the approval of materials, the opinion, judgment, and decision of the Architect/Engineer shall be final and bind all parties concerned.
- B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified shall be submitted for approval in writing ten (10) calendar days before the bid opening date to the Architect/Engineer. Requests shall be accompanied by samples, literature, and information as necessary to fully identify and allow appraisal of the material or equipment. Submittals shall be as concise, clear, and brief as possible. Incomplete submittals or submittals requiring lengthy research to ascertain quality will not be considered.
- C. Approval of the Architect/Engineer to use materials or equipment, if granted, will be in the form of a written addendum. Approved substitutions may be used at the Contractor's option. No

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substitutions will be allowed if substitutions are requested later than ten (10) days before the bid opening date.

- D. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are indicated in the form of a letter that is enclosed with the submittals. The Contractor shall be responsible for verifying all dimensions with available space. If, in the opinion of the Architect/Engineer, the physical dimensions do not permit the substituted material or equipment to be properly operated, maintained, serviced, or otherwise accessed, or the physical dimension adversely impacts other components, a system's ability to be operated, maintained, serviced or otherwise accessed, the material or equipment shall be replaced at the Contractor's expense.

1.7 VERIFICATION OF DIMENSIONS AND LOCATIONS

- A. The Contractor shall visit the facility and become thoroughly familiar with all details of the work, working conditions, dimensions, and clearances.
- B. Notify the Architect/Engineer of any discrepancy between actual conditions and conditions indicated on the contract documents that could cause changes, other than minor ones, to the installation of any systems or equipment.

1.8 ELECTRICAL CHARACTERISTICS FOR FIRE SUPPRESSIONS EQUIPMENT

- A. 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. The Contractor is responsible for the modifications to and the extension of connecting components as required for the equipment provided.
- B. The Contractor shall bear all costs for required changes in connection to equipment.

1.9 WORKMANSHIP

- A. Workmen shall be thoroughly experienced and fully capable of installing the work. Work shall be per the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to the Owner.
- B. All materials and equipment are to be installed per the manufacturer's printed recommendations using recommended accessories. Retain a copy on the job site and submit others for approval when required.

1.10 WARRANTIES

- A. General:
 - 1. Furnish to the Architect/Engineer a warranty form signed by the Contractor and Owner agreeing to the start and end dates of all systems and equipment under warranty.

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2. All defective materials or inferior workmanship shall be replaced or repaired as directed by the Owner's representative during the warranty period.

B. Equipment Warranties:

1. Equipment shall be warranted by the equipment manufacturer. Where labor is included in the warranty, the manufacturer, at his option, may permit the contractor to provide the required repairs on the equipment.
2. The equipment manufacturer shall include a written warranty with the closeout documentation.

C. Duration Period:

1. For work not otherwise specified, the duration shall be one year from substantial completion including all parts, labor, and other charges.
2. The Contractor is responsible for purchasing from the equipment manufacturers any additional warranties to ensure that the equipment is warranted by the manufacturer through the duration period specified.

D. Non-Warranted Items:

1. Nondurable replaceable items do not require replacement after the date of acceptance.

E. Warranty Repair:

1. Repair shall take place as soon as possible but not later than the following:
 - a. Items not essential for facility operation - 7 days.
 - b. Items that have a small impact on facility operation - 2 days.
 - c. Items that have a significant impact on the facility operation - immediately begin repairs or work necessary to minimize operational impact to the Owner.
2. The determination of the impact on the facility is solely that of the Owner and Architect/Engineer.
3. Where life safety issues are impacted, the contractor shall take all steps necessary to ensure the facility can continue to function safely.
4. If repairs cannot be made in the required period, temporary systems shall be installed until repairs can be completed.
5. All costs associated with warranty work shall be borne by the contractor.

1.11 EXISTING FACILITIES

- A. The location of pipes, sprinklers, valving, equipment, and appurtenances for existing facilities are shown on plans to indicate the extent of work required. The exact condition shall be field verified.
- B. Work shall be performed above existing ceilings except where removal of existing ceilings is specifically identified. Where working above existing ceilings, remove existing tile/grid and reinstall existing tile/grid as necessary. Any damaged tile/grid shall be replaced at the Contractor's expense.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRIOR CONDITIONS

- A. Before the installation of any equipment or system component, the Contractor shall review any prior work that has been completed to accommodate the equipment or system component to be installed.
- B. If the prior work does not make a proper installation of any equipment or system component possible, notify the Architect/Engineer before installation of any equipment or system component.

3.2 JOB CONDITIONS

- A. Where work requires interruption of existing public utility service, obtain written permission from the affected utility company for the interruption.
- B. Where work requires interruption of the Owner's existing utility service, schedule interruption with the Owner. Notify the Owner and Architect/Engineer at least 48 hours before the scheduled interruption.

3.3 INSTALLATION

- A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations and the manufacturer's shop drawings.
- B. If any equipment cannot be installed per Codes, contract documents, manufacturer's recommendations, and accepted practices notify the Architect/Engineer in writing before installation of equipment.
- C. If any system component cannot be installed per Codes, contract documents, and accepted practices, notify the Architect/Engineer in writing before installation of the system component.

3.4 LEAK DAMAGE

- A. This Contractor shall be responsible during the installation and testing periods of the sprinkler system for any damage to the work of others, to the building or its contents, or the site, etc., caused by leaks in any equipment, by unplugged or disconnected pipes, fittings, etc., or by overflow and shall pay for necessary replacement or repairs to work of others, buildings, sites, merchandise damage or furniture and equipment by such leakage.

3.5 HOSE THREADS

- A. Hose threads shall conform to the standards of the local fire department. The Contractor shall verify the exact threads used before ordering materials.

3.6 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage before final inspections, repair or replace damaged items as determined by the Architect/Engineer, at no cost to the Owner.
- B. Store equipment on elevated supports and cover them on all sides with securely fastened waterproof coverings. All equipment openings shall be securely sealed.
- C. Piping shall be protected by storing it on elevated supports and capping the ends.
- D. During construction, all open ends of all pipes, equipment, etc. which could collect construction debris shall be properly capped.

3.7 CLEANING OF SYSTEMS AND EQUIPMENT

- A. All equipment and systems shall be cleaned of all extraneous materials to leave equipment and system finish in a new condition.
- B. Where equipment and systems cannot be properly cleaned, take all measures necessary to replace or repair equipment and systems to bring them back to a "like new" condition. All costs shall be borne by the Contractor.
- C. All extraneous materials shall be removed on the site regularly to provide access to all work as well as a safe working environment.

END OF SECTION

SECTION 21 05 01 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. This Section includes the following:
 - 1. Sleeves
 - 2. Escutcheons
 - 3. Fire-suppression equipment and piping demolition
 - 4. Equipment installation requirements common to equipment sections
 - 5. Painting and finishing
 - 6. Supports and anchorages

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical 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.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Escutcheons

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1.5 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in the building structure during the progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 SLEEVES

- A. General:
 - 1. Provide sleeves for each pipe passing through walls, partitions, floors, and roofs unless specific details indicate otherwise.
 - 2. Provide sleeves where required by UL firestop assembly selected. Sleeve size, length, and type shall be equal to that required for the UL firestop assembly utilized.
 - 3. Do not provide a sleeve when not permitted by UL firestop assembly selected.
 - 4. Core drilled holes in concrete walls do not require sleeves unless required by UL firestop assembly where applicable.
- B. Type:
 - 1. Sleeves in non-masonry or concrete construction shall be a minimum of 24-gauge sheet metal.
 - 2. Sleeves in masonry or concrete construction shall be Schedule 40 black or galvanized steel.
 - 3. Sleeves in the membrane or waterproof construction shall have a flashing ring or other method acceptable to the membrane or waterproofing manufacturer.
 - 4. Sleeves provided at floor slabs and support piping weight shall be cast in place and have a minimum of four anchoring tabs.
 - 5. Split sleeves shall be permitted only when approved by the Engineer.
- C. Sleeve Sizes:
 - 1. Sleeves for piping (insulated and uninsulated) shall have annular space as required by NFPA 13.
- D. Sleeve Length:
 - 1. Sleeves shall be equal to the thickness of constructions and terminated flush with surfaces.

- E. Sleeve Packing:
 - 1. Sleeves shall be packed as follows:
 - a. As indicated in detail or fire-stopping specification.
 - b. If not indicated otherwise, seal the entire sleeve at the exterior wall/floor with a flexible elastomeric or silicone caulk.
- F. Fire-Rated Assemblies:
 - 1. Provide a sleeve where required by UL firestop assembly utilized.
 - 2. Do not provide a sleeve if not permitted by UL firestop assembly utilized.

2.3 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an internal diameter to closely fit around the pipe, tube, and insulation of insulated piping and an outside diameter that completely covers the opening.
- B. General:
 - 1. Escutcheons shall be chrome-plated brass.
 - 2. Escutcheons shall be held in place by the internal spring tension of set screws.

2.4 SPRINKLER GUARDS AND WATER SHIELDS

- A. Sprinkler Guards:
 - 1. Provide guards for sprinklers located within 7 feet of the finished floor or wherever sprinklers may be subject to mechanical damage.
 - 2. Sprinkler guards shall be "Thread Guard" with a white powder coat finish manufactured by SprinkGUARD. The sprinkler shall be UL listed for use with fire sprinkler guards as manufactured by SprinkGUARD.
 - 3. Sprinkler guards shall be listed for use with the proposed sprinkler.

PART 3 - EXECUTION

3.1 FIRE-SUPPRESSION DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove the portion of piping indicated to be removed and cap or plug the remaining piping with the same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with the same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

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4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If the pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace them with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate the general location and arrangement of piping systems.
- 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 or as required by NFPA13.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow the application of insulation.
- K. Select system components with a pressure rating equal to or greater than the system operating pressure.
- L. Install escutcheons for all exposed piping penetrations of walls, ceilings, and floors except in unoccupied equipment rooms (i.e., fire pump/riser rooms, mechanical rooms, etc.)
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide annular clear space between the sleeve and pipe or pipe insulation as required for seismic conditions per IBC and NFPA 13 and per Fire Barrier penetration requirements.

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- N. Aboveground interior and exterior wall penetrations: Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for the size, depth, and location of the joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- 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 07 Section "Penetration Firestopping" for additional information.
- P. Verify final equipment locations for roughing-in.
- Q. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match the original factory finish.

END OF SECTION

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SECTION 21 05 03 – SELECTIVE DEMOLITION

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.
- B. Refer to Division 01 Section "Execution" and Division 02 Section "Selective Demolition" for general demolition requirements and procedures.
- C. All sections of Division 21 Specifications apply to this section.

1.2 SUMMARY

- A. General:
 - 1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the demolition of all Fire Protection equipment, piping, sprinklers, and appurtenances where shown on the drawings and specified hereinafter.
 - 2. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the patching and repair of the building structure, finishes, and building assemblies as specified hereinafter.
 - 3. All existing utilities, water, controls, etc. shall be reconnected to new systems as required to maintain the same functions as existed before new work.
 - 4. Maintain fire protection facilities in service during selective demolition operations.
- B. Descriptions:
 - 1. Cut openings thru the existing building walls, roof, floors, and finishes to accommodate the installation of Division 21 equipment, controls, piping, and appurtenances.
 - 2. Remove and dispose of existing Fire Protection equipment, piping, and appurtenances.
 - 3. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure, and materials required for the installation of such work following standard practices.
 - 4. All penetrations thru exterior walls, floors, and roof systems shall be sealed watertight.
 - 5. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

PART 2 – PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Post-tensioned slabs, beams, columns, and other load-bearing structures shall not be drilled, cut, or otherwise modified without written approval by the structural engineer.

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3.2 PROTECTION

- A. Provide barricades and take all other precautionary measures necessary to protect personnel and property.
- B. The Contractor shall be responsible for any damages to adjacent areas to the construction area.
- C. Areas not included in the scope of work, areas where work is minimal, and, in the case of a phased contract, areas that remain inactive for long periods shall be protected from the area in which the work is being performed by a slab to slab barrier acceptable to engineer and local authorities.
- D. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.
- E. At no time shall required means of egress be blocked by equipment materials, permanent or temporary barriers.

3.3 COORDINATION

- A. All demolition work shall be coordinated with the Owner. Work that will interrupt building utilities or cause the disruption of the normal environment in areas of the building not within the scope of this project will be performed outside the Owner's normal working hours.

3.4 PIPE PENETRATIONS

- A. All pipe penetrations shall be core drilled. All other penetrations shall be saw cut. Openings shall not be larger than required for proper installation of pipe or duct unless required due to seismic requirements.

3.5 MATERIAL REMOVAL

- A. The Owner shall retain the first right of refusal on all existing equipment, piping, and appurtenances that are to be removed as a result of this contract.
- B. Coordinate demolition work with the Owner using extreme care not to damage existing equipment which Owner elects to retain.
- C. Remove Owner retained equipment from the existing location and store equipment at a location on the site where specified by the Owner.
- D. All material, equipment, supports, and appurtenances not required as the result of demolition or renovation of the building systems shall be removed from the project site and disposed of properly unless retained by the Owner.

END OF SECTION

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SECTION 21 05 10 - DOCUMENTATION AND CLOSEOUT

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the project documentation and closeout.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 21 specifications apply to this section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. All reports, forms, and manuals shall be submitted to the Architect/Engineer in triplicate unless additional copies are noted.
- B. Reports, forms, and manuals are to be submitted as soon as possible, but no later than thirty (30) days after the earliest date they can be prepared.

3.2 OWNER TRAINING

- A. The contractor shall schedule the training on equipment and systems at least 21 days before training is to take place. The contractor shall provide multiple dates and times for the training to allow the Owner to coordinate the schedules of their staff to be trained.
- B. The contractor shall provide all training aids, manuals, etc. for the Owner's staff at the training classes. These are in addition to whatever is required for the Operations and Maintenance manuals. The contractor shall coordinate the number required with the Owner but shall include a maximum of 8 sets for the training class.
- C. The person providing the training shall be thoroughly knowledgeable in the subject matter and shall be certified by the equipment or system manufacturer.

3.3 PROJECT JOB DRAWINGS AND AS-BUILT DRAWINGS

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- A. Keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, materials, and equipment on the project job drawings.
- B. As built drawings shall have the information transferred from the project job drawings including all addenda, supplemental instructions, change orders, and similar information.
- C. Qualified draftsmen shall perform this task.
- D. **SPRINKLER SUPPRESSION SYSTEM DOCUMENTS CABINET:**
 - 1. Provide a heavy-duty red-hinged cabinet with a locking door installed in the Sprinkler Riser/Fire Pump Room.
 - 2. The cabinet shall be a surface-type enclosure constructed of 16 gauge cold rolled steel and shall be finished with a durable red textured, heat-resistant baked-on enamel finish.
 - 3. The cabinet door shall have a stainless steel piano hinge and a high-security CAT 30 keyed door lock.
 - 4. The front cover shall include a durable label displaying "SPRINKLER SUPPRESSION SYSTEM DOCUMENTS" in 1" white indelible lettering, applied to the cover relative to the orientation of the installed back box.
 - 5. The documentation cabinet shall be sized to include all necessary documentation which shall include, as a minimum:
 - a. Approved submittal drawings/as-built drawings
 - b. Copy of the currently adopted edition of NFPA 25
 - c. Fully executed Contractor's Material and Test Certificate for Aboveground Piping and Underground Piping as applicable
 - d. Backflow preventer test certificate as applicable
 - 6. Cabinet shall be equal to DBX As Built Drawing Cabinet as manufactured by Space Age Electronics model #SSU00677 (26-1/4" W x 14-1/4" H x 4" D), minimum size with lettering as specified above.
- E. Provide a compact disc with computer-generated plans of the Contractor's submittal/as-built drawings in Portable Document Format (PDF).

3.4 OPERATING AND MAINTENANCE MANUALS

- A. Compile and bind three (3) sets of all manufacturers' instructions and descriptive literature on all items of equipment furnished under this work. Additionally, provide this information on a CD in PDF format. PDF shall be book marked to identify all equipment.
- B. The binder shall be a hardcover, three-ring notebook, embossed with the name of the project, 11" x 8-1/2" with heavy-duty rings. Maximum binder size shall be 2-1/2".
- C. The front of the binder shall be titled "Fire Suppression Operating and Maintenance Instructions," with the name of the job and documents date under the title.
- D. Where laminated documents are required, only one set shall be provided.
- E. Operating and Maintenance Instructions shall include the following:
 - 1. Cover sheet in each binder listing the architect, engineer, and all contractors. List addresses and phone numbers.

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2. List the name, address, and phone number of the organization responsible for warranty work, if other than Contractor, and the specific work for which he is responsible.
 3. List the name, address, and phone number of the nearest sales and the nearest service organization for each product.
 4. Schedules of all equipment including identification tag numbers shown on plans cross-referenced to field applied identification tag numbers.
 5. Performance Curves: For pumps, valves, and similar equipment at the operating conditions.
 6. Lubrication Schedule: Indicating type and frequency of lubrication required.
 7. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list marked or attached to this submittal.
 8. NFPA-25 (2020 latest edition) "Inspection, Testing, and Maintenance of Water Based Fire Protection Systems."
 9. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 10. Instruction Books: These may be standard booklets but shall be marked to indicate applicable equipment and characteristics.
 11. Wiring Diagrams: Generalized diagrams are not acceptable; submittal shall be specifically prepared for this Project.
- F. The following diagrams, schematics, and lists shall be laminated (8-1/2" x 11" or 11" x 17" as needed for clarity):
1. Valve diagrams of each sprinklered building indicating the locations of all control valves, low point drains, inspector tests, and air vent valves. The diagrams shall be neatly drawn and color-coded to indicate the portion of the building protected by each system.
 2. Provide two copies – one to be kept in Operations and Maintenance Manual and one to be installed on the wall adjacent to the fire riser.

3.5 ENGINEERING FIELD REPORTS AND FINAL INSPECTION REPORTS

- A. The Architect/Engineer will review the Contractor's work periodically throughout the project. A report will be submitted to the Contractor.
- B. The reports shall be responded to within ten days of receipt by the Contractor. Each item shall be addressed with comments written on the inspection report if possible. The contractor's response shall address the status of each item and all discrepancies.

3.6 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. After all final tests and adjustments have been completed; the Owner's Representatives shall be instructed in all details of operation and maintenance for the systems installed.
- B. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.
- C. The contractor shall provide all training aids, manuals, etc. for the Owner's staff at the training classes. These are in addition to whatever is required for the Operations and Maintenance manuals. The contractor shall coordinate the number required with the Owner but shall include a maximum of 8 sets for the training class.

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- D. Instruction shall be provided as follows:
1. Equipment: Trained factory representative
 2. System: Competent employee of the Contractor

3.7 ACCEPTANCE

- A. Upon notification by the Contractor and after completion of Operation and Maintenance Instructions, the Architect/Engineer will visit the project for a demonstration of the building system and an inspection of the completed work.
- B. Items that do not comply with the Contract Documents or that function incorrectly will be listed. The list will be provided by the Architect/Engineer to the Contractor for correction of the installed work.
- C. After all corrections have been made, the Contractor shall notify the Architect/Engineer who will recheck the systems for compliance of all items listed.

PART 4 - STANDARD FORMS

4.1 GENERAL

- A. All forms shall be filled out by the Contractor before acceptance of the project by the Architect/Engineer.

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4.2 FIRE PROTECTION CLOSEOUT LIST

FIRE PROTECTION CLOSEOUT DOCUMENT PROJECT: MTC AMSC CENTER ADDITION & RENOVATIONS BGA PROJECT NO.: 24094			
DOCUMENT	DATE REVIEWED	DATE RETURNED	COMMENTS
Fire Protection O&M Manual			
Contractor As-Built Submittal Drawings – Printed (1 set minimum)			
Contractor As-Built Submittal Drawings/Holder Located in Riser Room (1 set per Riser room)			
Contractor As-Built Submittal Compact Disc PDF Format			
NFPA 13 and 24 Contractor's Material and Test Certificate for Aboveground Piping			
Valve diagrams (laminated)			
Punchlist dated _____			
Punchlist dated _____			
Punchlist dated _____			
Walk-Through with Owner			
NOTE: Not all closeout documents may be listed. See other sections of specifications for additional requirements.			

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SECTION 21 05 11 - SUBMITTALS

PART 1 - GENERAL

1.1 GENERAL

- A. Refer to Division 1 specification for information and shop drawings and submittals requirements. When conflicts exist, more stringent requirements shall apply.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 21 specifications apply to this section.

1.3 PREPARATION OF SUBMITTALS

- A. Before preparing submittals, consult all contract drawings and specifications in detail, obtain the manufacturer's recommended installation instructions, and have shop drawings prepared based on specific equipment and material intended for installation. Obtain all drawings and submittals from other trades as necessary to coordinate submittals.
- B. Sign all shop drawings indicating conformance with contract documents before submitting them to the Architect/Engineer.

1.4 SUBMITTALS

- A. General:
 - 1. Submittals are required on all items of equipment.
 - 2. Submittals shall include, but not be limited to:
 - a. All requirements of Division 1.
 - b. Complete information about appurtenances and accessories
 - c. Information properly marked with service or function identification as related to the project.
 - d. Where the submittal consists of catalog sheets displaying other items which are not applicable, the proper features shall be identified.
 - e. External connections are properly marked, as related to the specific use intended, on standard factory assembly and field installation drawings.
 - f. All performance characteristics and physical characteristics.
 - g. Wiring and control diagram.
 - h. All requirements listed in the specific section of specifications.
 - i. Electrical data on all motors greater than one horsepower. Data shall include horsepower unit served, power factor, efficiency, and product of P.F. x EFF.

1.5 REVIEW OF SUBMITTALS

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- A. Review of submittals or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless the Contractor has, in letter form, called attention to such deviations at the time of submission and secured written approval of the specific deviations.
- B. Any materials and equipment listed which are not per the equipment shown on the schedule shall be of the size and physical arrangement to allow unobstructed access, when installed, for routine maintenance, motor removal, and other similar operations. Deviation from the characteristics of that equipment or layout system components will not necessarily be cause for rejection.
- C. A review of the submittal does not relieve the Contractor of his responsibility. Should an installation not meet the intent of the contract documents, the Contractor may be required by the Architect/Engineer to modify or replace equipment or system components with all costs, direct and indirect, borne by the Contractor.
- D. It is strongly recommended that the Contractor not purchase or install any equipment or system components before receipt of reviewed shop drawings.
- E. Reviewed with notations on the submittal shall not prohibit the Contractor from purchasing equipment. If the Contractor does not comply with the notations, the submittal shall be deemed rejected.
- F. Submittal documents shall be submitted for approval to the Architect/Engineer. Once approval has been obtained from the Architect/Engineer, the submittal shall be submitted to the Authority Having Jurisdiction and/or State Fire Marshal for final approval. Fire suppression system installation shall not begin until the Authority Having Jurisdiction and/or the State Fire Marshal's acceptance of submittal documents has been received.

1.6 EQUIPMENT DIMENSIONS AND WEIGHTS

- A. The contract documents may indicate specific equipment dimensions. The Contractor is responsible for verification of the dimensions of the equipment submitted before submitting shop drawings. Equipment larger than the equipment indicated on the contract documents may not be acceptable to the Architect/Engineer.
- B. The contract documents may indicate specific equipment weights. The Contractor is responsible for verification of the weight of the equipment submitted before submitting shop drawings. Equipment weighing more than the equipment indicated on the contract documents may not be acceptable to the Architect/Engineer.
- C. If equipment is not acceptable to the Architect/Engineer due to dimensions or weights exceeding those indicated on contract documents, the Contractor shall accept all responsibility and costs for providing equipment that meets the dimension and weight requirements of the contract documents.

1.7 ELECTRICAL CHARACTERISTICS

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- A. Electrical characteristics for fire suppression equipment are indicated on the fire suppression documents. The electrical documents indicate power and wiring requirements for each piece of fire suppression equipment.
- B. It shall be the fire suppression installer's responsibility to verify before submitting shop drawings that the equipment submitted meets the electrical requirements of both the fire suppression and electrical documents. If there is a discrepancy, the contractor shall bring the discrepancy to the Architect/Engineer's attention before submitting shop drawings.
- C. If the discrepancy is brought to the Architect/Engineer's attention before ordering the fire suppression equipment or electrical materials associated with that equipment, the Architect/Engineer will issue additional instructions to the Contractor.
- D. If the discrepancy is not brought to the Architect/Engineer's attention before ordering the fire suppression equipment and electrical materials (i.e., the Contractor does not verify electrical requirements), the Contractor shall be responsible for all costs except those that would have been incurred if the discrepancy was determined before ordering the fire suppression equipment and electrical materials.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRODUCT SUBMITTALS

- A. The following list may be used as a checklist for the contractor and Architect/Engineer. All products may not be listed.
 - Equipment and Pipe Identification
 - Escutcheons
 - Flexible Pipe Connections (sprinkler piping)
 - Hydraulic Calculations
 - List of Pipe and Fitting Material for Each System
 - Pipe Hangers and Supports
 - Pipe Sleeves
 - Seismic Products and Calculations
 - Sprinklers
 - Submittal Drawings (Pipe/Sprinkler Layout, Seismic Zone of Influence, etc.)
 - Supervisory Devices
 - Thermometers and Gauges
 - Valves
 - Vapor Phase Corrosion Inhibitor System
 - Water Flow Alarm Devices

3.2 TEST AND REPORT SUBMITTALS

- A. The following list may be used as a checklist for the Contractor and Architect/Engineer. All tests may not be listed.
 - 1. Fire suppression piping

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2. System start-up
3. Vapor Phase Corrosion Inhibitor System

3.3 SUBMITTAL DRAWINGS

- A. This section may not include all drawings required. See specific specifications for additional requirements. All drawings shall be drawn 1/8" = 1'0" minimum. Fire Pump rooms shall be drawn 1/4" = 1'-0" minimum.
- B. Review structural and architectural drawings to determine the method of attachment or support of pipe and equipment to slabs, walls, and other structural elements.
- C. Provide dimensional drawings in the plan with all site utilities shown. Underground utilities shall have all inverts listed where work is to be performed within a municipality, approval shall be obtained from the proper authority before submitting shop drawings to Architect/Engineer.
- D. When equipment is to be installed on supports provided by installers other than Division 21, the Division 21 installer shall provide:
 1. Size, orientation, weights, and connection locations for all equipment to be installed. Information shall include all seismic components, point loads, elevations, etc.
 2. Location and required size and elevation of all pipe supports.
- E. Provide a complete reflected ceiling plan indicating the locations of each sprinkler in addition to other utilities (i.e., lights, diffusers/grilles, speakers, etc.) Provide additional sprinklers (over Code minimum quantities) if requested by the Architect, to obtain symmetrical layouts.
- F. Provide a separate piping plan indicating seismic bracing locations, seismic zones of influence, flexible coupling locations, and all other seismic-related items.

3.4 SUBMITTAL DRAWINGS TO AUTHORITY HAVING JURISDICTION AND/OR STATE FIRE MARSHAL

- A. At the time of submission to the Authority Having Jurisdiction and/or State Fire Marshal, Contractor shall provide an electronic copy in PDF format of the Fire Sprinkler Submittal Plans to Engineer.

3.5 SUBMITTAL COVER SHEET

- A. A separate cover sheet shall be submitted with each product type (i.e., valves can be submitted together, etc.)

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3.6 SUBMITTAL COVER SHEET
(Provide one page for each group of submittal documents.)

PROJECT NAME: MTC AMSC CENTER ADDITION & RENOVATIONS BGA FILE No. 24094-6-33
OWNER PROJECT NO. _____ BGA SHOP DWG. No. _____
PRODUCT: _____

NOTE TO CONTRACTOR

1. All submittal comments by Buford Goff & Associates shall be complied with or the submittals shall be declared rejected.
2. If this form is not submitted and signed by the Contractor, the Contractor shall verify that items 1 to 8 below are answered YES or N/A or the submittals shall be declared rejected.
3. Sprinklers, valves, etc., are reviewed for characteristics but not for size and quantity. It is the Contractor's responsibility to verify sizes and quantity.

SHOP DRAWING SUBMITTAL (Contractor to complete this section)

1. Does the submittal comply with the contract documents? Yes No
If no, list all deviations on an attached page.
2. Have the electrical characteristics (i.e., volt/phase/amps, MOP, MCA, and connection location) been reviewed with the electrical schedules and the electrical circuit sizing meet the requirements of that equipment? Yes No N/A
3. Is product an approved manufacturer listed in the specifications or addendum? Yes No N/A
4. Does the product submitted meet the manufacturer's recommended service clearance for the space in which it is to be installed? Yes No N/A
5. Have the fire alarm components of the product been reviewed and do they meet with the requirements of the fire alarm contractor? Yes No N/A
6. Have the equipment connections been reviewed (size and locations) and has the Contractor included all provisions to make the required connections? Yes No N/A
7. Is the equipment within the weight limitations specified, if any? Yes No N/A

BGA'S SHOP DRAWING STAMP (Engineer to complete this section)

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Contractor is responsible for specific compliance with the information given in the Contract Documents; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades, and the safe and satisfactory performance of his work.

- Reviewed Reviewed as Noted Revise and Resubmit Revise and Resubmit Items Indicated
 See attached for additional comments Reject

Comments: _____

Reviewer: _____ Date: _____

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END OF SECTION

SECTION 21 05 48 - SEISMIC CONTROLS FOR FIRE SUPPRESSION 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 01 specification sections, apply to this section.
- B. All sections of Division 21 specifications apply to this section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Restrained elastomeric isolation mounts
 - 2. Restraining braces

1.3 DEFINITIONS

- A. IBC: International Building Code
- B. ICC-ES: ICC-Evaluation Service
- C. NFPA: National Fire Prevention Association

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class and Seismic Design Category as Defined in the IBC: Obtain from architectural and/or structural drawings.
 - 2. Assigned Seismic Occupancy Category as Defined in the IBC: Obtain from architectural and/or structural drawings.
 - a. Component Importance Factor, Ip: 1.5
 - 3. Mapped MCE Spectral Response Acceleration at Short Periods (0.2 second), Ss: 0.346,
 - 4. Seismic coefficient, Cp, per NFPA 13: 0.36

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

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3. Design calculations.

B. Submittal Drawings:

1. Submit drawings indicating the following items as a minimum:
 - a. Zone of influence areas
 - b. Flexible coupling locations
 - c. Location of piping penetrating masonry walls and/or impact-resistant gypsum board indicating either flexible couplings or annular clearances per NFPA 13.
 - d. 4-way bracing
 - e. Restraint of the end of sprinkler lines and branch lines
 - f. Restraining straps as required by NFPA 13
2. Submittal drawings shall be separate from fire sprinkler drawings and shall include minimal information needed from fire sprinkler drawings (i.e., sprinkler piping and sprinklers) to complete seismic drawings.

1.6 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFCON; an ASC Engineered Solution
 2. TOLCO Incorporated; a brand by EATON
- B. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to the braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

2.2 ANCHORAGE TO BUILDING STRUCTURE

- A. General:
1. Anchorage to the building structure shall meet the latest requirements of:
 - a. International Building Code (Chapter 19)
 - b. ASCE Standard 7-16 (Chapter 13)
 - c. American Concrete Institute (ACI) 318
 - d. NFPA 13 (Chapter 18)
 2. Requirements of this section of specifications are minimum requirements. When other requirements are indicated, the greater requirement shall be met or exceeded.

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B. Anchorage in Concrete or Masonry:

1. The following anchorage and attachments are not permitted:
 - a. Powder-driven fasteners for tension load applications in Category D, E, and F unless specifically approved for this application.
 - b. Friction clips.

C. Post-Installed Anchors:

1. Post-installed anchors for Seismic Design Category C, D, E, and F shall meet the requirements of ACI 318.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. All hardware shall be electro-galvanized. Hot-dip galvanized metal components for exterior use.
2. Bolts shall be zinc coated for interior applications and stainless steel for exterior applications.
3. Seismic restraint devices shall have a hot dipped galvanized or stainless steel finish for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze members with clamps approved for application by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction.
- B. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

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- A. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between the anchor and adjacent surface exceeds 0.125 inches.
 - 2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for the component.

- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127 and NFPA 13.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

- C. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES or an agency acceptable to authorities having jurisdiction providing required submittals for the component.

- D. Attachment to Structure: If a specific attachment is not indicated, anchor bracing to the structure at flanges of beams, at upper truss chords of bar joists, or concrete members.

- E. Drilled-in Anchors:
 - 1. Identify the position of reinforcing steel and other embedded items before drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with the sleeve fully engaged in the structural element to which the anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust before installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid the introduction of air pockets in the adhesive.
 - 5. Set anchors to the manufacturer's recommended torque, using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

END OF SECTION

SECTION 21 05 53 - IDENTIFICATION FOR FIRE SUPPRESSION 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 01 specification sections, apply to this section.
- B. All sections of Division 21 specifications apply to this section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels
 - 2. Miscellaneous signs and labels
 - 3. Flexible Sprinkler Hose Fittings label
 - 4. Stock of spare sprinklers sign
 - 5. Sprinkler System General Information sign

1.3 SUBMITTALS

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

- A. General:
 - 1. Nameplates shall be black plastic with white engraved lettering.
 - 2. All information shall be provided on a single nameplate per device if practical.

3. Nameplates shall have screw holes and screws for mounting unless screws would damage the intended use of the product to which it is attached (i.e., NEMA4 panel, etc.). In that case, provide stick-on nameplates.
4. Nameplates shall be 1/16" thick.

B. Size:

1. Three-quarter inch (3/4") high nameplate when located on ceiling grid.
2. Two-inch (2") high nameplate when located on fire protection equipment located either indoors or outdoors.
3. Three-quarter inch (3/4") high nameplates when located on starter and panels.

2.2 MISCELLANEOUS SIGNS AND LABELS

A. Metal labels:

1. Material and Thickness: Aluminum, 0.020" minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum label size: Length and width vary for required label content, but not less than 2- $\frac{1}{2}$ x $\frac{3}{4}$ inch.
3. Minimum letter size: $\frac{1}{2}$ inch.
4. Fasteners: Stainless steel rivets or self-tapping screws.
5. Chain: #16 single jack chain length as required.

B. Label content: As required.

C. Signage for miscellaneous valves, hydraulic placards, inspector's test connection, etc. Refer to NFPA 13 for identification requirements for valves.

2.3 STOCK OF SPARE SPRINKLERS SIGN

A. Material: 8 $\frac{1}{2}$ x 11-inch bond paper laminated and framed, mounted on the wall, or attached to the inside face of the spare sprinkler cabinet.

B. Information required:

1. Sprinkler Identification Number (SIN) if equipped, or the manufacturer, model, K-factor, deflector type, thermal sensitivity, and pressure rating.
2. General description.
3. Quantity of each type to be contained in the cabinet.
4. Issue or revision date of the list.

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C. Sample sign:

Sprinklers Contained in this Cabinet			
Sprinkler Identification, SIN	General Description	Temperature Rating, °F	Sprinkler Quantity Maintained
TY9128	Extended Coverage, K=25, upright	155	6
VK425	Concealed pendent residential	145	6
Issued: 10/3/21		Revised:	

2.4 SPRINKLER SYSTEM GENERAL INFORMATION SIGN

A. Metal Sign:

1. Material and Thickness: Anodized aluminum, 0.20" minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Lettering: Permanent lettering, size as required.

B. Information Required:

1. Name and location of the facility protected
2. Occupancy classification
3. Commodity classification
4. Presence of high-piled and/or rack storage
5. Maximum height of storage planned
6. Aisle width planned
7. Commodity classification
8. Encapsulation of pallet loads
9. Presence of solid shelving
10. Flow test data
11. Presence of flammable/combustible liquids
12. Presence of hazardous materials
13. Presence of other special storage
14. Location of venting valve
15. Location of auxiliary drains and low point drains on dry pipe and preaction systems
16. Original results of main drain flow test
17. Name of installing contractor or designer
18. Indication of presence and location of antifreeze or other auxiliary systems
19. Where injection systems are installed to treat MIC or corrosion, the type of chemical, concentration of the chemical, and where information can be found as to the proper disposal of the chemical

Sample sign:

SPRINKLER SYSTEM – GENERAL INFORMATION	
for	

High-piled storage <input type="checkbox"/> Yes <input type="checkbox"/> No	Date: _____
Rack storage: <input type="checkbox"/> Yes <input type="checkbox"/> No	Flow test data:
Commodity class: _____	Static: _____ psi
Max. storage height _____ ft.	Resid: _____ psi
Aisle width (min.) _____ ft.	Flow: _____ gpm
Encapsulation <input type="checkbox"/> Yes <input type="checkbox"/> No	Pitot: _____ psi
Solid Shelving: <input type="checkbox"/> Yes <input type="checkbox"/> No	Date: _____
Flammable/ combustible liquids: <input type="checkbox"/> Yes <input type="checkbox"/> No	Location: _____
Other storage: <input type="checkbox"/> Yes <input type="checkbox"/> No	_____
Location of aux/low point drains:	
Hazardous materials: <input type="checkbox"/> Yes <input type="checkbox"/> No	_____
Idle pallets: <input type="checkbox"/> Yes <input type="checkbox"/> No	_____
Antifreeze systems <input type="checkbox"/> Yes <input type="checkbox"/> No	Dry pipe/double interlock preaction test results
Location: _____	Original main drain test results:
Dry or aux systems <input type="checkbox"/> Yes <input type="checkbox"/> No	Original main drain test results:
Location: _____	Static: _____ psi
	Residual: _____ psi
	Venting valve location: _____
Where injection systems are used to treat MIC or corrosion:	
Type of chemical: _____	Concentration: _____
For proper disposal, see: _____	
Name of contractor or designer: _____	
Address: _____	
Phone: _____	

2.5 FLEXIBLE SPRINKLER HOSE FITTINGS

- A. Where flexible sprinkler hose fittings are used to connect sprinklers to branch lines in suspended ceilings, a label limiting relocation of the sprinkler shall be provided on the anchoring component.

1. An example of language for the label is as follows:

CAUTION: DO NOT REMOVE THIS LABEL.

Relocation of this device should only be performed by qualified and/or licensed individuals that are aware of the original system design criteria, hydraulic criteria, sprinkler listing parameters, and knowledge of the state and local codes including NFPA 13 installation standards. Relocation of the device without this knowledge could adversely affect the performance of this fire protection and life safety system.

2.6 CEILING LOCATION MARKERS

- A. Provide nameplates to indicate the location of equipment and devices located above the ceiling.

- B. Equipment shall include:

1. Floor control valves assemblies
2. Control valves
3. Drain valves, plugs, etc.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair the 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 fire suppression equipment.
- B. Locate equipment labels where accessible and visible.

3.3 STOCK OF SPARE SPRINKLERS SIGN

- A. Mount on the wall adjacent to the sprinkler cabinet or the inside face of the spare sprinkler cabinet.

3.4 SPRINKLER SYSTEM GENERAL INFORMATION SIGN

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- A. The sign shall be installed at each system control riser, antifreeze loop, and auxiliary system control valve.

3.5 CEILING LOCATION MARKERS

- A. After A/E approval, attach the nameplate to the ceiling grid as close to the device as practical.

3.6 NAMEPLATES

- A. Submit a listing of all nameplates with associated information to A/E for approval before fabrication.
- B. Coordinate the method of attachment and location of the nameplate with the contractor who is responsible for the installation of the device (i.e., control panel, air handler, etc.).

END OF SECTION

SECTION 21 13 00 – FIRE SUPPRESSION SPRINKLER SYSTEMS

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. Pipes, fittings, and specialties
2. Fire-protection valves
3. Sprinklers
4. Sprinkler specialty pipe fittings
5. Alarm devices
6. Pressure gages

B. Related Sections:

1. Division 21 Section "Seismic Controls for Fire Suppression Piping and Equipment" for vibration and seismic-related items.
2. Division 21 Section "Identification for Fire Suppression Piping and Equipment" for signs, labels, and identification requirements.
3. Division 28 Section "Fire Alarm System" for alarm devices not specified in this Section.

1.3 DEFINITIONS

- A. High-Pressure Piping: System piping designed to operate at working pressure higher than standard 175 psi but not higher than 250 psig.
- B. Standard-Pressure Piping: System piping is designed to operate at a working pressure of 175 psig maximum.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for a 175-psig minimum working pressure.
- B. Fire Suppression system design shall be approved by the State Fire Marshal. Approval by the State Fire Marshal shall be received before any installation work commences.
 1. Fire Suppression systems shall be hydraulically calculated.
 2. The margin of Safety for Available Water Flow and Pressure: 20 percent or 10 psi, whichever is greater, including losses through water-service piping, valves, and backflow preventers. If submittals for review by the State Fire Marshal are submitted one year or more after the date of the water flow test date noted on the "FIRE SPRINKLER

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SPECIFICATION SHEET" in Part 3 of this Section, the Contractor shall provide a new water flow test at no additional cost to the Owner. Any additional hydraulic calculations required due to the requirement of a new water flow test will be conducted by the Contractor at no additional cost to the Owner.

3. Refer to Part 3 of this Section for a completed "FIRE SPRINKLER SYSTEM SPECIFICATION SHEET" for bidding and design purposes.

C. Sprinkler design shall be hydraulically calculated based on the following:

1. Wet sprinkler systems are as follows:
 - a. Light Hazard Areas: Minimum 0.10 GPM per square foot over the most remote 1,500 square feet with a maximum sprinkler spacing of 225 square feet per sprinkler or UL listing. Reduction in remote area size is allowed when using quick response sprinklers per paragraph 19.3.3.2.3 of NFPA 13/2019. Calculations shall include a 100 GPM hose stream allowance.
 - 1) Classrooms
 - 2) Where noted on plans
 - b. Ordinary Hazard (Group 1) Areas: Minimum 0.15 GPM per square foot over the most remote 1,500 square feet with a maximum sprinkler spacing of 130 square feet per sprinkler or per UL listing. Reduction in remote area size is allowed when using quick response sprinklers per paragraph 19.3.3.2.3 of NFPA 13/2019. Calculations shall include a 250 GPM hose stream allowance.
 - 1) Assembly rooms
 - 2) Where noted on plans
2. Dry sprinkler systems are as follows:
 - a. Ordinary Hazard (Group 2) Areas: Minimum 0.20 GPM per square foot over the most remote 1,950 square feet with a maximum sprinkler spacing of 130 square feet per sprinkler. Calculations shall include a 250 GPM hose stream allowance.
 - 1) Canopy areas
 - 2) Where noted on plans

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For fire suppression systems. Include plans, elevations, sections, details, and attachments to other work.
- 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 equipment
 3. Items penetrating the finished ceiling include the following:
 - a. Lighting fixtures
 - b. Air outlets and inlets
 - c. Speakers
 - d. Projectors

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4. Drawings shall include sections and elevations as required to indicate pipe routing and coordination with other utilities.
- D. Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, shall be submitted to the Architect/Engineer, including hydraulic calculations. Once the Architect/Engineer's approval has been received, the Contractor shall submit plans and calculations to State Fire Marshall for final approval.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" as applicable.
- F. Field quality-control reports.
- G. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. The systems shall be designed, fabricated, and installed by a licensed fire protection contractor or contracting firm regularly engaged in the installation of fire protection systems. The Architect may require evidence to support the above requirements and may reject any proposed contractor who cannot show suitable experience.
 2. The Contractor must be certified as a NICET Level III, minimum, for fire sprinkler systems and shall submit data showing the same.
 3. The Contractor shall furnish evidence that there is an experienced and effective service organization that carries a stock of repair parts for the system to be furnished. Should the Contractor fail to comply with the service requirements of this Section, the Owner or his Representative will then have the option to make the necessary repairs and back-charge the Contractor without any loss of warranty or guarantee as provided by the Contract Documents.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 (2020 Edition), by a qualified testing agency, and marked for intended location and application.
- C. NFPA Standards: Fire Suppression system equipment, specialties, accessories, installation, and testing shall comply with the following:
 1. NFPA 13 (2019 Edition), "Installation of Sprinkler Systems."
 2. NFPA 25 (2020 Edition), "Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems."
- D. Piping: The Owner and Architect/Engineer reserve the right to inspect, sample, and test any pipe after delivery and to reject all pipes represented by any sample which fails to comply with the specified requirements. Inspection of the pipe shall be for pits, blisters, rough spots, breakage, or other imperfections. Any pipe which has been rejected because of the above shall be conspicuously identified and immediately removed from the construction site.

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1.7 PROJECT CONDITIONS

- A. Interruption of Existing Fire Suppression Service: Do not interrupt fire suppression service to facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire suppression service according to the requirements indicated:
1. Notify Architect and Owner no fewer than two days in advance of the proposed interruption of sprinkler service.
 2. Do not proceed with the interruption of sprinkler service without Architect's and Owner's written permission.

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 EXTRA MATERIALS

- A. Furnish extra materials that match the products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for a minimum of six spare sprinklers plus sprinkler wrench. Provide a minimum of two sprinklers of each type and temperature rating. Include a separate cabinet with sprinklers and a wrench for each type of sprinkler used on the Project. Provide "Stock of Spare Sprinkler Sign" as required by NFPA 13 and section 21 0553 of these specifications.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Piping shall meet the requirements of NFPA 13. Material shall be new domestic materials of standard manufacture suitable for specified use. The contractor shall base his bid on the use of one or a combination of the following:
1. Above Grade Piping:
 - a. Piping 1-1/4" and larger shall be Schedule 10 (meeting ASTM A-135 or A-795 requirements) or Schedule 40 (meeting ASTM A-53 requirements) steel piping with welded outlets and mechanical grooved ends.
 - b. Piping 1 through 2" shall be Schedule 40 with threaded fittings.
 - c. Instead of threaded steel piping systems, Victaulic Installation-Ready™ Fittings for sizes 1-1/4" thru 2-1/2" and FireLock IGS System with "Installation-Ready™ fittings and couplings may be used for 1" diameter Schedule 10 and 40 steel pipe. The system shall be rated for a working pressure of 365 psi.
 - 1) Installation-Ready™ fittings shall consist of a ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, pre-lubricated Grade "E" EPDM Type 'A' gasket, and ASTM A449

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- electroplated steel bolts and nuts. UL listed for a working pressure of 300 psi and FM approved for a working pressure of 365 psi.
- 2) Groove: IGS "Innovative Groove System" groove with shortened "A" dimension and tapered groove backside for ease of installation.
 - a) Grooving Tool: Victaulic RG2100, with IGS Confirmation Gauge.
 - 3) IGS Fittings:
 - a) Ductile iron housing conforming to ASTM A-536, Grade 65-45-12. Orange enamel-coated or galvanized.
 - i. Victaulic Style 101 (90-degree elbow), Style 102 (tee), and Style 108 (coupling) with Installation-Ready™ ends.
 - ii. Style 108 single-bolt coupling provided with EPDM Type A pressure-responsive gasket with Vic-Plus lubricant, and ASTM A449 compliant electroplated steel bolt and nut. CrMo alloy steel coupling linkage.
 - b) Thread x Groove adapter fittings and welded outlets with IGS grooved end, ASTM A53, grade A.
 - d. Pipe and fittings used in dry pipe systems shall be Schedule 40 (meeting ASTM A-53 requirements) steel piping with mechanical cut grooved pipe couplings and fittings for piping 1-1/2" and larger; threaded fittings for piping 1-1/4" and smaller. Dry pipe system piping exposed to the weather shall be hot-dipped zinc-coated (galvanized).
 - e. Piping and fittings exposed to ambient conditions or installed on the exterior shall be hot-dipped zinc-coated (galvanized).
 - f. Pipe and fittings exposed to the weather shall be hot-dipped zinc-coated (galvanized) including drain piping (main and auxiliary) downstream of the drain valve.
- B. Malleable- or Ductile-Iron Unions: UL 860, 2" and smaller.
- C. Grooved-Joint, Steel-Pipe Appurtenances:
1. Manufacturers: Material shall be new domestic materials of standard manufacture suitable for specified use. The installing contractor shall select one manufacturer to be used throughout the project. The use of multiple manufacturers is not acceptable. Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company
 - b. Anvil International, Inc./ASC Engineered Solutions
 - c. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP
 2. Pressure Rating: 175 psig minimum.
 3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A536, ductile-iron casting; with dimensions matching steel pipe. In applicable sizes, fittings shall be short pattern, with flow equal to standard pattern fittings. Basis of Design: Victaulic Fire-Lock.
 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, Grade "A" EPDM-rubber gasket, and bolts and nuts.
 - a. Provide Installation-Ready center-leg gaskets with pipe stop to ensure proper groove engagement, alignment, and pipe insertion depth where applicable.

- b. Provide Tri-Seal or Flush Seal® Grade "E" EPDM-rubber flush seal gaskets for dry pipe service.
- c. Rigid Type: Housings cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging per NFPA 13, fully installed at visual pad-to-pad offset contact. Couplings that require exact gapping at specific torque ratings are not permitted.
 - 1) Installation-Ready, for direct stab installation without field disassembly. Basis of Design: Victaulic Style 009N and 107N.
- d. Flexible Type: For use in locations where vibration attenuation, and stress relief or seismic areas as required by NFPA 13.
 - 1) Basis of Design: Victaulic Installation-Ready Style 177.

2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8-inch-thick or ASME B16.21, nonmetallic, and asbestos-free.
 - 1. Class 125, Cast-Iron Flanges, and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges, and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts, and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Grooved Joint Lubricants: Lubricate the gasket per the manufacturer's published instructions with lubricant approved for the gasket elastomer and fluid media.

2.3 HANGERS AND SUPPORTS

- A. General: The Contractor shall provide all necessary hangers, supports, bracing, accessories, etc., as required for proper installation of the work, and only approved type hangers shall be used. All piping must be substantially supported by the building structure.
- B. Structural steel, other than the building structure or special supports provided under another section of the specifications, required for proper supporting of piping and equipment shall be furnished and installed under this section of the specifications.
- C. Piping supported from floors shall be provided with steel support bases.
- D. All hangers on piping including clevis hangers, inserts, clamps, stanchions, and brackets, shall be dipped in zinc chromate primer before installation. Rods shall be galvanized.
- E. All threaded rods, bolts, clamps, fasteners, concrete inserts, saddles, and accessories installed on the roof, in the crawl space, or exposed to ambient shall be 304L stainless steel.
- F. All auxiliary support steel installed on the roof, in the crawl space, or exposed to ambient may be hot-dipped galvanized if not welded or field cut or drilled, and 304L stainless steel if welded or field cut or drilled.
- G. Piping shall be seismically restrained as required in Section 210548.

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2.4 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.
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.

B. Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company
 - b. Anvil International, Inc./ASC Engineered Solutions
2. Standard: UL 1091 except with a ball instead of a disc.
3. Valves NPS 1-1/2 and Smaller: Bronze or brass body with threaded or grooved ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Iron Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company
 - b. Anvil International, Inc./ASC Engineered Solutions
 - c. Kennedy Valve; a division of McWane, Inc.
 - d. Milwaukee Valve Company
 - e. NIBCO INC.
 - f. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP
2. Standard: UL 1091.
3. Pressure Rating: 300 psig
4. Body Material: Cast or ductile iron
5. Seat: Pressure responsive elastomer
6. Stem: Stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating.
7. End Connections: Grooved

D. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company
 - b. Anvil International, Inc./ASC Engineered Solutions
 - c. Fire-End & Croker Corporation
 - d. Globe Fire Sprinkler Corporation
 - e. Kennedy Valve; a division of McWane, Inc.
 - f. Mueller Co.; Water Products Division
 - g. NIBCO INC.
 - h. Reliable Automatic Sprinkler Co., Inc.
 - i. Tyco Fire & Building Products LP
 - j. Viking Corporation

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2. Standard: UL 312
3. Pressure Rating: 250 psig minimum
4. Type: Spring-assisted swing check
5. Body Material: Cast ductile iron
6. Spring: Stainless steel
7. End Connections: Flanged or grooved

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E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company
 - b. Anvil International, Inc./ASC Engineered Solutions
 - c. Kennedy Valve; a division of McWane, Inc.
 - d. Milwaukee Valve Company
 - e. NIBCO INC.
 - f. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP
2. Standard: UL 1091
3. Pressure Rating: 175 psig minimum
4. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly
 - b. Body Material: Bronze or brass
 - c. End Connections: Threaded or grooved
5. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly
 - b. Body Material: Cast or ductile iron
 - c. Seat: Pressure responsive elastomer
 - d. Stem: Stainless steel, offset from the disc centerline to provide complete 360-degree circumferential seating
 - e. End Connections: Flanged, grooved, or wafer
6. Valve Operation: Weatherproof actuator housing with integral electrical, 125-V ac, prewired, two-circuit, supervisory switch visual indicating device.
7. Valves installed on the backflow preventer test connection line, fire pump test header line, flow meter line, and elsewhere, as noted on plans, shall be designed for normally closed position monitoring.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing
2. Pressure Rating: 175 psig minimum

B. Universal Test & Drain Assembly:

1. A single-body universal test and drain valve with a 3-way body shall be of bronze body construction, incorporating stainless steel components, and shall be rated for a working pressure of 300 psi., and a universal test orifice of K2.8 (1-1/2" pipe and smaller), K4.2 (2"-3" piping), and K5.6 (4" and larger piping); to provide testing capabilities of systems with k-factors ranging from K5.6 and larger.
2. UL listed and FM approved.
3. Basis of Design: Victaulic Series UTD; Universal Test & Drain Valve with Victaulic Series ARV; Adjustable Relief Valve.

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2.6 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 minimum
 - b. High-Pressure Piping Specialty Valves: 250 psig minimum
3. Body Material: Cast or ductile iron
4. Size: Same as connected piping
5. End Connections: Flanged or grooved

B. Vapor Phase Corrosion Inhibitor System:

1. Basis-of-Design Product: Subject to compliance with requirements, provide General Air Products, Inc.; Vapor Pipe Shield.
2. Description: Vapor phase Corrosion Inhibitor (VpCI®) delivery system for dry fire sprinkler systems providing corrosion protection within the sprinkler system piping network. A pneumatic and mechanical device that requires no electricity.
3. Standard: UL 2901B
4. Capacities and Characteristics:
 - a. The system shall be based on the total sprinkler system capacity and the largest single system capacity of the dry pipe system as calculated by the Division 21 Contractor.
 - b. The system shall include a shutoff valve to permit servicing without shutting down the sprinkler system.
 - c. Maximum Operating Pressure: 150-psig
 - d. Operating Temperature Range: 40°F - 150°F
5. Included Components:
 - a. Stainless Steel Media Enclosure
 - b. Water Removal Pre-filter and After-filter
 - c. (2) Coalescing Pre-filters
 - d. Air Inlet and Outlet ½" FNPT Connections
 - e. Shutoff / Isolation Valve
 - f. Automatic Drain Ports 3/8" push to connect tubing
 - g. ½" Union and 30" Stainless Steel Flex Hose with ½" MNPT Connections
 - h. Vapor Indicator Test Port
 - i. Wall Mounting Kit

C. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum
4. Type: Automatic draining, ball check
5. Size: NPS 3/4
6. End Connections: Threaded

2.7 SPRINKLER SPECIALTY PIPE FITTINGS

A. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP.
 - d. Victaulic Company.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with an orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

B. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AGF Manufacturing Inc.
 - b. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.
7. Accessories: Pressure relief valve.

C. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic, VicFlex AH2
 - b. FlexHead Industries, Inc. Superflex
2. Standard: UL 2443 and FM 1637.
3. Type: Braided flexible hose for connection to a sprinkler, and with a bracket for connection to the ceiling grid. Coordinate with ceiling grid requirements for bracket length.
4. Pressure Rating: 175 psig minimum.
5. Bend radius to 2 inches (UL Listed) for proper installation in confined spaces.
6. The hose shall be listed for (4) bends at 31" length, (5) bends at 36" length, (8) bends at 48" length, (10) bends at 60" length, and (12) bends at 72" length. Union joints shall be provided for ease of installation.
7. Size: Same as connected piping, for a sprinkler.

D. In-Line Corrosion Monitor for Wet and Dry Pipe Fire Sprinkler Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.; CORRinSITE™ Model 7700.
2. Standards:
 - a. NFPA 13 and NFPA 25.
3. Specifications:
 - a. Service Pressure: 300 PSI.
 - b. Operating Temp.: -40°F to 200°F.
 - c. Material: Mild Carbon Steel.
 - d. Wear Dimension: 0.040 inches.
 - e. Sizes: As required for piping; 2" through 8" diameter.
 - f. Pipe Schedule 10.
 - g. Pipe System Application For Black and Galvanized Pipe to match the piping material used for the fire sprinkler system.
4. Model 7700 is an In-Line Spool version.
Model 7800 is a Mechanical Tee version.
5. Finishes:
 - a. Powder-coat.
 - 1) Color: Red.

E. Automatic Air Vent Assembly:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc. PURGE_NVENT model
2. Automatic Air Vent:
 - a. Pressure Rating: 300 psig and, 175 psi for air vent.
 - b. Body Material: Forged brass body.
 - c. Components: Integrated ball valve, stainless steel strainer, purge valve with hose connection (field adjustable), thread cap with lanyard, automatic air vent.
 - d. Size: NPS 1 NPT inlet by NPS 3/4 NPT outlet.
 - e. Drainage Piping: NPS 1/2.
3. Pressure Rating: 175 psi

2.8 SPRINKLERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Reliable Automatic Sprinkler Co., Inc.
 2. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP.
 3. Victaulic Company.
 4. Viking Corporation.

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- 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 minimum.
 - 3. Sprinklers installed in light hazard occupancies shall be quick response.
- C. Sprinkler Types:
 - 1. Refer to plans for sprinkler types and locations.
- D. The actual sprinkler count, by sprinkler type, shall be provided by the Contractor.
- E. Install sprinklers of proper temperature rating, as required by NFPA 13, and as follows:
 - 1. Ordinary temperature-rated sprinklers shall be installed in all areas unless there are other areas requiring higher temperature rating sprinklers as required by NFPA 13.

2.9 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Pressure Switches:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
 - c. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP.
 - d. Viking Corporation.
 - 2. Standard: UL 346.
 - 3. Type: Electrically supervised water-flow switch with retard feature.
 - 4. Components: Single-pole, double-throw switch with normally closed contacts.
 - 5. Design Operation: Rising pressure signals water flow.
- C. High-Low Air Pressure Switch:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Potter Electric Signal Company
 - b. System Sensor; a Honeywell company
 - c. Tyco-Fire, a division of Johnson Controls Fire & Building Products LP
 - d. Viking Corporation
 - 2. Type: Electrically supervised pressure type supervisory switch.
 - 3. Components: Two single-pole, double-throw switches
 - 4. Design Operation: Indicate a pressure decrease of 10 psi from normal and a pressure increase of 120 psi from normal.

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D. Valve Supervisory Switches:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kennedy Valve; a division of McWane, Inc.
 - b. Potter Electric Signal Company.
 - c. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that the controlled valve is in other than a fully open position.

2.10 PRESSURE GAUGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. AMETEK; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig minimum.
- E. Accuracy: Plus or minus 3-2-3 percent minimum.
- F. Pressure gauges installed on Fire Pump lines shall be liquid-filled.
- G. Water System Piping Gage: Include a "WATER" or "AIR/WATER" label on the dial face.
- H. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on the dial face.

PART 3 - EXECUTION

3.1 SERVICE-ENTRANCE PIPING

- A. Connect sprinkler piping to existing dry and wet sprinkler system.

3.2 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate the 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 authorities having jurisdiction. File the written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with a shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. All drain lines, relief lines, etc. shall extend to the exterior unless noted otherwise. Piping shall discharge to a 24" square x 4" thick concrete pad.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13 unless noted otherwise in this section.
- M. Pressurize and check dry sprinkler system piping and air-pressure maintenance devices.
- N. Fill sprinkler system piping with water.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings the same as or higher than the system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and removes any 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. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove at the end of the 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.
- I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with the materials of both piping systems.

3.4 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 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open (unless noted otherwise), located to control sources of water supply except fire-department connections. Install permanent identification signs indicating the portion of the system controlled by each valve.
- C. Specialty Valves:
 - 1. General Requirements: Install in a vertical position for proper direction of flow, in the main supply to the system.
- D. Vapor Phase Corrosion Inhibitor System: Install at fire riser assembly and per manufacturer's requirements.
- E. In-Line Corrosion Monitor for Wet and Dry Pipe Fire Sprinkler Systems: Install at each fire riser assembly and per manufacturer's requirements.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in the center of the narrow dimension of and at quarter points (for 2' x 4' acoustical panels) acoustical ceiling panels.

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- B. Install dry-type sprinklers with a water supply from a heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Sprinklers installed in lay-in suspended ceilings shall be installed into flexible, sprinkler hose fittings and install hose into the bracket on ceiling grid.

3.6 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Refer to Division 21 "Identification for Fire Suppression Piping and Equipment" for additional information.
- C. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

- A. Flushing and pressure testing of piping shall be witnessed by a third-party inspection service, engineer of record, or local fire official. Invitations to witness flushing and/or testing shall be provided to all parties noted above. Provide a minimum of forty-eight (48) hours of notification before flushing and/or testing the system.
- B. Perform tests and inspections.
- C. 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, "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 the same as local fire department equipment.
- D. The sprinkler piping system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 CLEANING

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

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3.9 FIRE SPRINKLER SYSTEM SPECIFICATION SHEET

- A. Attached is a completed fire sprinkler system specification sheet for bidding and design purposes.



Fire Sprinkler System Specification Sheet

(Per §40-10-250)



Project Data

Project name: MTC AMSC Center Addition & Renovations			
Location in South Carolina:	Address (street # & name): 1260 Lexington Drive		State Project: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	City: West Columbia	County: Lexington	State Project #: T07-N301-PG

Water Supply Information (Flow test data must be less than 1 year old per §40-10-250(A)(1))

Date test conducted: 03/03/2025	Static pressure (psi): 48	Residual pressure (psi): 36	Flow (gpm): 1,425
Distances of test gauges relative to the base of the riser:		Horizontal (ft):	Vertical (elevation difference in ft):
Source of water supply:	<input type="checkbox"/> Municipal dead-end <input checked="" type="checkbox"/> Municipal circulation <input type="checkbox"/> existing fire pump <input type="checkbox"/> Other:		Pipe Size (in.): 10
Test data by/from:	Name: Ricardo Haigler/Wesley Oseman		Title:
	Organization: City of Cayce		Phone: 803-796-9020
Fire pump:	<input type="checkbox"/> New <input checked="" type="checkbox"/> Existing	Rated Pressure (psi): 80	Churn Pressure (psi): 96
	<input type="checkbox"/> No Pump	Rated Capacity (gpm): 750	Pressure @ 150% flow (psi): 57
On-site water storage:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	<input type="checkbox"/> New <input type="checkbox"/> Existing	<input type="checkbox"/> Tank <input type="checkbox"/> Other:
Capacity (gal):			

NFPA Hazard Classification (Attach continuation page when necessary)

Area #	Hazard Class or Code Reference	Description of Hazard Protected (including occupancy use group, and details of storage arrangement as applicable (including commodity class, rack arrangement/type, ceiling and storage height.))
1	Light Hazard Occupancy	Classrooms; Where noted on plans
2	Ord. Hazard Group II	Assembly Rooms; Where noted on plans
3	Ord. Hazard Group I	Exterior Canopy Area; Where noted on plans

Design Parameters (Attach continuation page when necessary)

Area #	System Type	Density(gpm/ft ²)/Area(ft ²), or Other (Reference code sections)	Inside Hose (gpm)	Outside Hose (gpm)
1	Wet Sprinkler	0.10 gpm/ft ² / 1,500 ft ² *	0	100
2	Wet Sprinkler	0.20 gpm/ft ² / 1,500 ft ² *	0	250
3	Dry Sprinkler	0.15 gpm/ft ² / 1,950 ft ²	0	250

Seismic Design Data:	SS= 0.346	Site Classification= D	Seismic Design Category= C
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Codes and Standards (Attach continuation page when necessary)

Applicable Codes, Standards, & Editions (i.e., 2018 IBC, 2016 NFPA 13, etc.) for the Scope of Work on the Fire Sprinkler System
IBC/2021; IFC/2021; NFPA 13/2019

* - Reduction in the hydraulically remote area when using quick response sprinklers per paragraph 19.3.3.2.3 of NFPA 13/2019.

Scope of work (i.e., sprinkler system A.G. from 1'-0" A.F.F., U.G. from tap to 5'-0" outside, etc.) and notes (attach continuation page when necessary):
Scope of work begins to connection to existing aboveground system.

Specifier's Information

Name:	Mark L. Watts		
Engineering services provided through a firm:	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		
Firm name:	Buford Goff & Associates, Inc.		
Address:	1331 Elmwood Avenue, Suite 200		
City:	Columbia		
State:	South Carolina	Zip:	29201
Phone #:	803-254-6302	Fax #:	803-771-6142
E-mail:	Mark.Watts@BGAINC.com		



Certificate of Authorization



Professional Engineer's Seal

Revision No.: _____

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Signature:

Date: 04/17/2026

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END OF SECTION

SECTION 22 05 00 - GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Plumbing Work shall include, but not be limited to, the following:
 - 1. Soil and waste and vent systems
 - 2. Domestic water systems
 - 3. Domestic water heating
 - 4. Plumbing fixtures and trim

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 DELINEATION OF WORK

- A. Provide all necessary supervision and coordination of information to installers who are performing work to accommodate Division 22 installations.
- B. Where the Division 22 installer is required to install items which they do not purchase, they shall include for such items:
 - 1. The coordination of their delivery.
 - 2. Their unloading from delivery trucks driven into any designated point on the property line at grade level.
 - 3. Their safe handling and field storage up to the time of permanent placement in the project.
 - 4. The correction of any damage, defacement or corrosion to which they may have been subjected.
 - 5. Their field assembly and internal connection may be necessary for their proper operation.
 - 6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
 - 7. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- C. Items which are to be installed by the Division 22 installer but not purchased as part of the work of Division 22 shall be carefully examined upon delivery to the project. The Division 22 installer shall provide all work necessary to properly install these items.
- D. If any items have been received in such condition that their installation will require additional work beyond the project scope of the work, the A/E shall be notified in writing within 10 working days of the date of delivery of the items. Any claims beyond 10 days will not be considered by the A/E.

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1.4 QUALITY ASSURANCE

- A. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All 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, if so directed by the Engineer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.
- B. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. ASME Code Ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- C. All equipment of one type (such as pumps, valves, etc.) shall be the products of one manufacturer unless specifically stated otherwise.
- D. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
- E. All materials with a manufacturers listed shelf life shall be used at least six months prior to the expiration of the materials' shelf life.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

- A. Submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.
- B. All work shall conform to the following Building Codes (latest edition):
 - 1. International Building Codes
 - 2. National Fire Protection Association
- C. All work shall conform to all federal, state, and local ordinances.
- D. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:
 - 1. Factory Mutual Laboratories (FM)
 - 2. Underwriters Laboratories, Inc. (UL)
- E. All fuel fired equipment shall meet the requirements of the insurers and agencies listed and also meet the owner's insurer requirements.

1.6 STANDARDS AND PROCEDURES

- A. All work shall meet or exceed the standards and procedures of the following:

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1. ANSI: American National Standards Institute
2. ASME: American Society of Mechanical Engineers
3. ASTM: American Society of Testing and Materials
4. AWWA: American Water Works Association
5. NEMA: National Electrical Manufacturer's Association
6. OSHA: Occupational Safety & Health Administration
7. IRM: Improved Risk Mutuals

1.7 APPROVAL OF SUBSTITUTIONS

- A. Specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgment of the A/E expressed in writing, is equal to that named. Where quality and other characteristics are nearly the same, the question of determining equal materials and readily available service sometimes resolves itself to a matter of personal opinion and judgment and in these and all other cases involving the approval of materials, the opinion, judgment and decision of the A/E shall be final and bind all parties concerned.
- B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified shall be submitted for approval in writing ten (10) calendar days prior to bid opening date to the A/E. Requests shall be accompanied by samples, literature, and information as necessary to fully identify and allow appraisal of the material or equipment. Submittals shall be concise, clear, and brief as possible. Incomplete submittals or submittals requiring lengthy research to ascertain quality will not be considered.
- C. Approval of the A/E to use materials or equipment, if granted, will be in the form of a written addendum. Approved substitutions may be used at the Contractor's option. No substitutions will be allowed if substitutions are requested later than ten (10) days prior to bid opening date.
- D. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly indicated in the form of a letter that is enclosed with the submittals. The Contractor shall be responsible for verifying all dimensions with available space. If, in the opinion of the A/E, the physical dimensions do not permit the substituted material or equipment to be properly operated, maintained, serviced, or otherwise accessed, or the physical dimension adversely impact other components, a system's ability to be operated, maintained, serviced or otherwise accessed, the material or equipment shall be replaced at the Contractor's expense.

1.8 VERIFICATION OF DIMENSIONS AND LOCATIONS

- A. The Contractor shall visit the facility and become thoroughly familiar with all details of the work, working conditions, dimensions and clearances.
- B. Notify the A/E of any discrepancy between actual conditions and conditions indicated on the contract documents that could cause changes, other than minor ones, to the installation of any systems or equipment.

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1.9 EQUIPMENT CONNECTIONS

- A. The contract documents may indicate specific electrical, duct, and piping connection locations to equipment. Each manufacturer approved for bidding may have different connection arrangements. The Contractor is responsible for the modifications to and the extension of connecting components as required for the equipment provided.
- B. The Contractor shall bear all costs for required changes in connection to equipment.

1.10 WORKMANSHIP

- A. Workmen shall be thoroughly experienced and fully capable of installing the work. Work shall be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner.
- B. All material and equipment to be installed in accordance with manufacturer's printed recommendations using recommended accessories. Retain a copy on job site and submit others for approval when required.

1.11 GUARANTEES AND WARRANTIES

- A. General:
 - 1. Furnish to the A/E a guarantee form, included in these specifications, signed by the Contractor and Owner agreeing to the start and end dates of all systems and equipment under warranty.
 - 2. All defective materials or inferior workmanship shall be replaced or repaired as directed by the Owner's representative during the guarantee period.
- B. Equipment Warranties:
 - 1. Equipment shall be warranted by the equipment manufacturer. Where labor is included in the warranty, the manufacturer, at his option, may permit the contractor to provide the required repairs on the equipment.
 - 2. The equipment manufacturer shall include a written guarantee with the closeout documentation.
- C. Duration Period:
 - 1. For work not otherwise specified, the duration shall be one year from substantial completion including all parts, labor, and other charges.
 - 2. The Contractor is responsible for purchasing from the equipment manufacturers any additional warranties to ensure that the equipment is warranted by the manufacturer through the duration period specified.
- D. Extended Warranties:
 - 1. Warranty periods shall be extended where specifically stated in these specifications.
 - 2. The extended warranties shall meet the requirements of the base warranty unless specifically noted otherwise.
 - 3. The extended warranty time listed is time in addition to the base warranty period.

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4. The following systems or equipment shall have extended warranties:
 - a. Variable frequency drives shall have a one-year extended warranty.

E. Non-Warranted Items:

1. Nondurable replaceable items do not require replacement after the date of acceptance.

F. Warranty Repair:

1. Repair shall take place as soon as possible but not later than the following:
 - a. Items not essential for facility operation - 7 days.
 - b. Items that have a small impact on facility operation - 2 days.
 - c. Items that have a significant impact on the facility operation - immediately begin repairs or work necessary to minimize operational impact to Owner.
2. The determination of the impact on the facility is solely that of the Owner and A/E.
3. Where life safety issues are impacted, the contractor shall take all steps necessary to ensure the facility can continue to function in a safe manner.
4. If repairs cannot be made in the required time period, temporary systems shall be installed until repairs can be completed.
5. All costs associated with warranty work shall be borne by the contractor.

1.12 EXISTING FACILITIES

- A. The location of duct, pipe, fixtures, equipment and appurtenances for existing facilities are shown on plans to indicate the extent of work required. Exact condition shall be field verified.
- B. Work shall be performed above existing ceilings except where removal of existing ceilings is specifically identified. Where working above existing ceilings, remove existing tile/grid and reinstall existing tile/grid as necessary. Any damaged tile/grid shall be replaced at the Contractor's expense.

PART 2 - PRODUCTS: (NOT USED)

PART 3 - EXECUTION:

3.1 PRIOR CONDITIONS

- A. Prior to the installation of any equipment or system component, the Contractor shall review any prior work that has been completed to accommodate the equipment or system component to be installed.
- B. If the prior work does not make a proper installation of any equipment or system component possible, notify the A/E prior to installation of any equipment or system component.

3.2 INSTALLATION

- A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations and the manufacturer's shop drawings.

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- B. If any equipment cannot be installed in accordance with Codes, contract documents, manufacturer's recommendations and accepted practices, notify the A/E in writing prior to installation of equipment.
- C. If any system component cannot be installed in accordance with Codes, contract documents and accepted practices, notify the A/E in writing prior to installation of the system component.

3.3 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, repair or replace damaged items as determined by the A/E, at no cost to the Owner.
- B. Store equipment on elevated supports and cover them on all sides with securely fastened waterproof coverings. All equipment openings shall be securely sealed.
- C. Piping shall be protected by storing it on elevated supports and capping the ends.
- D. During construction, all open ends of pipe, floor drains, etc. which could collect construction debris shall be properly capped.

3.4 CLEANING OF SYSTEMS AND EQUIPMENT

- A. All equipment and systems shall be cleaned of all extraneous materials to leave equipment and system finish in a new condition.
- B. Where equipment and systems cannot be properly cleaned, take all measures necessary to replace or repair equipment and systems to bring back to a "like new" condition. All costs shall be borne by the Contractor.
- C. All extraneous materials shall be removed on the site on a regular basis to provide access to all work as well as a safe working environment.

3.5 SUPPORT OF SYSTEMS

- A. Hanging piping or equipment from un-reinforced metal roof decks (i.e., metal roof deck w/o concrete is not permitted).
- B. The following methods of support are not permitted:
 - 1. Wire hangers unless specifically indicated
 - 2. Perforated straps

END OF SECTION

SECTION 22 05 01 - COMMON PLUMBING MATERIALS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of the plumbing systems shown on the drawings and specified hereinafter.

B. Description:

1. Rooftop curbs shall include all supports for rooftop pipe and accessories.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

- A. All work shall meet or exceed the standards and procedures (latest edition) of the following:

1. AISC Steel Handbook

- B. All work shall be applicable by mechanics normally employed in the trade. All work shall be installed in accordance with the manufacturer's recommendations.

C. Manufacturers:

1. The following paint manufacturers are acceptable:
 - a. Glidden
 - b. Sherwin-Williams
 - c. Devoe Paints
2. The following caulking manufacturers are acceptable:
 - a. TREMCO
 - b. Sonneborn - Contech
 - c. W. R. Meadows
3. The following acoustical sealant (gypboard) manufacturers are acceptable:
 - a. USG or equal

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PART 2 - PRODUCTS

2.1 PRODUCT REFERENCES:

- A. Unless specifically indicated otherwise, the following products or product accessories shall be provided with the indicated equipment.
 - 1. Roof curbs and piping support curbs shall be provided for all flues and piping located on a roof.

2.2 PAINT

- A. General:
 - 1. Painting shall be in strict accordance with the paint manufacturer with regards to surface preparation, priming, and finish painting.
 - 2. High temperature paint, chemical resistant paint, and similar special paints shall be provided as required for specific application.
 - 3. Color shall be as selected by A/E. Color can be any available color from manufacturer.
 - 4. In addition to prime coat, two finish coats shall be applied.
 - 5. Refer to Section 22 0553 "Identification for Plumbing Piping and Equipment" for additional materials to be painted.
- B. The following items shall not be painted unless specifically specified otherwise:
 - 1. Concealed Supports and Accessories
 - 2. Hot Dipped Galvanized Steel
 - 3. Stainless Steel
 - 4. Aluminum
 - 5. Threaded Rods
 - 6. Factory Painted Items
- C. In addition to equipment and materials specified elsewhere to be painted, the following shall be painted (except where excluded elsewhere in this section of specifications):
 - 1. All hangers, non-threaded rods, fasteners, supports, and accessories where not located in concealed locations.
 - 2. Flues on the exterior of the building.
- D. Paint shall be:
 - 1. Glidden Industrial Enamel
 - 2. Sherwin-Williams Industrial Enamel
 - 3. Devco Paints Industrial Enamel

2.3 FLASHING

- A. General:
 - 1. Provide flashing and counter flashing on all pipes, and other plumbing system components which penetrate exterior walls or roofs.
 - 2. Flashing sizes shown are minimum sizes but in no case shall they be less than size required by roofing manufacturer.

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- B. Plumbing Vents:
 - 1. Rubber flashing caps shall be provided on metal roofing systems in accordance with the metal roofing manufacturer's requirements.
- C. Plumbing Pipe:
 - 1. Rubber flashing caps shall be provided.

2.4 FASTENERS, ANCHORS, AND ACCESSORIES

- A. Unless indicated otherwise, all fasteners, anchors, and accessories shall be metallic.
- B. Materials provided shall be considered industry standard for commercial or industrial use.
- C. All materials shall be installed in accordance with the manufacturer's recommendations for the intent use and application.
- D. Materials installed outdoors, in attics, in crawl spaces, in tunnels and other areas exposed to ambient temperature or humidity shall be stainless steel or hot dipped galvanized.
- E. Unless otherwise specified or required by the manufacturer, bolts shall meet or exceed the following strengths:
 - 1. Proof Load: 74 ksi
 - 2. Yield Strength: 81 ksi
 - 3. Tensile Strength: 105 ksi

2.5 SEALANT

- A. Exterior joint sealant shall be polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding.
- B. Penetrations and fire rated assemblies shall meet the requirements of the Firestopping and Smokestopping specification.
- C. Color shall be approved by A/E.

PART 3 - EXECUTION

3.1 FLASHING

- A. Plumbing Vents:
 - 1. Vent piping shall terminate a minimum of twelve (12) inches above finished roof level unless noted otherwise. Where vent piping is located in a roof "well" area or areas enclosed with high parapet walls, vent piping shall terminate a minimum of twelve (12) inches above highest parapet wall.

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2. Metal flashing shall extend at least 12" in all directions from pipe and be turned down a minimum of 3" inside top of pipe.
3. Rubber flashing shall be secured to pipe with stainless steel clamps.

3.2 PAINTING

- A. All vapor barriers shall be sealed as specified elsewhere in the appropriate sections before painting.
- B. All conditions that prohibit proper application of paint shall be reported in writing to the A/E.
- C. Submit manufacturer of paint, type, and paint color samples to the A/E for review.

3.3 EQUIPMENT STORAGE

- A. Facilities for storing materials and equipment shall be provided by the Contractor.
- B. All equipment and materials shall be protected from ambient conditions including freezing and exposure to sunlight when these conditions could affect the product.
- C. All stored items shall be elevated off slab or grade.

3.4 EXTERIOR SEALANT

- A. Submit color charts to A/E.

3.5 EQUIPMENT ATTACHMENT

- A. Equipment shall be secured to the building or structure. Where equipment is provided with a method of attachment, they shall be used to attach the equipment. Where equipment is not provided with a method of attachment, the contractor shall add gussets, angles, or similar material to the unit without affecting the performance or warranty of the equipment, which shall be used to attach the equipment.

END OF SECTION

SECTION 22 05 03 - DEMOLITION, PATCHING AND REPAIR

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the demolition of all plumbing equipment, piping, and appurtenances where shown on the drawings and specified hereinafter.
2. Furnish all labor, materials, tools and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building assemblies as specified hereinafter.
3. All existing utilities, water, etc. shall be reconnected to new systems as required to maintain the same functions as existed prior to new work.

B. Descriptions:

1. Cut openings thru the existing building walls, roof, floors, and finishes to accommodate the installation of Division 22 equipment, controls, piping, and appurtenances.
2. Remove and dispose of existing plumbing equipment, piping, and appurtenances.
3. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
4. All penetrations thru exterior walls, floors, and roof systems shall be sealed watertight.
5. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

PART 2 - EXECUTION

2.1 GENERAL

- A. Beams, columns and other load bearing structures shall not be drilled, cut, or otherwise modified without written approval by structural engineer.

2.2 PROTECTION

- A. Provide barricades and take all other precautionary measures necessary to protect personnel and property.

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- B. The Contractor shall be responsible for any damages to adjacent areas to the construction area.
- C. Areas not included in the scope of work, areas where work is minimal, and, in the case of a phased contract, areas which remain inactive for long periods shall be protected from the area in which the work is being performed by a slab-to-slab barrier acceptable to engineer and local authorities.
- D. At no time shall require means of egress be blocked by equipment materials, permanent or temporary barriers.

2.3 COORDINATION

- A. All demolition work shall be coordinated with the Owner. Work which will interrupt building utilities or cause the disruption of the normal environment in areas of the building not within the scope of this project will be performed at other than the Owner's normal working hours.

2.4 PIPE PENETRATIONS

- A. All pipe penetrations shall be core drilled. All other penetrations shall be saw cut. Openings shall not be larger than required for proper installation of pipe.

2.5 MATERIAL REMOVAL

- A. The Owner shall retain first right of refusal on all existing equipment, piping, and appurtenances which are to be removed as a result of this contract.
- B. Coordinate demolition work with Owner using extreme care not to damage existing equipment which Owner elects to retain.
- C. Remove Owner retained equipment from existing location and store equipment at a location on the site where specified by Owner.
- D. All material, equipment, supports, and appurtenances not required as the result of demolition to or renovation of the building systems shall be removed from the project site and disposed of properly unless retained by Owner.

END OF SECTION

SECTION 22 05 05 - TRENCHING AND EXCAVATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the trenching and excavation of grade required for the installation of pipe, conduit, and other below grade systems where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

- A. All work shall meet or exceed the standards and procedures (latest edition) of the following:
 1. OSHA
 2. ASTM D698

PART 2 - EXECUTION

2.1 TRENCH EXCAVATION

- A. Trench excavation shall be open cut to the depth required and shall be kept free of water using well points if required. Trenches will be sheeted and braced as soil conditions indicate and required by the Occupational Safety and Health Act. Such sheeting shall be removed after backfilling has progressed to a stage that no damage to pipelines or structures will result from its removal.
- B. When rock excavation is encountered at grade in trenches, the trench shall be excavated not less than six (6) inches below the bottom of the pipe bell, refilled with gravel or crushed stone, thoroughly tamped in place, and shaped to the pipe as heretofore specified.
- C. Excavated rock shall not be mixed with material selected for tamped backfilling under and around the pipe up to a level at least one (1) foot above the pipe.
- D. If in the opinion of the A/E the material excavated is objectionable, the Contractor shall be required to remove and properly dispose of the excavated material and provide acceptable fill material.

2.2 PREPARATION OF FOUNDATION FOR PIPE LAYING

- A. Width of trenches at any point below top of pipe shall not be greater than outside diameter of pipe plus 16 inches for pipes measuring up to 30 inches, and 24 inches for pipe measuring greater than 30 inches, to permit satisfactory jointing and thorough tamping of bedding material under and around pipe.
- B. When the excavation is in firm earth, care shall be taken to avoid excavation below the established grade. If this should occur, the area so excavated shall be backfilled in two-inch lifts thoroughly compacted with mechanical tampers or with granular fill. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints and as hereinafter specified. Bell holes and depressions for joints shall be dug after the trench bottom has been graded, and, in order that the pipe rest on the prepared bottom for as nearly its full length as practicable, bell holes and depression shall be only of such length, depth, and width as required for properly making the particular type of joint.
- C. Where unstable earth or muck is encountered in the excavation, a minimum of 6" below grade will be removed and backfilled with stone, sand or other suitable material to give a stable subgrade.

2.3 BACKFILLING

- A. Backfill for trenches shall be suitable earth free of rocks, large roots, excessive sod, broken pavements, or other objectionable foreign matter. Backfill shall first be carefully hand tamped under and around the pipe and then thoroughly compacted by mechanical tampers in layers not over 8" in loose depth. Top of the backfill shall be carried above the surrounding grade so that upon subsequent settlement, the backfill will be at proper elevation. In all cases mechanical tamping must be carried evenly on both sides of the pipe to the top of the excavation. All pipe that has its line or grade disturbed, or becomes defective in any other manner whatsoever, shall be removed and replaced at the Contractor's expense.
- B. All backfill material shall be compacted to a density equal to 95% of the Standard Proctor maximum dry density as defined by ASTM D698. The Contractor may add moisture or dry the backfill material as required.
- C. Compaction shall be done in such a way so that the equipment is not used directly over the pipe until sufficient backfill has been placed so that the equipment will not have a damaging effect on the pipe.

2.4 STONE STABILIZATION

- A. When trench conditions or the bottoms of excavations for structures are such as to require stabilization of the bed, the Contractor shall remove the unstable material in the excavation and replace it with stabilizer material. Stabilizer material shall be either stone having a maximum size of 3/4", or other hard, durable material obtained from local sources and approved by the A/E.

2.5 PIPE LAYING

- A. Proper implement tools and facilities satisfactory to the Engineer shall be provided and used for the safe and convenient prosecution of the work. All pipe, fittings, valves and specials shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes, or other suitable tools or equipment in such a manner as to prevent damage to the water line materials and protective coating and linings. Under no circumstances shall water line materials be dropped or dumped into the trench.
- B. All pipe and fittings shall be carefully examined for defects and no piece shall be laid which is known to be defective. Before lowering, and while suspended, cast and ductile iron pipe may be gently tapped with a hammer to sound for cracks. Any defective, damaged, or unsound pipe shall be rejected. If any defective piece shall be discovered after having been laid, it shall be removed and replaced with sound ones at the Contractor's expense. All pipes and fittings shall be thoroughly cleaned before they are laid and shall be kept clean until accepted in the completed work.
- C. The pipe shall be supported its full length by the uniform grade of the trench, and a bell hole shall be dug at each joint, said hole being of sufficient size to ensure the proper "making up" of each joint. Pipe ends shall not be left open such as at the end of a day's work or during temporary suspension of construction but shall be securely covered to prevent the entry of foreign matter or small animals. Kinks or sharp bends giving excessive deflection or which put pipe joints in strain will not be permitted. Horizontal and vertical curvature, where fittings are not specified, can be obtained by cutting pipe to short lengths.
- D. When cutting short lengths of pipe, pipe cutter will be used, and care will be taken to make the cut at right angles to the centerline of the pipe.
- E. Thrust blocking, pads, straps and clamp, and rod assemblies shall be provided at fittings, valves, and changes of direction.
- F. Clamps, rods, straps, nuts, and bolts shall be coated with coal tar enamel after assembly and installation.
- G. All underground water piping shall have a minimum depth of cover of at least 30 inches.

2.6 SEPARATION

- A. Water and sewer pipes shall be separated by not less than five (5) feet of undisturbed or compacted earth.
 - 1. Exceptions:
 - a. The required separation distance shall not apply where the bottom of the water pipe within five feet of the sewer pipe is not less than twelve inches above the top of the highest point of the sewer pipe. The water pipe is permitted to be located in the same trench with the sewer pipe.
 - b. The required separation distance shall not apply where a water line crosses a sewer line, provided the water line is sleeved to a point not less than five feet horizontally from the sewer pipe centerline on both sides of such crossing.

2.7 SHEETING, SHORING, AND BRACING

- A. Furnish and install all sheeting, shoring, and bracing required for the protection of trench and structure excavations, existing structures, and utilities including such temporary sheeting as may be required by the Contractor's operation not specifically shown or specified.
- B. Sheeting, shoring, and bracing shall meet the requirements of the following standard publications.
 - 1. AASHTO M 168 Standard specifications for structural timber, lumber and piling.
 - 2. ASTM D 390 Specification for coal-tar creosote for the preservation treatment of piles, poles, and timbers for land and freshwater use.
 - 3. ASTM D 1760 Specification for pressure treatment of timber products.

2.8 CLEARING

- A. Perform all clearing work required for the installation of the complete work. Clearing shall consist of the removal and disposal of all trees, stumps, roots, brush, or debris in the way of the work and the disposal of such items at an approved landfill.

2.9 UNLOADING MATERIALS

- A. Pipe, fittings, and other materials shall be carefully handled so as to prevent breakage and so as to prevent damage to the cement lining in pipe and fittings. Pipe shall not be unloaded by rolling or dropping off of trucks or cars but shall be handled by carefully lifting and lowering into position using approved slings or clamps which shall be provided for the purpose.

2.10 SIGNS, BARRICADES, ETC.

- A. Furnish and install all necessary and required signs, barricades, flagmen, protection devices, etc. as required to protect persons and to protect the materials and services provided under this contract.

2.11 CARE OF EXISTING UTILITIES

- A. The general location of buried utilities and structures has been indicated on the plans from the best information available. The locations shown on the plans do not imply a guarantee of their accuracy or completeness.
- B. It is the Contractor's responsibility to accurately locate all utilities, structures, and appurtenances in the field. Make all arrangements and liaisons with the utility companies concerned to mark their lines, structures, and appurtenances by coded symbols on the pavement or marked stakes for flags.

END OF SECTION

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SECTION 22 05 10 - DOCUMENTATION AND CLOSEOUT

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, tools and equipment and perform all operations in connection with the project documentation and closeout.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. All reports, forms, and manuals shall be submitted to the A/E in triplicate unless additional copies are noted.
- B. Reports, forms, and manuals are to be submitted as soon as possible, but no later than thirty (30) days after the earliest date they can be prepared.

3.2 OWNER TRAINING

- A. The contractor shall schedule the training on equipment and systems at least 21 days before training is to take place. The contractor shall provide multiple dates and times for the training to allow the Owner to coordinate the schedules of their staff to be trained.
- B. The contractor shall provide all training aids, manuals, etc. for the Owner's staff at the training classes. These are in addition to whatever is required for the Operations and Maintenance manuals. The contractor shall coordinate the number required with the Owner but shall include a maximum of 8 sets for the training class.
- C. The person providing the training shall be thoroughly knowledgeable in the subject matter.

3.3 PROJECT JOB DRAWINGS AND AS-BUILT DRAWINGS

- A. Keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of all items, material, and equipment on the project job drawings.

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- B. At the time of final inspection, one corrected set of prints shall be delivered to the A/E. All drawing costs to be by the Contractor.
- C. As built drawings shall have the information transferred from the project job drawings including all addendum, supplemental instructions, change orders, and similar information.
- D. Qualified draftsmen shall perform this task.

3.4 OPERATING AND MAINTENANCE MANUALS

- A. Compile and bind three (3) sets of all manufacturers' instructions and descriptive literature on all items of equipment furnished under this work. Provide a PDF of this information on a CD.
- B. Where laminated documents are required, only one set shall be provided.
- C. The Operating and Maintenance Manual shall include the following:
 - 1. Cover sheet in each binder listing the architect, engineer, and all contractors. List addresses and phone numbers.
 - 2. List name, address and phone number of organization responsible for warranty work, if other than Contractor, and the specific work for which he is responsible.
 - 3. List name, address and phone number of the nearest sales and the nearest service organization for each product.
 - 4. Schedules of all equipment including identification tag numbers shown on plans cross referenced to field applied identification tag numbers.
 - 5. List of Spare Parts: Recommended for normal service requirements. Each piece of equipment shall have this list clearly marked or attached to this submittal.
 - 6. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 - 7. Wiring Diagrams: Generalized diagrams are not acceptable; submittal shall be specifically prepared for this Project.
 - 8. All start-up reports.

3.5 ENGINEERING FIELD REPORTS AND FINAL INSPECTION REPORTS

- A. The A/E will review the Contractor's work periodically throughout the project. A report will be submitted to the Contractor.
- B. The reports shall be responded to within ten days of receipt by the Contractor. Each item shall be addressed with comments written on the inspection report if possible. Contractor's response shall address the status of each item and all discrepancies.

3.6 OPERATION AND MAINTENANCE INSTRUCTIONS

- A. After all final tests and adjustments have been completed, the Owner's Representatives shall be instructed in all details of operation and maintenance for the systems installed.
- B. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.

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- C. Fifty percent of instructions shall be in a formal classroom setting.
- D. Instructions shall be provided as follows:
 - 1. Equipment: Trained factory representative
 - 2. System: Competent employee of the Contractor

3.7 ACCEPTANCE

- A. Upon notification by the Contractor and after completion of Operation and Maintenance Instructions, the A/E will visit the project for a demonstration of the building system and an inspection of the completed work.
- B. Items which do not comply with the Contract Documents, or which function incorrectly will be listed. The list will be provided by the A/E to the Contractor for correction of the installed work.
- C. After all corrections have been made, the Contractor shall notify the A/E who will recheck the systems for compliance of all items listed.

PART 4 - STANDARD FORMS

4.1 GENERAL

- A. All forms shall be filled out by the Contractor prior to acceptance of the project by the A/E.

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4.2 PLUMBING CLOSEOUT LIST

PLUMBING CLOSEOUT DOCUMENT PROJECT: MTC AMSC CENTER ADDITION & RENOVATIONS BGA PROJECT NO.: 24094			
DOCUMENT	DATE REVIEWED	DATE RETURNED	COMMENTS
Water Quality Report			
Plumbing marked-up As-Builts (1 set red lined)			
Factory Test Reports			
Equipment Start-Up Reports			
Piping Start-Up Reports			
Punchlist dated _____			
Punchlist dated _____			
Punchlist dated _____			
Walk-Through with Owner			
NOTE: Not all closeout documents may be listed. See other sections of specifications for additional requirements.			

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4.3 PLUMBING INSTRUCTIONS TO OWNER

PLUMBING INSTRUCTIONS TO OWNER PROJECT: MTC AMSC CENTER ADDITION & RENOVATIONS BGA PROJECT NO.: 24094					
INSTRUCTIONS	DATE/TIME SCHEDULED	MINIMUM SPECIFIED HOURS	ESTIMATED HOURS OF INSTRUCTION	PERSONS ATTENDING	COPY OF SIGN-IN LIST SENT TO BGA
Plumbing General					
NOTE: Not all instructions may be listed. See other sections of specifications for additional requirements. Up to 8 sets of training material required. Provide per number of persons indicated. Where no minimum specified hours indicated, training shall be provided as necessary for technician to provide the Owner a good understanding of the operation, function, and maintenance requirements of the equipment or system installed.					

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4.4 PLUMBING SPARE MATERIALS

PLUMBING SPARE MATERIALS LIST PROJECT: MTC AMSC CENTER ADDITION & RENOVATIONS BGA PROJECT NO.: 24094			
ITEM	DATE DELIVERED	ACCEPTED BY	COPY OF RECEIPT SENT TO BGA
Keys for Stops			
Gauges			
Keys			
Tools			
NOTE: Not all spare materials may be listed. See other sections of specifications for additional requirements.			

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4.5 INSTRUCTIONS TO OWNER

OWNER INSTRUCTIONS SIGN-IN SHEET				
PROJECT: MTC AMSC CENTER ADDITION & RENOVATIONS				
BGA PROJECT NO.: 24094				
SYSTEM/EQUIPMENT:	DATE	TIME		LOCATION:
		START	FINISH	
INSTRUCTORS (PRINT NAME AND SIGN)				
1.	_____			
—				
2.	_____			
—				
ATTENDEES (PRINT NAME AND SIGN)				
1.	_____			
2.	_____			
3.	_____			
4.	_____			
5.	_____			
6.	_____			
7.	_____			
8.	_____			
WRITTEN MATERIALS PROVIDED TO ALL ATTENDEES: _____ YES _____ NO				
INSTRUCTIONS IN CLASSROOM: _____ YES _____ NO				
INSTRUCTIONS IN FIELD: _____ YES _____ NO				

END OF SECTION

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SECTION 22 05 11 - SUBMITTALS

PART 1 - GENERAL

1.1 GENERAL

- A. Refer to Division 1 specification for information and shop drawings and submittals requirements. When conflicts exist, the more stringent requirements shall apply.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 PREPARATION OF SUBMITTALS

- A. Before preparing submittals, consult all contract drawings and specifications in detail, obtain manufacturer's recommended installation instructions, and have shop drawings prepared based on specific equipment and material intended for installation. Obtain all drawings and submittals from other trades as necessary to coordinate submittals.
- B. Sign all shop drawings indicating conformance with contract documents before submitting to the A/E.

1.4 SUBMITTALS

- A. General:
 - 1. Submittals are required on all items of equipment.
 - 2. Submittals shall be bound with an index identifying all types of equipment or system components included. All like items shall be grouped together.
 - 3. Submittals shall include, but not be limited to:
 - a. All requirements of Division 1.
 - b. Complete information pertaining to appurtenances and accessories
 - c. Information properly marked with service or function identification as related to the project.
 - d. Where the submittal consists of catalog sheets displaying other items which are not applicable, the proper features shall be clearly identified.
 - e. External connections properly marked, as related to the specific use intended, on standard factory assembly and field installation drawings.
 - f. All performance characteristics and physical characteristics.
 - g. Wiring and control diagram.
 - h. All requirements listed in the specific section of specifications.
 - i. Electrical data on all motors is greater than one horsepower. Data shall include horsepower unit served, power factor, efficiency and product of P.F. x EFF.

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B. Field Fabricated Components:

1. When field fabricated components are permitted by the specifications, scaled detailed drawings shall be submitted, clearly showing the materials used, dimensions, sizes, and means of assembly. For example, drawings shall be submitted for pump housings (insulation), support stands, etc.

C. Submittal Summary:

1. A submittal summary shall be prepared by the contractor within (30) (60) days of project award.
2. The summary shall include all products and samples to be submitted along with the date the submittal will be received by the prime contractor.

1.5 SAMPLES

- A. Samples shall be provided when specified or required by the A/E to check product acceptability or for coordination purposes.
- B. Samples will not be returned and shall not be included in the total required on the project.

1.6 REVIEW OF SUBMITTALS

- A. Review of shop drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless the Contractor has, in letter form, called attention to such deviations at the time of submission and secured written approval of the specific deviations.
- B. Any materials and equipment listed which are not in accordance with the equipment shown on the schedule shall be of size and physical arrangement to allow unobstructed access, when installed, for routine maintenance, coil removal, shaft removal, motor removal and other similar operations. Deviation from the characteristics of that equipment or layout system components will not necessarily be cause for rejection. Review of submittal does not relieve the Contractor of his responsibility. Should an installation not meet the intent of the contract documents, the Contractor may be required by the A/E to modify or replace equipment or system components with all costs, direct and indirect, borne by the Contractor.
- C. It is strongly recommended that the Contractor not purchase or install any equipment or system components prior to receipt of reviewed shop drawings.
- D. Reviewed with notations on the submittal shall not prohibit the Contractor from purchasing equipment. If the Contractor does not comply with the notations, the submittal shall be deemed rejected.

1.7 EQUIPMENT DIMENSIONS AND WEIGHTS

- A. The contract documents may indicate specific equipment dimensions. The Contractor is responsible for verification of the dimensions for the equipment submitted prior to submitting shop drawings. Equipment larger than the equipment indicated on the contract documents may not be acceptable to the A/E.

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- B. The contract documents may indicate specific equipment weights. The Contractor is responsible for verification of the weight of the equipment submitted prior to submitting shop drawings. Equipment weighing more than the equipment indicated on the contract documents may not be acceptable to the A/E.
- C. Equipment shall not exceed maximum weight indicated on the schedules. If the equipment weight exceeds that indicated on the schedule, even where the manufacturer is an approved manufacturer, that equipment cannot be bid on for this project.
- D. If equipment is not acceptable to the A/E due to dimensions or weights exceeding those indicated on contract documents, the Contractor shall accept all responsibility and costs for providing equipment that meets the dimension and weight requirements of the contract documents.

1.8 ELECTRICAL CHARACTERISTICS

- A. Electrical characteristics for plumbing equipment are generally indicated on the plumbing documents. The electrical documents generally indicate power and wiring requirements to each piece of plumbing equipment.
- B. It shall be the plumbing installer's responsibility to verify prior to submitting shop drawings that the equipment submitted meets the electrical requirements of both the plumbing and electrical documents. If there is a discrepancy, the contractor shall bring the discrepancy to the A/E's attention prior to submitting shop drawings.
- C. If the discrepancy is brought to the A/E's attention prior to ordering the plumbing equipment or electrical materials associated with that equipment, the A/E will issue additional instructions to the Contractor.
- D. If the discrepancy is not brought to the A/E's attention prior to ordering the plumbing equipment and electrical materials (i.e. Contractor does not verify electrical requirements), the Contractor shall be responsible for all costs except those that would have been incurred if the discrepancy was determined prior to ordering the plumbing equipment and electrical materials.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRODUCT SUBMITTALS

- A. The following list may be used as a checklist for the contractor and A/E. All products may not be listed.

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PRODUCT SUBMITTALS

BGA NO.	PRODUCT	NO.	DATE		STATUS				ITEMS TO RESUBMIT	DATE ITEMS RESUBMITTED
			In	Out	App.	AAN	Resub.	Rej.		
	Access Panels									
	Backflow Preventors									
	Balancing Valves									
	Chair Carriers									
	Dielectric Fittings									
	Electric Heat Tape									
	Equipment and Pipe Identification									
	Escutcheons									
	Firestop Material									
	Fittings and Flange Certificates									
	Flexible Pipe Connections									
	Hose Bibbs									
	Insulation, Mastics, and Sealants									
	List of Pipe and Fitting Material for Each System									
	No Hub Pipe Clamps									
	Paints									
	Pipe and Pipe Fittings									
	Pipe Expansion Joints and Guides									
	Pipe Hangers and Supports									
	Pipe Shields									
	Pipe Sleeves									
	Plumbing Fixtures									

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BGA NO.	PRODUCT	NO.	DATE		STATUS				ITEMS TO RESUBMIT	DATE ITEMS RESUBMITTED
			In	Out	App.	AAN	Resub.	Rej.		
	Seismic Products									
	Strainers									
	Temperatures and Pressure Relief Valves									
	Thermometers and Gauges									
	Trap Seal Primers									
	Trap Seal Protection Device									
	Underground Piping System									
	Valves									
	Wall Hydrants									
	Water Heaters									

3.2 TEST AND REPORT SUBMITTALS:

- A. The following list may be used as a checklist for the Contractor and A/E. All tests may not be listed.
 - 1. Plumbing piping.
 - 2. Gas piping test.
 - 3. System start-up.

3.3 COORDINATION DRAWING SUBMITTAL

- A. This section may not include all drawings required. See specific specifications for additional requirements. All drawings shall be drawn (1/8") (1/4") = 1'-0" minimum. Each system shall be represented by a different color.
- B. Review structural and architectural drawings to determine method of attachment or support of pipe and equipment to slabs, walls, and other structural elements.
- C. Coordination Drawings:
 - 1. Provide dimensional coordination drawings of the following:
 - a. Building elements:
 - 1) Walls
 - 2) Casework (built-in)
 - 3) Ceiling
 - 4) Structure (located in ceiling plenum)
 - b. Plumbing elements:
 - 1) Piping and valve
 - 2) Water heaters
 - 3) Other plumbing equipment (with required clearances)
 - c. Other system elements:
 - 1) Lights
 - 2) Cable tray
 - 3) Sprinkler system
 - 4) HVAC ductwork and equipment
 - 5) HVAC piping
 - 6) Conduit 1-1/2" and above
 - 2. Drawings shall have the following line weights:
 - a. Building elements and lights – light
 - b. Duct, piping, conduit – medium
 - c. Equipment – heavy
 - 3. Each system shall be provided with a different color line.
 - 4. All non-essential text, symbols, objects, etc. (not necessary for systems coordination) shall be omitted from the coordination drawings.
 - 5. Submit drawings for entire project.
 - 6. Drawings shall be submitted in color.

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- D. Provide dimensional drawings in plan with all site utilities shown.
- E. Provide dimensional drawings on a plan indicating the following:
 - 1. Size and location of all rooftop equipment, equipment weights, and roof penetrations.
 - 2. Size and location of all concrete housekeeping pads.
 - 3. Size and location of all slab penetrations.
 - 4. Size and location of all precast wall penetrations.
 - 5. Size and location of all prestressed tee penetrations.
- F. All roof penetrations and equipment shall be drawn on approved roof structural plans to coordinate openings with structural elements.
- G. When equipment is to be installed on supports provided by installers other than Division 22, the Division 22 installer shall provide:
 - 1. Size, orientation, weights, and connection locations for all equipment to be installed. Information shall include all seismic components, point loads, elevations, etc.
 - 2. Location and required size and elevation of all pipe and duct supports.

3.4 SHOP DRAWING SUBMITTAL COVER SHEET

- A. A separate cover sheet shall be submitted with each product type (i.e., valves can be submitted together, etc.).

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3.5 SHOP DRAWING SUBMITTAL COVER SHEET
(Provide one page for each group of shop drawings.)

Project Name: MTC AMSC CENTER ADDITION & RENOVATIONS **BGA File No.** 24094-5-33
Owner Project No. _____ **BGA Shop Dwg. No.** _____
Product: _____

Note To Contractor

1. All shop drawing comments by Buford Goff & Associates shall be complied with or the shop drawings shall be declared rejected.
2. If this form is not submitted and signed by the Contractor, the Contractor shall verify that items 1 to 8 below are answered YES or N/A or the shop drawings shall be declared rejected.
3. Valves, plumbing fixtures, etc., are reviewed for characteristics but not for size and quantity. It is the Contractor's responsibility to verify sizes and quantity.

Shop Drawing Submittal (Contractor to complete this section)

1. Does the submittal comply with the contract documents? Yes No
If no, list all deviations on an attached page.
2. Have the electrical characteristics (i.e., volt/phase/amps, MOP, MCA, and connection location) been reviewed with the electrical schedules and the electrical circuit sizing meet the requirements of that equipment? Yes No N/A
3. Is product an approved manufacturer listed in the specifications or addendum? Yes No N/A
4. Does the product submitted meet the manufacturer's recommended service clearance for the space in which it is to be installed? Yes No N/A
5. Have the control components of the product been reviewed and do they meet with the requirements of the controls contractor? Yes No N/A
6. Have the equipment connections been reviewed (size and locations) and has the Contractor included all provisions to make the required connections? Yes No N/A
7. Has the seismic engineer reviewed and approved the method of connecting seismic restraints to equipment? Yes No N/A
8. Is the equipment within the weight limitations specified, if any? Yes No N/A

BGA's Shop Drawing Stamp (Engineer to complete this section)

Checking is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Contractor is responsible for specific compliance with the information given in the Contract Documents; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades, and the safe and satisfactory performance of his work.

- Reviewed Reviewed as Noted Revise and Resubmit Revise and Resubmit Items Indicated
 See attached for additional comments Reject

Comments: _____

Reviewer: _____ Date: _____

END OF SECTION

SECTION 22 05 17 - SLEEVES, SEALS, AND ESCUTCHEONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of sleeves, seals, and escutcheons where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

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

B. All sections of Division 22 Specifications apply to this section. In addition, refer to these specification sections:

1. Section 22 05 03 - Demolition, Patching and Repair
2. Section 22 05 07 - Firestopping and Smokestopping
3. Section 22 11 00 – Plumbing Piping

1.3 QUALITY ASSURANCE

A. Manufacturers:

1. The following mechanical seal and sleeve manufacturers are acceptable:
 - a. Thunderline Corporation
 - b. Metraflex

PART 2 - PRODUCTS

2.1 SLEEVES

A. General:

1. Provide sleeves for each pipe passing through walls, partitions, floors, and roofs unless specific details indicate otherwise.
2. Provide sleeves where required by UL fire stop assembly selected.
3. Do not provide sleeve when not permitted by UL firestop assembly selected.

B. Type:

1. Sleeves in non-masonry or concrete construction shall be minimum 24 gauge sheet metal.
2. Sleeves in masonry or concrete construction shall be schedule 40 black or galvanized steel.

3. Sleeves in membrane or waterproof construction shall have flashing ring or other method acceptable to the membrane or waterproofing manufacturer.
4. Sleeves provided at floor slabs and support piping weight shall be cast in place and have a minimum of four anchoring tabs.
5. Split sleeves shall be permitted only when approved by the Engineer.

C. Sleeve Sizes:

1. Sleeves for uninsulated piping shall be two pipe sizes larger than pipe passing through or a minimum of 1/2" clearance between inside of sleeve and outside of pipe.
2. Sleeves for insulated piping shall be adequate size to accommodate the full thickness of pipe covering with clearance for packing and caulking.
3. Sleeves for branches off of risers shall be sized as required for insulated or uninsulated pipe and shall also be sized to accommodate expansion of riser.
4. Sleeves for pipe passing through a foundation wall or under a footing shall be two pipe sizes greater than pipe passing through.

D. Sleeve Length:

1. Sleeves shall be equal to the thickness of construction and terminated flush with surfaces.

E. Sleeve Packing:

1. Sleeves shall be packed as follows:
 - a. As indicated on detail or firestopping specification.
 - b. If not indicated otherwise, seal entire sleeve at exterior wall with silicone caulk.

F. Fire Rated Assemblies:

1. Provide sleeve where required by UL firestop assembly utilized.
2. Do not provide sleeve where not permitted by UL firestop assembly utilized.
3. Sleeve size, length and type shall be equal to that required for the UL firestop assembly utilized.

2.2 ESCUTCHEONS

A. General:

1. Escutcheons shall be chrome plated brass.
2. Escutcheons shall be held in place by internal spring tension or set screws.
3. Escutcheon plates shall be large enough to completely close hole around pipes and sleeve and shall be square, octagonal or round.

B. Escutcheons shall be located:

1. On all exposed piping through walls, floors, partitions and ceilings except in unoccupied equipment rooms (i.e., boiler rooms and similar spaces).
2. At all piping in casework.

2.3 MECHANICAL SEALS

A. General:

1. Provide mechanical seals and sleeves at all pipe exiting building below slab and all pipe exiting basement utility spaces (i.e., mechanical room, etc.).
2. All pipe shall have seals and sleeves including but not limited to:
 - a. Domestic water
 - b. Sanitary sewer
 - c. Acid waste
 - d. Conduit

B. Sleeves:

1. Sleeves shall be constructed of high impact thermoplastic with water stop and anchor collar.
2. Sleeve shall be of length and size required for each pipe and wall thickness. Basement walls are approximately 30" thick.
3. Sleeve shall be:
 - a. Link Seal Type Century line sleeve model CS
 - b. Metraflex wall sleeve

C. Seal:

1. Seal shall be constructed of interlocking rubber links.
2. Seal shall be:
 - a. Link Seal
 - b. Metraseal

PART 3 - EXECUTION

3.1 GENERAL

A. Installation:

1. Install sleeve at time of construction of assembly.
2. Sleeve shall be grouted in place with appropriate grout to match construction.
3. Pipe shall be centered to the extent practical in the sleeve. Where proper firestopping or insulation cannot be installed, sleeve shall be reset.

3.2 MECHANICAL SEAL

- A. Install short section of capped pipe and test integrity of sleeve as recommended by the manufacturer.

END OF SECTION

SECTION 22 05 19 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of gauges where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Manufacturer:

1. The following thermometer, pressure gauge and accessories manufacturers are acceptable:
 - a. Terice
 - b. Weksler
 - c. Weiss
 - d. MILJOCO

PART 2 - PRODUCTS

2.1 GENERAL

- A. Gauges shall be suitable for the environment in which it is to be installed. Gauges installed outside shall be rust-proof and weather-resistant.
- B. Compound gauges shall be provided when both positive pressure and a vacuum can occur.
- C. All gauges shall be equipped with a 1/4" brass ball valve and shall be removable from hydronic and steam systems without loss of medium.
- D. Gauges installed outside shall be nonfreeze type to 0 degrees F.
- E. Gauges shall have extension to extend a minimum of 1" greater than the thickness of the insulation.

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2.2 THERMOMETERS

- A. Thermometer shall be provided at all thermometer wells.
- B. Thermometers shall be red reading, non-mercury, adjustable stem, angle type complete with sensing element.
- C. Case shall be aluminum with baked black enamel finish (or molded black nylon glass fiber reinforced). Front shall be plastic. Scale shall be 9" with black numerals on a white background. Case shall be rotatable.
- D. Sensing element shall be brass or aluminum extension, swivel union, and brass separable socket.
- E. Thermometers shall be accurate to within (+) or (-) one of the smallest divisions throughout the entire range.
- F. Thermometers shall be located so as to be easily read. In such cases where the thermometer cannot be easily located so as to be easily read, a remote reading type thermometer shall be installed.
- G. Thermometers used for liquid temperature shall be angle or straight way, with brass separable sockets.
- H. Where thermometers are installed in piping or tanks to be covered, they shall have an extension neck extending through the covering.
- I. Thermometers shall be so selected that normal operating temperature will be in the mid-range of the thermometer. Thermometers shall have a maximum of 2 degrees between graduations and shall have a maximum of 10 degrees between figures.
- J. Thermometers shall be:
 - 1. Weiss Type 9 VU

2.3 THERMOMETER WELLS

- A. Thermometer wells shall be provided at all heat transfer devices at inlet and outlet conditions including but not limited to:
 - 1. Locations shown on plans and details.
- B. Thermometer wells shall be designed to hold an engraved stem thermometer. The wells shall be made of heavy brass and shall be approximately 6 inches long, shall project 2-1/2 inches into the pipe and shall have dust protecting caps and chains. Pipes smaller than 3 inches shall be enlarged at the points where the wells are installed. Wells shall be set vertically or at an angle so as to retain oil.
- C. Thermometer wells shall be:
 - 1. Tetric
 - 2. Marshalltown
 - 3. Ashcroft

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2.4 PRESSURE GAUGES

- A. Pressure gauges shall be provided at all heat transfer devices at inlet and outlet conditions.
- B. Pressure gauges shall be single spring bourdon tube type with wear resisting moving parts and adjustable linkage. Gauge movement shall be suitably mounted in a cast aluminum case, baked black enamel finish, with glass front and plain removable ring. Gauges shall have 4-inch dials.
- C. Pressure gauges shall be accurate to within (+) or (-) 1.6% full scale.
- D. Range of gauge for each particular point of application shall be selected so that pointer is approximately in midpoint of scale under normal operating conditions.
- E. Pressure gauges shall be:
 - 1. Terice
 - 2. Ashcroft
 - 3. Marshalltown

PART 3 - EXECUTION

3.1 CALIBRATION

- A. After installation, check and calibrate all devices where field calibration is practical.

3.2 THERMOMETERS

- A. Thermometers shall be installed to be easily read from floor level, not over 8'-0" above floor. Where higher mounting heights are necessary remote reading type shall be substituted for model specified.

END OF SECTION

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State Project Number: H59-N301-SB | GMC Project Number: ACOL240010 | Date: 04/17/2026

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING – “LEAD FREE”

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. Bronze ball valve.
 - 2. Check valves.
 - 3. Iron, center-guided check valve.
 - 4. Automatic Flow Control valves.
 - 5. Balance valves (Calibrated).
 - 6. Thermostatic Water Mixing valves.
- B. Related Sections:
 - 1. All sections of Division 22 Specifications apply to this section.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non rising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. PTFE: Polytetrafluoroethylene plastic.
- H. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for solder-joint connections.
 - 6. ASME B31.9 for building services piping valves.
 - 7. ASME B16.10 for ferrous valve dimensions.
 - 8. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF/ANSI 61-G and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.
- D. Manufacturers:
 - 1. The following ball valve manufacturers are acceptable:
 - a. Apollo
 - b. Nibco
 - c. Milwaukee
 - 2. The following gate, globe and check valve manufacturers are acceptable:
 - a. Apollo
 - b. Nibco
 - c. Milwaukee
 - 3. The following thermostatic mixing valves are acceptable:
 - a. Leonard
 - b. Symmons
 - c. Rada
 - d. Lawler
 - e. Apollo

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.

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2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Products that come in contact with potable water shall comply with NSF/ANSI 61-G and/or NSF/ANSI 372. Provide certification of product when requested by Architect/Engineer.
- B. All domestic water (i.e., cold water, hot water and hot water recirculating) shut off valves shall be lead free ball valves for piping 2-1/2" and smaller and lead free butterfly valves for piping 3" and larger unless noted otherwise.
- C. Where specifically noted on drawings or acceptable (in writing) to Engineer, gate and globe valves may be used in domestic water lines where throttling flow (i.e., globe valve) is required or water hammer (i.e., gate or globe valve) is a concern.
- D. Bronze valves shall be made with dezincification-resistant materials. Manufacturer shall provide third party certification. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- E. Bronze Valves: NPS 2-1/2 and smaller with threaded or solder ends, unless otherwise indicated.
- F. Ferrous Valves: NPS 2-1/2 and larger with flanged ends, unless otherwise indicated.
- G. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- H. Valve Sizes: Same as upstream piping unless otherwise indicated.
- I. Valves in Insulated Piping: With 2-1/4" inch (minimum) stem extensions and the following features:
 1. Ball Valves (2" and smaller): With extended operating handle of non-thermal-conductive material that meets UL 2043 approved for inside air plenum, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Apollo "Therma-Seal" insulating tee-handle (-11 suffix in figure no.), NIBCO NIB-SEAL (-NS suffix in figure no.) handle extension; or equal.
 2. Ball Valves (2-1/2" and larger): Shall have minimum 2-1/4" (or 1/2" greater than insulation thickness) extended operating handle that allows operation of valve without disturbing insulation.

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J. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-piece, full port, Lead Free bronze ball valves with the capability of accepting extended operating handles.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Apollo Model 77CLF-A Series (-11 Therma-Seal for valves installed in insulated systems).
2. Description:
 - a. Standard: MSS SP-110
 - b. CWP Rating: 600 psig
 - c. Body Design: Two piece.
 - d. Body Material: Lead Free or Silicon bronze (ASTM Listed), corrosion resistant.
 - e. Ends: Threaded or soldered
 - f. Seats: Reinforced PTFE or TFE
 - g. Stem: Lead free brass
 - h. Ball: Lead free brass chrome plated
 - i. Port: Full

2.3 CHECK VALVES

A. General:

1. Swing check valves shall be installed in horizontal lines or vertical lines where flow is upwards.
2. Lift check valves shall be installed in horizontal lines.

B. BRONZE SWING CHECK VALVES:

1. 200 CWP, Bronze Swing Check Valves with Bronze Disc:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide Apollo Model 161S/T-LF.
 - b. Description:
 - 1) Standard: MSS SP-139
 - 2) CWP Rating: 200 psig
 - 3) Body Design: Y pattern, horizontal flow
 - 4) Body Material: ASTM B584 bronze
 - 5) Ends: Threaded or Soldered
 - 6) Disc: Renewable Bronze

C. BRONZE LIFT CHECK VALVES:

1. 250 CWP, Lift Check Valves with Nonmetallic TFE Disc:
 - a. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S-480-Y-LF.
 - b. Description:
 - 1) Standard: MSS SP-139

- 2) CWP Rating: 250 psig.
- 3) Body Material: Silicon bronze (ASTM Listed), corrosion resistant.
- 4) Ends: Threaded or Soldered.
- 5) Disc: PTFE.

2.4 THERMOSTATIC WATER-MIXING VALVES

A. General:

1. Provide a manually adjustable, thermostatic water-mixing valve with bronze body.
2. Mixing valves shall be certified in accordance with NSF/ ANSI 61 and/or NSF/ANSI 372 for low lead requirements.
3. The valve shall include checkstop and union on hot-water and cold-water supply inlets, adjustable temperature setting, and capacity at pressure loss as indicated.
4. Bimetal thermostat shall be rated for 125 psig minimum.
5. Piping component finish shall be rough brass.

B. ASSE Requirements:

1. Mixing valves at point of source shall meet ASSE 1017.
2. Mixing valves at point of use shall meet ASSE 1070.
3. High/low type mixing valves shall meet ASSE 1017 and 1069.

C. Manifolder, thermostatic water mixing valve assemblies:

1. Provide factory fabricated unit consisting of parallel arrangement of thermostatic water-mixing valves.
2. The valve shall include one large-flow thermostatic water mixing valve with flow control valve, pressure regulator, inlet and outlet pressure gauges, and one small-flow thermostatic water-mixing valve with flow control valve.
3. Assembly shall include outlet thermometer and factory or field installed inlet and outlet valves.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 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 upright at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. When soldering use paste fluxes that are approved by the manufacture for use with Lead Free Alloys.

3.3 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.

3.4 THERMOSTATIC WATER MIXING VALVE

- A. Start-Up and Testing:
 - 1. The manufacturer's representative shall demonstrate to the Owner the proper operation of the valve.
 - 2. The mixing valve, balance valve, and other devices in the system shall not be changed or adjusted in any way by the contractor without prior approval by the Owner.

END OF SECTION

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of supports and anchors on all piping and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

- A. Products not otherwise specified in these documents shall be furnished by the listed manufacturers and installed in accordance with the manufacturers recommendation.
- B. Products used shall be consistent with industry practice for use in commercial or industrial installation.
- C. Codes and Standards:
 1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. ANSI B31.3 - Pressure Piping
 - b. National Fire Protection Association
 - c. Factory Mutual
 - d. International Building Codes
 - e. Manufacturer's Standardization Society Documents, MSS-SP-58, MSS-SP-69
 - f. Pipe Fabrication Institute, Standard ES-26
 - g. AISC Specification for the Design, Fabrication, and Erection of Structural Steel Buildings
- D. Manufacturers:
 1. The following pipe hanger and support manufacturers are acceptable:
 - a. Cooper B-Line
 - b. Pipe Hangers and Devices Mfg. Inc.
 - c. Anvil International
 - d. Elite Components

PART 2 - PRODUCTS

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2.1 GENERAL

- A. It shall be the Contractor's responsibility to provide an adequate pipe support system in accordance with recognized engineering practices using, where possible, standard, commercially available hangers, support, guides, anchors and accessories.
- B. Model numbers are indicated for products not exposed to ambient conditions. The products exposed to ambient conditions shall be a similar product but with the material or finish specified for products exposed to ambient conditions.
- C. Materials shall be selected to prevent electrolysis and minimize corrosion for the environment in which the product is to be installed.
- D. Hanger shall be sized for insulation to run through hanger except small size domestic hot water piping as indicated.

2.2 SAFETY FACTOR

- A. All attachments, rods, and accessories selected based on weight load shall be selected for a two-time safety factor minimum.

2.3 SEISMIC RESTRAINTS

- A. Where seismic restraints of components is required, attachments shall be per the requirements of the Vibration and Seismic Control for plumbing specifications.

2.4 PRODUCTS EXPOSED TO AMBIENT CONDITIONS

- A. Materials:
 - 1. The material for all accessories including, but not limited to, rods, bolts, fasteners, inserts, saddles, supports, anchors, clamps, auxiliary steel, and accessories shall be stainless steel or hot dipped galvanized unless specifically noted otherwise.
- B. Hangers:
 - 1. Clevis hanger shall be stainless steel or hot dipped galvanized finish.
 - 2. Swivel loop hangers shall be zinc electroplate finish.
 - 3. Roller hangers shall be zinc electroplate finish.
- C. Supports:
 - 1. Roller supports shall be zinc electroplate finish.
- D. Shields:
 - 1. Shields shall be stainless steel.

2.5 PIPE HANGERS, SUPPORTS, AND ACCESSORIES - GENERAL (INDOOR)

A. General:

1. Other finishes may be specified for specific applications.
2. All threaded rods shall be hot dipped galvanized or stainless steel.

B. Hangers:

1. Swivel loop hangers for insulated pipe shall be carbon steel with zinc electroplate finish.
2. Clevis hangers for insulated pipe shall be carbon steel or carbon steel with zinc electroplate finish.
3. Roller hangers shall be carbon steel with cast iron roller.

C. Supports:

1. Roller supports shall be carbon steel with cast iron roller.

D. Shields and saddles:

1. Shields shall be carbon steel with zinc electroplate finish.
2. Saddles shall be carbon steel.

E. Insulation at shield:

1. Insulation shall be full pipe coverage (360 degrees).
2. Insulation shall be calcium silicate with FRK jacket and self-sealing flaps.
3. Insulation shall be suitable for 20 degrees F to 1200 degrees F temperature and 100 psi compressive strength (minimum).
4. Insulation shall overhang shield by 1" (minimum) each side. Insulation shall be equal to thickness of adjacent pipe insulation.

2.6 PIPE HANGERS - INSULATED COLD PIPING

A. Pipe 2" and smaller - Swivel loop hanger with shield:

1. B-Line Fig. 200 with B3151 shield
2. At contractor's option, clevis hanger may be used.

2.7 PIPE HANGERS - INSULATED HOT PIPING

A. Pipe 2" and smaller (domestic hot water only) - swivel loop hanger with shield, clevis hanger with shield, or long leg clevis hanger:

1. B-Line Fig. 200 with B3151 shield

2.8 PIPE HANGERS - NON-INSULATED PIPE (STEEL AND CAST IRON)

A. All pipe sizes (cast iron pipe) - clevis hanger:

1. B-Line B3102

- B. All pipe sizes (steel pipe) - clevis hanger:
 - 1. B-Line B3100
- C. All pipe sizes (galvanized pipe) - clevis hanger:
 - 1. B-Line B3100 (with hot dipped galvanized finish)
 - 2. B-Line B3100 (with electro galvanized finish)

2.9 PIPE HANGERS - NON-INSULATED PIPE (COPPER)

- A. All pipe sizes - Swivel loop hanger:
 - 1. B-Line B3170 CTC (with PVC coating)

2.10 PIPE HANGERS - NON-INSULATED PIPE (PVC)

- A. Pipe 2" and smaller - swivel loop hanger:
 - 1. B-Line Fig. 200C (with PVC coating)

2.11 PIPE SUPPORTS - GENERAL

- A. General:
 - 1. Finishes, shields, saddles, and shield insulation shall be provided as specified for pipe hangers for each system requiring pipe supports.
- B. Roll pipe support without vertical adjustment:
 - 1. B-Line B3117SL
- C. Roll pipe support with vertical adjustment:
 - 1. B-Line B31185L
 - 2. B-Line B3122

2.12 PIPE HANGER SPACING

- A. General:
 - 1. The maximum spacing for pipe hangers and supports shall not exceed those stated in these specifications or the hanger manufacturer's recommendations, which is less.
 - 2. Where concentrated loads of valves, fittings, etc. occur, closer spacing will be necessary and shall be based on the weight to be supported and the maximum recommended loads for the hanger components.
 - 3. Hangers shall be provided within 12" of each change of direction, at each valve, and at equipment connections.
 - 4. Pipe not listed shall meet the spacing requirements of the manufacturer.
- B. Non-metallic Pipe (PVC):
 - 1. Provide spacing as recommended by the manufacturer but no greater than 4 feet.

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C. Copper Pipe and Tubing:

<u>Size</u>	<u>Max. Span Ft.</u>
Smaller than 1-1/2"	5
1½" and larger	8

D. Steel (Std. Weight):

<u>Size</u>	<u>Max. Span Ft.</u>
1½" and smaller	7
2" and larger	10

2.13 HANGER RODS

- A. Threaded rods, if not indicated otherwise, shall be carbon steel with zinc electroplate finish.
- B. Where seismic restraints of components are required, rod sizes shall be per the requirements of the Mechanical Sound, Vibration, and Controls specifications.
- C. Rod capacity based upon ASTM A107 at 650 degrees F is as follows:

<u>Rod Dia.</u>	<u>Max. Load</u>	<u>Max. Load (@ 2 x SF)</u>
3/8	610	305
1/2	1130	565
5/8	1810	905
3/4	2710	1355
7/8	3770	1885
1	4960	2480

2.14 MISCELLANEOUS STRUCTURES

- A. Metal Roofing Systems:
 - 1. Provide steel angle stiffeners and supplemental steel as required by the metal roofing system manufacturer to attach hangers and supports to purlins.
 - 2. Provide steel angles or channels to support hangers located between purlins.

2.15 AUXILIARY SUPPORTS, FASTENERS, AND ACCESSORIES

- A. Provide all auxiliary supports, anchors, and fasteners necessary for the installation of piping, equipment, and accessories.
- B. Supports shall include angles, channels, flat steel, rods, bolts and appurtenances.

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- C. Special supports shall be provided where standard hanger, supports, or attachments cannot be used. This includes, but is not limited to, use of trapeze supports, suspending supports from other supports (where acceptable to manufacturers, etc.).

2.16 SWAY BRACING

- A. Sway bracing shall be located and constructed for pipe subject to horizontal movement unless movement is specifically designed to meet seismic requirements.
- B. On no hub cast iron sanitary systems where top of pipe is more than 18 inches from hanger attachment point, sway bracing shall be provided on every other hanger

2.17 CHANNEL SUPPORTS

- A. General:
 - 1. Channel supports shall be utilized wherever practical and whenever a channel support provides a cleaner installation than individual attachments to the structure.
- B. Construction:
 - 1. Channel supports shall be 12 gauge and dimensions as necessary to meet project conditions.
 - 2. Channels in conditioned spaces or in plenums above conditioned spaces shall be pregalvanized or powder coated carbon steel.
 - 3. Channels exposed to ambient conditions shall be stainless steel or PVC coated
 - 4. Channels shall have holes, slots, knockouts, etc. as required by the Contractor.
- C. Clamps and Accessories:
 - 1. Clamps, accessories, fasteners, etc. shall generally be the same materials as the channel supports unless indicated otherwise.
 - 2. Pipe clamps for indoor pipe shall be:
 - a. All piping - pipe cushion clamp
- D. Manufacturers shall be:
 - 1. Cooper B-Line
 - 2. Unistrut
 - 3. Pipe Hangers and Devices Mfg., Inc.
 - 4. Anvil International

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide all steel and concrete required for support and anchoring of pipes other than shown on structural or architectural drawings.

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- B. Contractor shall bear all responsibility for materials and workmanship as described in this section and shall make sure that all hangers and supports are properly and permanently connected to building structure.
- C. All pipe supports shall be designed to avoid interferences with other piping, hangers, electrical conduits and supports, building structures and equipment.
- D. Guide points for expansion joints shall be located and constructed wherever required or shown on drawings and at each side of an expansion joint or loop, to permit only free axial movement in piping systems. Guides shall be securely anchored to structure.
- E. Provide hanger rod nuts on both sides of clevis and trapeze hangers.

3.2 SUBMITTAL

- A. Manufacturer shall be responsible for reviewing all plans, specifications, and existing conditions to determine the types, quantities, and accessories required to provide a complete system of pipe support.
- B. Submit shop drawings for each product to be used and indicate where the product is to be installed (i.e., steam piping in tunnel, chilled water pipe in crawl space, etc.).

3.3 APPROVALS REQUIRED

- A. The Contractor shall request and receive written approval as follows before ordering support and attachment equipment and materials:
 - 1. Letter from lightweight metal truss manufacturer.
 - 2. Letter from metal roofing system manufacturer.
- B. The letters shall indicate methods of attachment to all structural components and the locations of these attachments.

3.4 AUXILIARY SUPPORTS, ANCHORS, AND FASTENERS

- A. Supports attaching to steel structure shall be by bolting or clamping without penetrating structural member. Welding is not permitted without written permission.
- B. All fasteners shall be provided which resist loosening from vibration.

END OF SECTION

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SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of mechanical identification on all plumbing equipment, systems, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work furnished and installed shall comply with all local codes and ordinances and shall meet or exceed the standards and procedures (latest editions) of the following:
 - a. ANSI A13.1 for the identification of piping systems.
 - b. ANSI/NEMA Standard Z535.1.

B. Manufacturer:

1. The following mechanical tag, band, nameplate, and identification marker manufacturers are acceptable:
 - a. Seton Name Plate Corporation
 - b. T&B/Westline Products
 - c. Brady
 - d. MSI

PART 2 - PRODUCTS

2.1 VALVES

A. All valves shall be tagged except for the following:

1. Exposed shutoff valves at plumbing fixtures.

B. Attach to each valve a 1-1/2" round brass tag stamped with designating number and system type (CW, HW, etc.) 1" high filled in with black enamel. Connect with braided cable and metal clamp.

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- C. Coordinate valve numbering to avoid duplication.
- D. Provide valve tagging in accordance with the Owner's standard practice for labeling.

2.2 NAMEPLATES:

- A. Nameplates shall be fabricated on black lamacoid with beveled edges. Markings shall be cut through to white background.
- B. Markings or lettering shall be minimum:
 - 1. 1/2" high on access doors
 - 2. 1/4" high on motor control centers
 - 3. 3/16" high on switches and other similar devices
- C. All information shall be scribed on a single nameplate per device.

2.3 PIPING PAINTING

- A. The following exposed piping systems, bare and insulated, in mechanical rooms, corridors, and all other spaces where visible without removing ceiling, shall be given two coats of finish paint over the prime coat:
 - Cold Water – Light Blue
 - Hot Water – Dark Orange
 - Hot Water Return – Light Orange
 - Sewer Piping – Dark Green
 - Vent Piping – Light Green

2.4 PIPE CODING (STICK ON)

- A. Apply color coded polyvinyl chloride pipe bands identifying service and direction of flow on all piping systems.

- B. Pipe identification sizing shall be:

<u>OUTSIDE DIAMETER OF PIPE OR COVERING</u>	<u>LENGTH OF COLOR FIELD INCHES</u>	<u>SIZE OF LETTERS INCHES</u>
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2

- C. Flow direction arrows shall be black on color background. Show flow direction arrows immediately adjacent to all pipe identification markers.
- D. Markers shall be self-sticking type.

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2.5 PIPE CODING (WRAP AROUND)

- A. Apply color coded coiled plastic pipe bands identifying service and direction of flow on all piping systems.
- B. Pipe identification shall meet ANSI A13.1 for color, letter height, and band size.
- C. Bands shall have flow direction arrows.
- D. Larger sizes shall have stainless steel springs.
- E. Manufacturer shall be:
 - 1. MSI MS-970

2.6 LOCATION MARKERS

- A. Provide approved ceiling tile markers near removable ceiling panels to indicate the location of valves or other devices. Markers shall be adhesive type of various colors.

PART 3 - EXECUTION

3.1 PIPE CODING

- A. On exposed piping apply bands at 20-foot centers on straight runs, at valve locations, and at points where piping enters and leaves a partition, wall, floor or ceiling.
- B. On concealed piping installed above removable ceiling construction, apply bands in the manner for exposed piping.
- C. On concealed piping installed above nonremovable ceiling construction, or in pipe shafts, apply bands at valves or other devices that are made accessible by means of access doors or panels.
- D. Apply bands at exit and entrance points to each vessel, tank or piece of equipment.
- E. For insulated pipes apply bands after insulation and painting work has been completed.
- F. Follow manufacturer's instructions for application procedures using noncombustible materials and contact adhesives.

3.2 PIPE CODING SUBMITTAL

- A. Submit a chart indicating each system and colors available for background and lettering. (The Contractor shall also include listing of existing identification colors used in this facility.)

3.3 VALVES

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- A. Furnish to Owner's Representative three (3) complete framed plastic laminated valve tag schedules. Schedule shall indicate tag number, valve location by floor and room number, valve size and service controlled.

END OF SECTION

SECTION 22 05 92 - SYSTEM START-UP

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the start-up of all building mechanical systems where shown on the drawings and specified hereinafter.

B. Description:

1. These systems shall include:
 - a. Domestic water systems
 - b. Sanitary drain, waste, storm drainage, and vent systems

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and standards:

1. All work shall meet or exceed the standards and procedures of the following (latest edition):
 - a. AWWA Standards
 - b. NFPA 99

B. Start-up of equipment shall be by manufacturer's representative unless noted otherwise.

C. Tests, in addition to those specified herein, required to prove code compliance, to meet insurance requirements, and to verify proper installation by the A/E, owner, or authorities having jurisdiction shall be provided by the Contractor.

D. All tests, instruments, and procedures shall be in accordance with the AABC National Standards and system test and balance specifications.

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PART 2 - PRODUCTS

2.1 GENERAL

- A. All concealed work must remain uncovered until required tests have been completed. Sections of the system may be tested prior to concealing as outlined hereinafter.
- B. The Owner and the A/E shall be notified in writing a minimum of three working days prior to any tests being performed.
- C. Local, state and federal authorities having jurisdiction shall be notified in writing with sufficient time to schedule inspection as required by the authority.
- D. In no case shall a system be started or operated in such a manner that the system or component pressure or temperature ratings, or the pressure or temperature to which a system or component has been tested, be exceeded.

2.2 START-UP

- A. Systems shall be started up by the Contractor except as required in specific portions of the mechanical specifications.

2.3 STARTING THE PIPING SYSTEMS

- A. Prior to putting any piping system in service, it shall be tested and thoroughly cleaned according to the procedures specified below. The Contractors are responsible to take all precautions necessary to prevent contamination of existing domestic water and also to prevent unauthorized use, when connecting new systems to existing water lines.

2.4 STERILIZATION OF POTABLE WATER SYSTEMS

- A. All pipelines and all appurtenances, both existing and new, which have been exposed to contamination by reason of this construction shall be sterilized before being placed into service.
- B. Prior to chlorination, all systems shall be flushed with water at a system velocity of not less than 2.5 feet per second.
- C. Sterilization shall be performed after all hydrostatic tests have been performed and before system is placed in service.
- D. All potable water systems shall be chlorinated in accordance with procedures described in AWWA Standards for disinfecting water mains, AWWA C601. The entire line shall be chlorinated with a gas-water mixture, or calcium hypochlorite (70% available chlorine) and water. The chlorinating agent shall be applied at the beginning of the section adjacent to the feeder connection and shall be injected through a corporation stop, hydrant or other connection insuring treatment of the entire line. Water shall be fed slowly into the new line with chlorine applied in such amounts as to produce a dosage of 50 parts per million. Lines previously filled shall be treated to a concentrated dosage at intervals along the line.

- E. A 24-hour residual of 10 parts per million shall be produced in all parts of the line. During the chlorination process all valves, hydrants and accessories shall be operated. After chlorination, the water shall be flushed from the line at its extremities until the replacement water tests are equal bacteriologically, to those of the permanent source of supply and shall conform otherwise in all respects to the requirements of the South Carolina Department of Health and Environmental Control. Two acceptable bacteriological tests shall be obtained 24 hours apart and reported by an independent laboratory. Test results must be on file with the Architect/Engineer prior to State Inspection.
- F. Furnish all HTH or liquid or gas chlorine required for sterilization and shall furnish all equipment and labor required for the work.

2.5 PIPING SYSTEM TESTS

A. General:

- 1. Upon completion of each system of work under this Division and at a designated time, all piping shall be pressure tested for leaks.
- 2. All piping located underground shall be tested before backfilling.
- 3. Sections of the system shall be tested prior to concealing the piping in walls, chases, false ceilings, etc.
- 4. If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests repeated at no additional cost to Owner. Make tight any leaks. Repeat tests until system is proven tight. Caulking of leaks will not be permitted.
- 5. All equipment not capable of withstanding the test pressure shall be valved off during test.
- 6. Provide all gauges, valves, caps and accessories to properly test system.
- 7. At no time shall a system be tested at a pressure greater than the piping system or component is rated.

B. Drain, Waste, and Vent Pipe:

- 1. All drain, waste, storm drainage and vent piping including branch bends and joints shall be tested before fixtures are set by closing all openings and filling entire system with water to a height of not less than ten feet above highest floor, or a pump may be used to maintain an equivalent pressure.
- 2. Test pressure shall be maintained for thirty minutes when using pump method. When using water column method, test period shall also be thirty minutes and water level shall not drop more than four inches.
- 3. No tests shall be made during freezing weather.

C. Domestic Water Pipe:

- 1. Where a portion of water system is to be concealed before completion, this portion shall be tested separately in a manner described for the entire system.
- 2. Water used for testing shall be from a potable source of supply.
- 3. Upon completion of rough-in and before setting fixtures, hydrostatically test water piping downstream of pressure reducing valves to 1-1/2 times the operating pressure, but not greater than 80 psig.
- 4. Hydrostatically test water piping upstream of pressure reducing valves to 1-1/2 times the operating pressure or 100 PSIG, whichever is greater.
- 5. The test shall be a minimum of two (2) hours without pressure drop.

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D. Plumbing Fixtures:

1. Water shall be turned onto all supply lines, all fixtures shall be demonstrated to operate properly, valves and stops adjusted, packed and repacked as may be required to eliminate leaks and produce proper flow, piping shall be adjusted to provide proper circulation and to prevent hammering and thumping.

2.6 SYSTEM START-UP

A. General:

1. System shall be started and checked to ensure safe and proper operation.
2. Minimum requirements are listed for each system and are in addition to manufacturer start-up requirements and the requirements stated in the specific sections of the specifications.

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Submit to the A/E all test results including a minimum of the following information:

1. System tested.
2. Location of test.
3. Date, time, and ambient temperature at test startup and completion.
4. Persons present for test.
5. Duration of test.
6. Test equipment.
7. Test results.

B. Partial system may be done at the Contractor's option except tests shall be completed:

1. For each phase designated by contract documents;
2. And, in accordance with building contracts schedule for completion;
3. And, as required to turn over portions of the system for the Owner's use.

C. Reports shall include but not be restricted to:

1. Tests during construction.
2. Manufacturer's start-up of equipment.
3. Manufacturer's representative start-up of equipment.
4. Contractor start-up of system.

D. Reports shall be submitted within ten days of test completion.

3.2 ENGINEER REVIEW

A. The A/E shall, at his discretion, recheck any or all of the test work. Provide ample number of technicians and test equipment to perform the tests required.

B. All systems not accepted shall be retested.

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- C. Systems shall be retested and rechecked until accepted by all parties.

END OF SECTION

SECTION 22 06 01 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of hydronic specialties where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures (latest editions) of the following:
 - a. USA Standard Face to Face Dimensions of Ferrous Flanged Valves ANSI B16.10.
 - b. USA Standard for Cast Iron Pipe Flanges and Flanged Fittings. ANSI B16.1.
 - c. SHEMA.

- B. All pressure vessels including expansion tanks, air separators and similar equipment shall be constructed, tested and stamped in accordance with ASME standards.

- C. Equipment shall be stamped for (125) (250) psig working pressure.

D. Manufacturers:

1. The following dielectric fitting manufacturers are acceptable:
 - a. Perfection Corporation
 - b. Victaulic

PART 2 - PRODUCTS

2.1 UNIONS AND FLANGES

A. Steel pipe:

1. Unions shall be malleable iron, zinc coated, ground joint type for steel pipe.

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- B. Copper tubing and pipe:
 - 1. Unions shall be brass.
- C. Flanges or unions shall be installed in the following locations:
 - 1. At locations indicated on plans.
 - 2. At equipment to permit mechanical removal of equipment.
 - 3. At equipment to permit servicing.
 - 4. At pressure reducing valves to permit mechanical removal of the valve.

2.2 DIELECTRIC FITTINGS

- A. Dielectric nipples shall have a high temperature, inert, thermoplastic copolymer liner. The nipple shall be electro-zinc plated steel. Current flow across a 3/4" nipple shall not exceed .010 ma.
- B. Provide dielectric fittings:
 - 1. To isolate dissimilar metals in piping systems
 - 2. At connections to all water heaters
- C. Dielectric fitting shall be:
 - 1. Hydronic systems - dielectric nipple

PART 3 - EXECUTION

3.1 STRAINERS

- A. There shall be approved strainers in the inlet connections to each pump, each automatic valve, each pressure reducing valve, and as shown on drawings.
- B. Strainers shall be so arranged as not to "trap" lines and to facilitate disconnection and opening-up for cleaning. Unless otherwise indicated, strainers shall be line size.
- C. Dirt blowoff valves shall be 6" to 1'-0" below strainer or as directed. Nipples and valves to be full size of strainer blowoff tapping. For all strainers, the blowout connection is to terminate in an approved manner, at a point where there will be no risk of flooding or damage.
- D. All strainers installed in horizontal piping shall be installed flat (on side) except strainers at pumps shall be installed in a vertical position.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of insulation required for thermal and acoustical installation on all Mechanical Equipment, Piping, Ductwork and appurtenances where shown on the drawings and specified hereinafter under applicable sections of this specification.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section. In addition, refer to these specification sections:
 1. Section 22 07 16 – Plumbing Equipment Insulation
 2. Section 22 07 19 – Plumbing Piping Insulation

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All insulation materials must have a maximum 25/50 flame/smoke rating as tested by ASTM E-84, NFPA 255 and UL 723 except where specifically noted otherwise.
 2. OSHA.
 3. Flame/smoke rating shall be minimum 25/250 in equipment rooms where the room is not used as a plenum.
- B. Insulation thickness shall equal those recommended by ASHRAE 90.1 or as scheduled, whichever is greater. Surface temperatures shall be below 140 degrees F.
 - C. Accessories such as adhesives, mastics, cements, and tapes for fittings shall have the same component rating as listed above.
 - D. All products or their shipping cartons shall bear a label indicating that flame and smoke ratings do not exceed requirements. Treatment of jackets or facing to impart flame and smoke safety shall be permanent. The use of water-soluble treatments is prohibited.
 - E. Installation and materials shall meet the requirements of the International Building Codes.
 - F. All insulation work shall be applied by mechanics normally employed in the trade. All insulation shall be installed in accordance with the manufacturer's recommendations.

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- G. All insulation furnished under this Division of the specifications shall be the product of one manufacturer except for special applications.
- H. Manufacturers:
 - 1. The following manufacturers of sealants, adhesives, and mastics shall be:
 - a. Foster

PART 2 – PRODUCTS

2.1 MASTICS, SEALANTS, AND ADHESIVES

- A. General:
 - 1. Materials shall be as recommended by the insulation manufacturer.
 - 2. Products shall be applied as recommended by the manufacturer for that specific application.
 - 3. The number of coats and thicknesses shall meet or exceed the manufacturer's recommendation or as indicated in these specifications or on the plans, whichever is greatest (coats and thickness).
 - 4. Materials shall meet LEED requirements for low emitting products.
- B. Finish:
 - 1. When material is applied where it is to be painted, the material shall be coated, if necessary, to allow the material to be properly painted with use of special paints or primers.

PART 3 - EXECUTION

3.1 GENERAL

- A. All insulation materials shall be delivered and stored in manufacturer's container and kept free from dirt, water, chemical and mechanical damage.
- B. Insulation shall be applied by experienced workmen in a workmanlike manner.
- C. Insulation shall not be applied until all pressure testing has been completed, inspected and released for insulation application.
- D. Surfaces to be insulated shall be clean and dry.
- E. All insulation joints shall be butted firmly together, and all jackets and tapes shall be smoothly and securely installed.
- F. Insulation shall be run continuously through walls, ceiling openings, and sleeves except where fire stop or firesafing materials are required.
- G. Items that are factory insulated shall not receive additional insulation where not otherwise specified.

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3.2 INSTALLATION

A. General:

1. Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal.
2. Insulation on equipment that must be opened periodically for inspection, cleaning, and repair must be constructed so insulation can be removed and replaced without damage.

END OF SECTION

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SECTION 22 07 19 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of insulation required for thermal and acoustical installation on all piping including valves, mechanical couplings, fittings, flanges, strainers, expansion joints, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section. In addition, refer to these specification sections:
 1. Section 220700 – Plumbing Insulation

1.3 QUALITY ASSURANCE

A. Manufacturers:

1. The following fiberglass piping insulation manufacturers are acceptable:
 - a. Owens/Corning
 - b. Knauf
 - c. Johns Manville
2. The following elastomeric pipe insulation manufacturers are acceptable:
 - a. Armacell
 - b. K-Flex
 - c. Nomaco Insulation
3. The following aluminum jacket manufacturers are acceptable:
 - a. Childers
 - b. RPR Products
4. The following stainless steel jacket manufacturers are acceptable:
 - a. Childers
 - b. RPR Products

PART 2 - PRODUCTS

2.1 GENERAL

- A. Pipe insulation shall comply with the International Energy Conservation Code or these specifications, whichever is greater.

2.2 TYPES OF INSULATION:

A. Fiberglass Insulation:

- 1. Physical properties:
 - a. Thermal conductivity (k) is 0.25 at 100 degrees F.
- 2. Jacket:
 - a. ASJ jacket with or without self-sealing adhesive system.
- 3. Insulation shall be:
 - a. Owens/Corning Heavy Density Fiberglass Insulation ASJ/SSL or ASJ

B. Elastomeric Insulation:

- 1. General:
 - a. The insulation shall have a factory applied adhesive closure system.
- 2. Physical properties:
 - a. Thermal conductivity (k) is 0.27 at 75 degrees F.
 - b. Water transmission is 0.08 perms - inch.
 - c. Will not significantly contribute to fire.
- 3. Insulation shall be:
 - a. Armacell type AP Armaflex SS
 - b. K-Flex USA type LS Seam-Seal or Insul-Lock
 - c. Nomaco Insulation FlexTherm

2.3 PIPE INSULATION APPLICATION

A. General:

- 1. All fittings, valves, and accessories in the piping system shall be insulated similar to the piping system.
- 2. Insulation in return air plenums shall have a flame/smoke rating not to exceed 25/50.

B. Fiberglass Pipe Insulation:

- 1. Fiberglass pipe insulation is required for the following piping systems:
 - a. Indoor piping up to 850 degrees F except for those where other types of pipe insulation is specified.

C. Elastomeric and Polyolefin Pipe Insulation:

- 1. Elastomeric and polyolefin pipe insulation is only permitted on the following:

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- a. Piping concealed in walls, partitions and chases.
- b. Where details or notes specifically allow the use of elastomeric or polyolefin insulation.

2.4 FITTINGS

A. General:

1. Fittings shall be factory molded except where indicated otherwise.
2. Fittings shall have a factory installed vapor barrier or have a field installed vapor barrier equal to the pipe vapor barrier.

B. Fiberglass Pipe Insulation:

1. Piping (up to 1-1/4"):
 - a. Fittings may be mitered at contractor's option.
2. Piping (1-1/2" and larger):
 - a. Fittings shall be insulated with 3/4 PCF density, all service faced FSK duct wrap, 2" thick.

C. Elastomeric and Polyolefin Pipe Insulation:

1. Piping (up to 3/4"):
 - a. Fittings may be mitered at contractor's option.

D. All Other Insulation:

1. Piping (all sizes):
 - a. Per manufacturer's recommendations.

2.5 JACKETING

A. Aluminum Jacketing:

1. General:
 - a. Jacketing shall be manufactured from Type 1100, 3003, 3105 and 5005 alloys.
 - b. Jacketing on piping shall be corrugated. Corrugation shall be 3/16 inches.
 - c. Jacketing on equipment shall be smooth.
2. Thickness:
 - a. Pipe jacket shall be .016 inches.
 - b. Equipment jacket shall be .024 inches.
3. Vapor Barrier:
 - a. Continuous lamination to jacket.
 - b. One mil polyethylene film with 40 lb. virgin kraft paper.

B. Stainless Steel Jacketing:

1. General:
 - a. Provide a complete system of manufactured jacketing for valves, piping, fittings, and equipment.

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- b. Jacketing shall be Type 304L stainless steel with a standard 2B mill finish.
- 2. Pipe:
 - a. Jacket shall be factory fabricated for each pipe size. The jacketing shall have a continuous modified Pittsburg Z-lock.
 - b. Jacket shall be smooth and shall be .016" thick.
 - c. Jacket shall be:
 - 1) Childers Strap-On Fabricated Jacketing System
- 3. Fittings and Valves:
 - a. Jackets for fitting, valves, and accessories shall be factory fabricated for each fitting, valve, and accessories including, but not limited to, elbows, tees, valves, and flanges.
 - b. Jackets larger than available from manufacturers in standard sizes shall be custom fabricated by the manufacturer.
 - c. Jacket shall be smooth and shall be .024" thick.
- 4. Equipment:
 - a. Jacketing shall be smooth and .016" thick.
- 5. Vapor Barrier:
 - a. Continuous lamination to jacket.
 - b. One mil polyethylene film with 40 lb. virgin kraft paper.

2.6 FINISH

- A. Exposed Piping (in equipment rooms and elsewhere throughout the facility) shall be one of the finishes listed below as selected by the contractor unless a type of finish is specifically indicated:
 - 1. Glass fabric and two coats mastic, one coat vapor barrier sealant.
- B. Fittings:
 - 1. Fittings adjacent to ASJ jacket shall be finished with PVC jacket.
 - 2. Fittings adjacent to jacketing other than ASJ shall be finished similar to piping.

2.7 GLASS FABRIC

- A. General:
 - 1. Fabric shall be 100% fiberglass scrim with non-combustible finish.
 - 2. Fabric shall be 1.9 oz. + .3 oz. per square yard.
 - 3. Thread count shall be 20 x 10 (yarns per inch).

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PART 3 - INSULATION THICKNESS SCHEDULES

3.1 GENERAL

- A. Specific insulation requirements may be indicated elsewhere in these specifications or on the contract drawings.
- B. Insulation for piping exposed to ambient conditions based upon 90 degrees F, 90% RH, and 7 MPH wind speed.

3.2 FIBERGLASS INSULATION SCHEDULE

- A. Domestic Cold-Water Piping:
 - 1. Up to 1-1/4" pipe - 1/2" thk.
 - 2. 1 1/2" pipe and larger - 1" thk.
- B. Domestic Hot Water Piping:
 - 1. Up to 1-1/4" pipe - 1" thk.
 - 2. 1 1/2" pipe and larger - 1-1/2" thk.

3.3 ELASTOMERIC SCHEDULE

- A. Domestic Cold-Water Piping located in chase/wall:
 - 1. All pipe - 1/2" thk.
- B. Domestic Hot Water Piping located in chase/wall:
 - 1. All pipe - 1" thk.
- C. Horizontal Drinking Fountain Waste Tubing:
 - 1. All pipe - 3/4" thk.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Apply adhesives, sealants, coatings, and other materials as recommended by the manufacturer.
- B. Outward clinching staples shall be used on ASJ jacketing and be sealed with vapor barrier sealer on cold pipe. Piping not easily accessible for repair or maintenance shall be banded with three aluminum bands per section.
- C. All penetrations through vapor barrier shall be sealed with vapor barrier sealer. Where metallic jacketing is used, all penetrations through jacket and at termination of jacket shall be sealed.

- D. Butt joints and seams of elastomeric and polyolefin insulation shall be sealed with contact adhesive as recommended by the insulation manufacturer. Where possible, insulation shall be used without slitting and slipped over tubing. All fittings shall be covered and sealed with fabricated pieces of the same insulation and adhesive.
- E. Insulation for heat traced pipe shall be sealed with tape or adhesive. Staples shall not be used.

4.2 ANCHORS AND SUPPORTS

- A. Anchors and supports that are secured directly to cold surfaces shall be adequately insulated and vapor sealed to prevent condensation.
- B. Jacketing shall be carried through hanger on inside of 16-gauge sheet metal shields and sealed to maintain continuous vapor barrier except domestic hot water may be insulated around the hanger.
- C. Where inserts occur at pipe supports and guides, provide the following:
 - 1. On hot pipes apply 3" wide vapor barrier tape or band over the butt joints.
 - 2. On cold pipes apply a wet coat of vapor barrier lap cement on all butt joints and seal the joints with 3" wide vapor barrier tape or band.

4.3 FITTINGS

- A. General:
 - 1. Apply vapor barrier to insulation and all seams.
- B. FSK Ductwrap:
 - 1. Apply pressure sensitive vapor barrier tape.

4.4 METALLIC JACKETING

- A. Jacketing shall be held in place with a friction type, Z lock, or 2" overlap joint. Joints shall be completely sealed along the longitudinal seam and shall be installed to shed water. Circumferential joints shall be sealed by using 2" wide butt strips. ½" bands shall secure jacketing. Space as recommended by the manufacturer.
- B. Straps shall secure jacket. Straps shall be the same material as jacket. Provide 1/2" straps for jackets up to 12" in diameter. Provide 3/4" straps for 14" and larger diameter jackets.

4.5 FIRERATED ASSEMBLIES

- A. Insulation shall run through firerated assemblies. Where insulation is not approved for routing through fire rated assemblies, transition to an approved fire rated insulation of the same thickness where the insulation is routed through the fire rated assembly. The transition shall occur between a minimum of six (6) inches and a maximum of twelve (12) inches from assembly on both sides of assembly.

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4.6 MULTI-LAYER INSTALLATION

- A. Joints shall be staggered.

END OF SECTION

SECTION 22 11 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of pipe, pipe fittings, accessories and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All pipe and pipe fittings shall comply with American National Standards Institute Code, all local codes and ordinances, and meet or exceed the standards and procedures (latest editions) of the following:
 - a. Ferrous Pipe and Fittings:
 - 1) Cast Iron Soil Pipe and Fittings, Hub And Spigot. ASTM A74
 - 2) Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary System. CISPIS 301 and ASTM 888
 - 3) Malleable Iron Screwed Fittings. ANSI B16.3
 - 4) Steel Flanges. ANSI B16.5
 - 5) Steel Fittings. ANSI B16.9
 - 6) Steel Pipe, Welded or Seamless, Black or Galvanized. ASTM A53, A106, and A120.
 - 7) Steel Pipe, Welded or Seamless (for coiling) Black or Galvanized. ASTM A53
 - 8) Wrought Iron Pipe. ASTM A72
 - b. Non-Ferrous Metallic Pipe and Fittings:
 - 1) Copper Tube, Water, (Fuel Oil) Seamless, Types K, L, and M. ASTM B88
 - 2) Pipe Fittings, Brass or Bronze, 125 and 250 lbs., Cast or Wrought. ANSI B16.15
 - 3) Solder Joint Fittings, Pressure, Copper Alloy. ANSI B16.22
 - 4) Refrigerant Piping. ANSI B31.5, ANSI B36.40, ASTM A333
 - 5) Copper tube (drain, vent) DWV. ASTM B306
 - 6) Copper tube (natural gas, LP), ACR. ASTM B280
 - 7) Copper tube (medical gas), oxygen, med. ASTM B819

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- c. Non-metallic Pipe and Fittings:
 - 1) PVC Sewer Pipe and Fittings, Type PSM (up to 6"). ASTM D3034
 - 2) PVC Sewer Pipe and Fittings, Type PSM (8", 10", 12"). ASTM D3034
 - 3) PVC Plastic Pipe Schedule 40, 80, and 120 ANSI B72.7, ASTM D1785
 - 4) PVC Plastic Pipe (SDR-PR). ASTM D2241
 - 5) Socket-type PVC Plastic Pipe Fittings Schedule 40. ASTM D2466
 - d. Pipe Joining Materials, Gaskets, Methods, and Accessories:
 - 1) Rubber Gaskets for Cast Iron Soil Pipe and Fittings. ASTM C564
 - 2) Hubless Soil Pipe Heavy Duty Shielded Couplings (304 Stainless Steel). ASTM C1540
 - 3) Solvent Cements for PVC Plastic Pipe and Fittings. ANSI B72.16, ASTM D2564
 - 4) Elastomeric Gaskets for Plastic Hub and Spigot Piping. ASTM F477
 - 5) Soldering and Brazing ANSI B9.1
 - e. AWWA - Standards for Plastic Water Pipe and Fittings.
 - f. NSF - National Sanitation Foundation Seal of Approval.
- B. Material shall be new domestic materials (made in the USA) of standard manufacture suitable for specified use.
- C. The Owner and A/E reserve the right to inspect, sample and test any pipe after delivery and to reject all pipe represented by any sample which fails to comply with the specified requirements. Inspection of pipe shall be for pits, blisters, rough spots, breakage or other imperfections. Any pipe which has been rejected because of the above shall be conspicuously identified and immediately removed from the construction site.
- D. Manufacturer shall certify materials conform to reference specifications, or specification number shall be cast into or marked on each piece.
- E. All Cast Iron soil pipe and fittings shall be labeled with the Cast Iron Soil Pipe Institute mark of quality and permanence.
- F. Manufacturers:
- 1. The following no-hub clamp manufacturers are acceptable:
 - a. UPC Clamp-All
 - b. ANACO Husky SD 2000
 - c. Mifab Heavy Duty
 - d. Ideal Heavy Duty
 - 2. The following gasketed pipe manufacturers are acceptable:
 - a. Charlotte Seal
 - b. Tyler Pipe Industries
 - 3. The following solder manufacturers are acceptable:
 - a. United Wire
 - b. Engelhard
 - c. Elkhart
 - 4. The Following PVC pipe Manufacturers are acceptable:
 - a. Charlotte

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- b. NIBCO
 - c. Approved equal
5. The following cast iron pipe manufacturers are acceptable:
- a. Tyler
 - b. Charlotte Cast Iron Pipe
 - c. AB&I Cast Iron Pipe

PART 2 - PRODUCTS

2.1 GENERAL

- A. No materials shall be co-mingled within the same system except those which are specifically approved in these specifications.

2.2 PIPE SCHEDULE

- A. Building Sewer Piping, Building Storm Drainpipes, and Plumbing Vent Piping:
- 1. Piping above ground shall be service weight, Cast Iron, soil pipe and fittings.
 - 2. Piping above grade shall be no-hub type. Each joint shall consist of a housing and clamp.
 - 3. The housing and clamp assembly shall consist of type 304 stainless steel housing, type 304 stainless steel clamps, type 305 stainless steel screws, and a one piece molded neoprene gasket.
 - 4. Assemblies shall be provided with a minimum of two high torque clamps of 100-125 in/lbs or four clamps with a minimum rating of 80 in/lbs.
 - 5. Housings shall be 3" wide for pipe sizes up to 4" and 4" wide for 5" thru 10" pipe sizes.
 - 6. Piping and fittings below grade may be Schedule 40 PVC Solid Wall with solvent welded fittings.
- B. Sanitary Sewer Pipes and Storm Drain Piping, Exterior:
- 1. Piping installed from 5'-0" outside of building to connection with existing sanitary sewer and storm drain shall be Polyvinyl Chloride Schedule 40 Solid Wall sewer pipe and fittings.
 - 2. Pipe and fittings shall be hub and spigot type with gasketed joints/fittings.
- C. Domestic Water Piping:
- 1. Fittings shall be Class 150 with permanent identification markings.
 - 2. All domestic water piping, up to 4 inches, below grade and to a point five (5) feet outside of building shall be seamless hard drawn, Type K copper pipe, with wrought copper fittings.
 - 3. All domestic water piping up to 4 inches, above grade shall be seamless hard drawn, Type L, copper pipe, with wrought copper fittings.
 - 4. All exposed water piping to plumbing fixtures and to kitchen equipment shall be IPS chrome-plated yellow brass pipe with polish chrome-plated 125 pound screwed brass fittings. Pipe shall be seamless drawn semi-annealed containing not less than 85% copper and conforming to ANSI H27-1.

- D. Relief Valve Discharge and Vent Piping:
 - 1. Piping shall be seamless hard drawn, Type L, copper pipe.

2.3 FITTINGS AND CONNECTIONS

- A. Fittings shall be the same material and weight as the pipes joined by the fitting unless noted otherwise. Fittings shall comply with all applicable standards.
- B. Prohibited Fittings:
 - 1. The following are prohibited fittings:
 - a. Bullhead tee's
 - b. Street ells
 - c. Bushings
 - d. Close nipples
 - e. "T" drill fittings
 - f. No mitered fittings in welded systems
- C. Welded Fittings and Pipe Connections:
 - 1. All welded pipe and fittings shall be delivered to job with machine beveled ends. Where necessary, beveling may be done in filed by gas torch, in which case surfaces shall be thoroughly cleaned of scale and oxidation after beveling.
 - 2. Welded pipe shall have flanges at valves and elsewhere to permit disassembly for maintenance.
 - 3. With the exception of pipe welded end-to-end, all welded joints shall be made by the use of one-piece welding neck flanges, nozzles, elbows and tees.
 - 4. All welding elbows shall be long radius.
 - 5. Welding end fittings shall have the same bursting pressure as pipe of the same size and schedule. Tee fittings shall be one piece except that shaped nipples are permitted where branches are at least three pipe sizes smaller than the main.
- D. Flanged Fittings:
 - 1. Flanges and flanged fittings shall conform to ANSI standards and ASTM standards.
- E. Cast Iron Fittings:
 - 1. Fittings for sewage lines, drain lines and plumbing vents shall be the same type as the pipes joined by the fitting.
 - 2. Cast iron pipe and joints must conform to ANSI A21.1, A21.8, A21.10, and A21.11, latest revisions.
- F. Malleable Iron Fittings - Water Service:
 - 1. All malleable iron fittings shall conform to ASA B16.3, B2.1 and ASTM A47 Grade 32510.
- G. Copper Pipe Fittings - Water Service:
 - 1. Fittings shall be wrought copper.
 - 2. Solder used for fittings shall be zero percent lead, 200 PSI working pressure, installed as recommended by the manufacturer and applied to clean surfaces. Connections to valves and other types of piping shall be made with brass, copper or bronze adapters, sweat

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- type to threaded type or cast copper companion flanges. Connections to valves and other dissimilar materials shall be made with dielectric unions where hereafter specified.
3. Fittings in concealed location:
 - a. Fittings shall be brazed.
 - b. Solder shall be:
 - 1) United Wire SIL-PH0S
 4. Fittings in non-concealed locations:
 - a. Fittings shall be soldered unless noted otherwise.
 - b. Solder shall be:
 - 1) United Wire SIL-PH0S
 - 2) Engelhard Silvabrite 100
- H. Brass Pipe Fittings - Exposed Water Piping to Fixture:
 1. Fittings shall be polished chromium plated cast brass screwed type.
- I. Plastic Fittings - Potable Water Mains:
 1. Fitting shall be Type I, solvent weld type.

2.4 PIPE COVERINGS

- A. Pipe Coverings:
 1. Pipes not specified to be covered in the Underground Pipe Coating specification or specifically indicated elsewhere shall be covered per this section.
 2. Type 1: Mechanically wrapped with asphalt primer and asphalt saturated felt or glass wrapper bonded to enamel with Asphalt Institute specification M1. Joints and pipe less than 10 feet in length may be field coated.
 3. Type 2: Polyken 826 sheathing, 12 mil minimum thickness.
- B. Pipe Requirements:
 1. Underground Pipe - Type 1 or Type 2.
 2. Pipes in contact with masonry: Type 1 or Type 2.

PART 3 - EXECUTION

3.1 GENERAL

- A. Pipe shall be installed in strict accordance with manufacturer's recommendations.
- B. Cut pipe accurately to measurements established at building or site, and work into place without springing or forcing, properly clearing all window, doors, and other openings or obstructions. Excessive cutting or other weakening of building to facilitate piping installation will not be permitted. Piping shall line up flanges and fittings freely and shall have adequate unions and flanges so that all equipment can be disassembled for repairs.
- C. Each length of pipe, as erected, shall be upended and rapped. Dirt and all foreign matter shall be cleaned from pipe and fittings before installation.

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- D. All turns and connections shall be made with long radius fittings as specified hereinafter.
- E. Provide proper provision for expansion and contraction in all portions of pipework, to prevent undue strains on piping or apparatus connected therewith. Provide double swings at coil connections, riser transfers, and other offsets wherever necessary to take up expansion. Arrange riser branches to take up motion of riser.

3.2 ISOLATION VALVES

- A. Provide shutoff valves at all major branches and at each riser.

3.3 GASKETED HUB AND SPIGOT PIPING:

- A. The spigot end of the pipe shall be prepared by cleaning and applying a thin coat of adhesive lubricant.
- B. The spigot end is centered in the hub and jacked on by using a special jack and choker sling.

3.4 PIPING ARRANGEMENT

A. Drainage and Vent Piping:

1. All horizontal drainage and vent piping shall be installed with a uniform grade. Piping 2-1/2" and less shall slope a minimum of 1/4" per foot of fall in the direction of flow. Piping 3" and larger shall slope a minimum of 1/8" per foot of fall in the direction of flow. Fall shall be greater where indicated.
2. Soil and waste vent pipes shall extend 12" minimum through roof full size except where noted otherwise. Vents through the roof shall be a minimum 3". Provide increasers as required.
3. Changes in direction or size of drainage piping shall be made with appropriate fittings having long radius. The use of short radius fittings shall be limited to points where the space limitations prevent the use of long radius fittings.
4. Slip joints shall be permitted only on trap connections. Couplings or hub drainage fittings shall be used for union connections.
5. All vertical stacks shall be supported at each floor with clamp anchors to relieve stresses. Vertical stacks shall be installed with provision for expansion.

3.5 PIPING TO EQUIPMENT

- A. Where items in piping such as control valves, pumps, coils and equipment connections are different sizes than the piping, reducers and increasers shall be installed adjacent to such items so there is a minimum of reduced size pipe.
- B. Eccentric reducers shall be installed on suction side of pumps allowing continuous flow of air.
- C. All piping connections to coils, equipment, valves and other system components shall be made with offsets with flanges or unions so arranged that the equipment can be serviced or removed without dismantling the piping.

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- D. Provide all final pipe connections to systems and equipment.

3.6 BELOW GRADE PIPE

- A. All pipes shall be inspected before backfilling.

3.7 CONCEALED PIPE

- A. Test all pipe prior to concealing or insulating.

3.8 PIPE INSPECTION

- A. The Owner and A/E reserve the right to inspect, sample and test any pipe after delivery and to reject all pipe represented by any sample which fails to comply with the specified requirements. Inspection of pipe shall be for pits, blisters, rough spots, breakage or other imperfections. Any pipe which has been rejected because of the above shall be conspicuously identified and immediately removed from the construction site.

END OF SECTION

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SECTION 22 40 11 - PLUMBING ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of the plumbing system, accessories, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All equipment shall comply with American National Standards Institute Code, all local codes and ordinances, and meet or exceed the standards and procedures (latest editions) of the following:
 - a. South Carolina Department of Health & Environmental Control.
 - b. Plumbing and Drainage Institute Standard No. WH201 "Standard for Water Hammer Arresters."
 - c. Plumbing and Drainage Institute Standard No. G-101 "Testing and Rating Procedure for Hydro Mechanical Grease Interceptors with Appendix of Installation and Maintenance."
 - d. ASSE Standard 1010-2004 "Performance Requirements for Water Hammer Arresters."
 - e. ASTM C1613 "Standard Specification for Precast Concrete Grease Interceptor Tanks"
 - f. American Concrete Institute (ACI)

B. Manufacturers:

1. The following roof drain manufacturers are acceptable:
 - a. Mifab
 - b. J. R. Smith
 - c. Wade
 - d. Josam
 - e. Zurn
 - f. Watts
2. The following floor drain manufacturers are acceptable:
 - a. Mifab

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- b. J. R. Smith
 - c. Wade
 - d. Josam
 - e. Zurn
 - f. Watts
3. The following floor cleanout manufacturers are acceptable:
- a. Mifab
 - b. J. R. Smith
 - c. Wade
 - d. Josam
 - e. Zurn
 - f. Watts
4. The following backflow preventer manufacturers are acceptable:
- a. Conbraco
 - b. Watts
 - c. Apollo
5. The following water hammer arrester manufacturers are acceptable:
- a. Mifab
 - b. J. R. Smith
 - c. Sioux Chief
 - d. Watts
 - e. Zurn
6. The following trap seal primer device manufacturers are acceptable:
- a. Mifab
 - b. Precision Plumbing Products
 - c. Josam
7. The following trap seal protection device manufacturers are acceptable:
- a. SureSeal Manufacturing; Inline Floor Drain Trap Sealer

PART 2 - PRODUCTS

2.1 ROOF DRAINS

- A. Provide roof drains at locations shown on plans. Where no size is shown, provide drain same size as connecting piping.
- B. Drains shall be cast iron body with combined flashing collar and gravel stop with non-ferrous dome.
- C. Expansion joints shall be provided as required. Provide Mifab Model R1900 vertical expansion joint.
- D. Roof drains shall be:
 - 1. Poured concrete decks: Provide Mifab Series R1200-M-80 set in poured roof deck slab with an aluminum dome. Flashing is secured by a non-puncturing type of flashing device.

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2. Pre-cast deck: Provide Mifab Series R1200-U-M-80 drain body with underdeck clamp. Use where roof drain openings are pre-sleeved in the slab. The Underdeck clamp shall provide positive anchoring of the drain body.
3. Insulated deck: Provide Mifab Series R1200-B-E-U-M-80 drain body with sump receiver, adjustable extension, underdeck clamp, and aluminum dome. Adjust extension for insulation thickness.
4. Promenade deck drain: Provide Mifab R1100-P-3 drain with 1" thick, 8" square adjustable ductile iron tractor grate with stainless steel veneer.

E. Roof Drain Flashing:

1. Flashing sizes where shown are minimum sizes but in no case shall they be less than the size required by the roofing manufacturer.
2. Drains shall be flashed and made watertight using a 4-pound sheet lead. Flashing shall extend 18 inches from the drain body in all directions.

2.2 FLOOR DRAINS (FD-X)

- A. Provide floor drains at locations shown on drawings.
- B. Each drain shall be provided with a cast iron p-trap. Provide full size of the drain outlet.
- C. Trap seal primers shall be provided where indicated on drawings. Provide trap seal protection devices for all floor drains and floor sinks.
- D. Vandal-proof screw where stated shall be Torx security pin type screw.
- E. Provide membrane clamp (-C) in floor areas with a waterproofing membrane.
- F. All strainer tops to be reinforced to prevent cupping.
- G. Outlet connection for floor drains installed at grade level shall be push-on. The contractor's option for outlet connection type for floor drains installed above grade.
- H. Floor drains shall be:
 - FD- 1: General Purpose Floor Drains (Toilets, Water Heater Rooms): Mifab Series F1000-3-7 cast iron drain with 6" round adjustable reinforced stainless-steel top with trap seal primer tapping.
 - FD-2: Mechanical Equipment Room Floor Drains: Mifab Series F1340-4-5-7-13-14 cast iron galvanized drain and sediment bucket with 12" round adjustable non-tilt ductile iron tractor grate with trap seal primer tapping.

2.3 CLEANOUTS

- A. Provide cleanouts at locations shown on plans and at all bends, angles, upper terminals, and each one hundred feet of pipe run.
- B. All Cleanouts to have full opening 4" access. Floor cleanouts to be provided with secondary threaded plastic/ABS plug lubricated with non-hardening thread lubricant.

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- C. Flush-with-floor cleanout tops shall have non-skid covers.
- D. Flashing flange with device required on membrane floors.
- E. Outlet connections for floor cleanouts installed at grade level shall be push-on. Contractor's option for outlet connection type for floor cleanouts installed above grade.
- F. Cleanouts shall be:
 - 1. Finished Room Floors (Round Top): Mifab Series C1220-R-3 (round top) cast iron adjustable floor level cleanout assembly with a stainless steel top.
 - 2. Finished Room Floors (Square Top): Mifab Series Mifab Series C1220-S-3 (square top) cast iron adjustable floor level cleanout assembly with a stainless steel top.
 - 3. Unfinished Floors: Mifab Series C1220-XR-4 all cast iron adjustable floor level cleanout assembly with round heavy-duty ductile iron top.
 - 4. Yard Areas: Mifab Series C1300-MF w/C1230 cast iron concrete surface level cleanout assembly with lifting device.
 - 5. Aboveground Caulk Ferrule Cleanouts: Mifab Series C1460-RD cast iron ferrule with 6" diameter stainless steel cover. Mifab Series C1460 for plug only.

2.4 VACUUM BREAKERS

- A. Vacuum breakers shall be constructed as follows:
 - 1. The body shall be chrome-plated brass.
 - 2. The retainer tube screen, cap, and collar shall be stainless steel.
 - 3. The ball check shall be stainless steel.
 - 4. The seat shall be a resilient "O" ring.
 - 5. Size shall be line size or as indicated on the drawing.
- B. Vacuum breakers shall be installed on all flush valves, service sinks, mop sinks, hose bibbs, wall hydrants, hose reels, threaded hose connections, any devices which can be installed or placed below a fixture flood rim, and elsewhere as specified.
- C. Dishwashers shall be provided with a satin chrome lead-free anti-siphon, spill-resistant vacuum breaker. The vacuum Breaker shall be Watts LF008PCQT or equal.

2.5 BACKFLOW PREVENTERS

- A. Backflow preventers shall be approved by the University of Southern California's Foundation for Cross Connection Control and Hydraulic Research (USC-FCCCHR) and local authority's approved manufacturer list.
- B. Provide an approved backflow prevention device (double check valve backflow preventer unless noted otherwise) at all points of possible backflow into potable water mains, as shown on plans and as follows:
 - 1. At entry into the building.
- C. Each backflow preventive device shall include shut-off valves, two approved check valves, and four properly installed test cocks. Shut-off valves shall be either ball valves or resilient wedged

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gate valves. Ball valves shall be used through 2" size. Provide unions for non-flanged assemblies.

- D. Provide bronze wye type strainer with stainless steel screen upstream of backflow prevention assemblies where indicated on drawings. The strainer shall have either threaded or flange connections. Threaded units shall have unions on each end for disassembly.

2.6 WATER HAMMER ARRESTERS

- A. Water hammer arresters shall be installed on both hot and cold water lines.
 - 1. Size by fixture unit rating of Plumbing and Drainage Institute (PDI).
 - 2. Select the next larger water hammer arrester when water pressure in the line exceeds 65 PSI.
 - 3. Water hammer arresters shall conform to ASSE 1010-2004.
- B. Water hammer arresters shall be permanently sealed, tested to 5000 cycles, and 125 PSI working pressure. Water hammer arrestors shall be suitable for installation in concealed locations without requiring access panels.
- C. Provide a water hammer arrester at the following locations:
 - 1. Flush valves (water closet/urinal):
 - a. Single fixture.
 - b. When in a battery and up to twenty (20) feet at the end of the branch line between the last two (2) fixtures.
 - 2. Quick closing valves.
 - 3. Lavatories:
 - a. When in a battery and up to twenty (20) feet at the end of the branch line.
 - 4. When fixtures in a battery and exceeds twenty (20) feet, provide an additional water hammer arrester midpoint.
- D. Water hammer arresters shall be, or equal to:
 - 1. Mifab MWH Series
 - 2. J. R. Smith No. 5000 Series Hydrotrol
 - 3. Sioux Chief No. 650 Series Hydra-Rester
 - 4. Watts No. 15M2 Series Water Hammer Arrester
 - 5. Zurn 1700 Series

2.7 TRAP SEAL PRIMERS

- A. Trap seal primer shall be pressure drop type configuration and shall be tested and certified to ASSE 1018 standard.
- B. Trap seal primer shall be installed on a cold water line where shown on drawings and shall operate on a minimum pressure drop of 5 psi to deliver water to trap(s).
- C. Provide distribution manifold to allow one trap seal primer to serve multiple (maximum of four) floor drains.

- D. Install trip seal primer per manufacturer's recommendations.

2.8 TRAP SEAL PROTECTION DEVICES

- A. The device shall be barrier type configuration and shall be tested and certified to ASSE 1072 Standard "Performance Requirements for Barrier Type Floor Drain Trap Seal Protection Devices".
- B. Body: ABS Plastic
- C. Diaphragm & Sealing Gasket: Neoprene Rubber
- D. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
- E. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometers.
- F. Provide at each floor drain or floor sink connection whether or not the floor drain or floor sink is specified with a trap seal primer.

PART 3 - EXECUTION

3.1 TEMPORARY PLUMBING FACILITIES

- A. Temporary toilet facilities and water for construction purposes shall be as specified in Division 1 all to be provided by the General Contractor. This Contractor shall cooperate to connect building facilities where required by the Architect/Engineer to expedite the progress of the work.

3.2 ROOF DRAINS

- A. Roof drains shall be clamped under flashing clamp and mopped into roofing. Drains shall be provided with deck clamps as detailed. Drains shall be painted with bitumen where the same is in contact with concrete.
- B. Drainage shall be furnished and installed as a complete system including cleanouts.
- C. Expansion joints as required shall be properly supported from the roof drain body.

3.3 FLOOR DRAINS

- A. All drains above grade shall be flashed with 4 lb. sheet lead clamped under flashing ring extending 18" from the drain in all directions, lead shall be mopped to the structural deck.
- B. All drains shall be provided with deep seal p-traps.
- C. Set drains to provide drainage of surrounding areas.

3.4 TRAP SEAL PRIMERS

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- A. Install trip seal primer per manufacturer's recommendations.
- B. Ensure that piping is properly flushed before connecting the trap seal primer and distribution unit (when required).
- C. Cycle trap seal primers a minimum of six (6) times to ensure optimum performance.

3.5 TRAP SEAL PROTECTION DEVICES

- A. Trap seal protection devices shall be installed at the trim-out stage of the project and not before.

3.6 VACUUM BREAKERS

- A. The vacuum breaker shall be installed per code and 6" above floor rim, whichever requirement is most stringent.

3.7 WATER HAMMER ARRESTERS

- A. Water hammer arresters shall be installed in an upright position.

3.8 STERILIZING AND CLEANUP

- A. After the system has been installed completely, the Contractor shall clean all fixtures removing all plaster, labels, etc. All water piping shall be sterilized per these specifications.

3.9 INSPECTIONS, TESTS, AND ADJUSTMENTS

- A. During progress and after completion of the work included under this specification, the Contractor shall make all required tests at his own expense in presence of Architect/Engineer as follows and per local codes. The contractor shall furnish all testing instruments, gauges, pumps, etc.
- B. All materials shall, as far as possible, be subjected to standard tests by manufacturers before shipment.
- C. All tests shall be conducted per System Test And Start-Up specification.
- D. Upon completion of work, the Contractor shall obtain and turn over to the Architect certificates of inspection and approval from all City and State Authorities having jurisdiction.

3.10 BACKFLOW PREVENTERS

- A. Backflow preventers installed above ceilings shall be observable from floor level when lay-in ceiling tile is removed where installed above accessible ceilings or when the ceiling access door is accessed when installed above a non-accessible ceiling. The contractor shall provide access door per requirements of Section 21 0501.

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B. Submittals:

1. Submit all backflow preventers to the local utility company for approval before submittal to A/E.
2. Submittal to utility company shall include a description of the intended application of each device.
3. Submittal to A/E shall include a copy of the letter of approval from the utility company to the contractor.

END OF SECTION

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SECTION 22 40 13 - PLUMBING FIXTURES (GENERAL)

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of plumbing fixtures where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All equipment shall comply with American Society of Testing Materials, all local codes and ordinances and meet or exceed the standards and procedures (latest editions) of the following:
 - a. A Sanitary Cast Iron Enameled Ware Commercial Standard
 - b. Staple Vitreous China Plumbing Fixtures
 - c. U. S. Department of Commerce CS 20-49, CS 77-48.
 - d. WW-P-542 Formed Steel Fixtures

B. Manufacturers:

1. The following emergency eyewash and shower equipment manufacturers are acceptable:
 - a. Haws
 - b. Acorn
 - c. Bradley
 - d. Speakman
 - e. Guardian
 - f. Stingray
2. The following wall hydrant and hose bib manufacturers are acceptable:
 - a. Woodford Manufacturing Company
 - b. MIFAB
 - c. Watts

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PART 2 – PRODUCTS

2.1 EMERGENCY SHOWER/EYE WASH:

A. Minimum supply connection shall be:

B. Fixtures shall be:

P-2 Emergency Eye/Face Wash: Floor mounted.

Fixture: Stingray model S2535-NP-NFT-ABNA Barrier-Free, Wall mounted
Emergency Face and Eye Wash with dust cover.

Note: Provide Lawler mixing valve model 911EF Thermometer with inlet piping
Cabinet mounted on wall. Supply 70-degree tepid water to emergency shower.

2.1 WALL HYDRANTS:

A. Wall hydrant minimum supply 3/4" with backflow preventer and vacuum breaker.

B. Hose bibb minimum supply 1/2" with backflow preventer and vacuum breaker.

C. Fixtures shall be:

P-3 Wall Hydrant (Outside Building): Wall mounted, 24" above finish grade.

Fixture: Woodford Model 67 backflow protected automatic draining freeze less
wall hydrant. ASSE Standard 1052 approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. All fixtures shall be installed in strict accordance with the manufacturers' recommendations.
2. All fixtures shall be protected during construction by covering with manila paper glued on. In addition, fixture shall be covered with shipping box taped to fixture.
3. All equipment, fixtures or devices shown on plans as new or relocated fixtures or devices shall require the Contractor to furnish and install all braces, supports, mounting brackets, spacers, shims, pads or other appurtenances required to make the fixture level and securely anchored to the wall, floor, or other component of the building structures. Supports not specified hereinafter shall be furnished in accordance with the equipment manufacturers recommendations.
4. In the event of damage, defects or flaws, regardless of the cause, immediately make all repairs and replacements at no additional cost to the Owner.
5. All fixtures shall be caulked to floor, wall, countertop, or other finished surfaces with compound recommended by fixture manufacturer. Color shall match fixture.

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3.2 FIXTURE MOUNTING HEIGHTS

- A. General:
 - 1. Mount fixtures as shown for each fixture type.

3.3 FIXTURE SUPPORTS

- A. General:
 - 1. All plumbing fixtures which are wall mounted shall be mounted and supported on concealed cast iron or steel fixture supports or carriers as hereinafter specified. These supports shall be completely concealed in the wall and shall support the load of the fixture by means of a suitable steel backing plate or face plate and base support, which is firmly anchored to the floor. In no case shall any wall mounted plumbing fixture be mounted in such a manner that the fixture load is transmitted to mounting wall surface material.

3.4 CLEANING

- A. All fixtures shall be kept in new condition during construction. Fixtures which have been obviously abused shall be replaced.
- B. Fixtures shall be cleaned spotless before final inspection.
- C. Cleaning agents and materials shall not scratch, mar, or otherwise harm the fixture.

END OF SECTION

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SECTION 22 41 00 - PLUMBING FIXTURES (SINKS AND LAVATORIES)

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of plumbing fixtures where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 22 Specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All equipment shall comply with American Society of Testing Materials, all local codes and ordinances and meet or exceed the standards and procedures (latest editions) of the following:
 - a. A Sanitary Cast Iron Enameled Ware Commercial Standard
 - b. Staple Vitreous China Plumbing Fixtures
 - c. U. S. Department of Commerce CS 20-49, CS 77-48.
 - d. WW-P-542 Formed Steel Fixtures

B. Manufacturers:

1. The following sink manufacturers are acceptable:
 - a. Just Manufacturing Company
 - b. Elkay Manufacturing Company
 - c. Advance Tabco
 - d. Kohler
 - e. American Standard
2. The following manual faucet and handle manufacturers are acceptable:
 - a. T&S Brass and Bronze Works, Inc.
 - b. Moen
 - c. Krown
 - d. Delta Commercial
 - e. Chicago
 - f. Zurn
 - g. Speakman

3. The following fixture trim manufacturers are acceptable:

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- a. Kohler Company
- b. McGuire Manufacturing Company
- c. Engineered Brass Company (EBC)
- d. Brass Craft

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES AND FIXTURE TRIM

A. General:

1. All fixtures and trimmings shall be designed to prevent backflow of polluted water or waste into water supply system.
2. All enamel on cast iron fixtures shall be acid resisting.
3. All wall hung fixtures shall have carriers.
4. Provide lavatories with angle stops. Provide all other plumbing fixtures with either angle or straight stops.
5. Exposed piping fittings and trimmings shall be chromium plated over nickel plated brass with polished, bright surfaces unless specifically noted otherwise.
6. All trim shall be manufactured by fixture manufacturer, unless specifically noted otherwise.
7. The color of fixtures shall be white unless specifically noted otherwise.

2.2 UTILITY SINK

A. Utility sink minimum connections shall be 3/8".

B. The utility sink shall be 18 gauge minimum, type 302 stainless steel unless noted otherwise.

C. Fixtures shall be:

P-1 Single Compartment Sink (ADA): stainless steel Freestanding, 27" length x 27" width. 34" from finish floor to fixture rim.

Fixture: Elkay, B1C24X24X (2 hole) 12" depth.

Fitting: T&S Brass, Model B-0330-04 with 4" wrist blades, vandal proof aerator and B-0230-KIT installation Kit.

Drain: Elkay, LKAD35 strainer with Offset Tailpiece, 1-1/2" tailpiece.

Supply: McGuire model 2165 LK.

P-Trap: McGuire Model 8912 - 1-1/2" p-trap.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. All fixtures shall be installed in strict accordance with the manufacturers' recommendations.
2. All fixtures shall be protected during construction by covering with manila paper glued on. In addition, fixture shall be covered with shipping box taped to fixture.
3. All equipment, fixtures or devices shown on plans as new or relocated fixtures or devices shall require the Contractor to furnish and install all braces, supports, mounting brackets, spacers, shims, pads or other appurtenances required to make the fixture level and securely anchored to the wall, floor, or other component of the building structures. Supports not specified hereinafter shall be furnished in accordance with the equipment manufacturers recommendations.
4. In the event of damage, defects or flaws, regardless of the cause, immediately make all repairs and replacements at no additional cost to the Owner.
5. All fixtures shall be caulked to floor, wall, countertop, or other finished surfaces with compound recommended by fixture manufacturer. Color shall match fixture.

3.2 FIXTURE MOUNTING HEIGHTS

A. General:

1. Mount fixtures as shown for each fixture type.

3.3 FIXTURE SUPPORTS

A. General:

1. All plumbing fixtures which are wall mounted shall be mounted and supported on concealed cast iron or steel fixture supports or carriers as hereinafter specified. These supports shall be completely concealed in the wall and shall support the load of the fixture by means of a suitable steel backing plate or face plate and base support, which is firmly anchored to the floor. In no case shall any wall mounted plumbing fixture be mounted in such a manner that the fixture load is transmitted to mounting wall surface material.

B. Lavatories and sinks mounted on stud walls:

1. Install a 1/4" thick by 6" wide steel plate which shall extend at least one stud beyond the first and last fixture mounting points.
2. In wood stud construction, the plate shall be securely attached to each stud which crosses with two (2) 1/2" steel bolts on 4" centers with 1/8" thick by 1-1/2" wide by 6' long steel backup plates.
3. In steel stud construction the plate shall be attached to each stud which crosses by 1/8" fillet weld across the full width of the steel stud flange or plate and support carrier J.R. Smith 800.
4. Fixture or supporting arms shall be securely and firmly attached to the steel plate in accordance with the manufacturer's instructions.

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5. Lavatories shall be punched for Smith No. 723 concealed arm fixture support. The arms shall be securely bolted to the steel backing plate in the wall as hereinbefore specified. They shall have positive mechanical locking device and shall be fully adjustable after installation of the finished wall.

C. Lavatories and sinks mounted on block walls.

1. Lavatories shall be punched for Smith No. 700 fixture support. Fixture support shall have concealed arms with positive mechanical locking device. Arms shall be fully adjustable after installation of finished wall. Uprights shall be high strength steel with block bases securely bolted to floor construction.
2. Heavy sinks shall be mounted on Smith No. 871 fixture support with porcelain enamel exposed arms. Uprights shall be high strength steel with block bases securely bolted to floor construction.

3.4 CLEANING

- A. All fixtures shall be kept in new condition during construction. Fixtures which have been obviously abused shall be replaced.
- B. Fixtures shall be cleaned spotless before final inspection.
- C. Cleaning agents and materials shall not scratch, mar, or otherwise harm the fixture.

END OF SECTION

SECTION 23 05 01 - GENERAL HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Heating, Ventilation, and Air Conditioning (HVAC) work shall include, but not be limited to, the following:
 - 1. Air Conditioning
 - 2. Air Distribution
 - 3. Controls and Instrumentation
 - 4. Balancing of Air Systems

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 DELINEATION OF WORK

- A. Provide all necessary coordination of information to installers who are performing work to accommodate Division 23 installations.
- B. Where the Division 23 installer is required to install items which they do not purchase, they shall include for such items:
 - 1. The coordination of their delivery.
 - 2. Their unloading from delivery trucks driven into any designated point on the property line at grade level.
 - 3. Their safe handling and field storage up to the time of permanent placement in the project.
 - 4. The correction of any damage, defacement or corrosion to which they may have been subjected.
 - 5. Their field assembly and internal connection may be necessary for their proper operation.
 - 6. Their mounting in place including the purchase and installation of all dunnage, supporting members, and fastenings necessary to adapt them to architectural and structural conditions.
 - 7. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.
- C. Items which are to be installed by the Division 23 installer but not purchased as part of the work of Division 23 shall be carefully examined upon delivery to the project. The Division 23 installer shall provide all work necessary to properly install these items.
- D. If any items have been received in such condition that their installation will require additional work beyond the project scope of the work, the Engineer shall be notified in writing within ten

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(10) working days of the date of delivery of the items. Any claims beyond 10 days will not be considered by the Engineer.

1.4 QUALITY ASSURANCE

- A. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service. Where no specific indication as to the type or quality of material or equipment is indicated, a first-class standard article shall be furnished. All 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, if so directed by the Engineer, be able to furnish proof of their ability to deliver this equipment by submitting affidavits supporting their claim.
- B. Each major component of equipment shall have the manufacturer's name, address, model number and rating on a plate securely affixed in a conspicuous place. The nameplate of a distributing agent will not be acceptable. ASME Code Ratings, UL label, or other data which is die-stamped into the surface of the equipment shall be stamped in a location easily visible. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.
- C. All equipment of one type (such as fans, grilles, etc.) shall be the products of one manufacturer unless specifically stated otherwise.
- D. Where the specifications do not list a specific model number for a manufacturer, the construction of a product shall be equal to those models specifically listed.
- E. All materials with a manufacturers listed shelf life shall be used at least six months prior to the expiration of the materials' shelf life.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

- A. Submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.
- B. Where Codes and Standards are referenced, they shall be the date stated in these specifications or on the drawings. If none are stated, they shall be the latest edition.
- C. All work shall conform to the following Building Codes:
 - 1. International Building Codes
 - 2. National Fire Protection Association
- D. All work shall conform to all federal, state, and local ordinances.
- E. Where applicable, all fixtures, equipment, and materials shall be as approved or listed by the following:
 - 1. Factory Mutual Laboratories (FM)
 - 2. Underwriters Laboratories, Inc. (UL)

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- F. All fuel fired equipment shall meet the requirements of the insurers and agencies listed and also meet the owner's insurer requirements.

1.6 STANDARDS AND PROCEDURES

- A. All work shall meet or exceed the standards and procedures of the following:
 1. ADC: Air Diffusion Council
 2. AMCA: Air Moving and Conditioning Association, Inc.
 3. ANSI: American National Standards Institute
 4. AHRI: Air-Conditioning, Heating, and Refrigeration Institute
 5. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers
 6. ASME: American Society of Mechanical Engineers
 7. ASTM: American Society of Testing and Materials
 8. MSS: Manufacturers Standardization Society
 9. NEMA: National Electrical Manufacturer's Association
 10. OSHA: Occupational Safety & Health Administration
 11. SMACNA: Sheet Metal and Air Conditioning Contractors National Association, Inc.

1.7 APPROVAL OF SUBSTITUTIONS

- A. Specific reference in the specifications to any article, device, product, materials, fixture, form or type of construction, etc., by name, make, or catalog number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor in such cases may, at his option, use any article, device, product, material, fixture, form or type of construction which, in the judgment of the Engineer expressed in writing, is equal to that named. Where quality and other characteristics are very nearly the same, the question of determining equal materials and readily available service sometimes resolves itself to a matter of personal opinion and judgment and in these and all other cases involving the approval of materials, the opinion, judgment and decision of the Engineer shall be final and bind all parties concerned.
- B. Requests for written approval to substitute materials or equipment considered by the Contractor as equal to those specified shall be submitted for approval in writing ten (10) calendar days prior to bid opening date to the Engineer. Requests shall be accompanied by samples, literature, and information as necessary to fully identify and allow appraisal of the material or equipment. Submittals shall be concise, clear, and brief as possible. Incomplete submittals or submittals requiring lengthy research to ascertain quality will not be considered.
- C. Approval of the Engineer to use materials or equipment, if granted, will be in the form of a written addendum. Approved substitutions may be used at the Contractor's option. No substitutions will be allowed if substitutions are requested later than ten (10) days prior to bid opening date.
- D. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly indicated in the form of a letter that is enclosed with the submittals. The Contractor shall be responsible for verifying all dimensions with available space. If, in the opinion of the Engineer, the physical dimensions do not permit the substituted material or equipment to be properly operated, maintained, serviced, or otherwise accessed, or the physical dimension adversely impact other components, a system's ability to

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be operated, maintained, serviced or otherwise accessed, the material or equipment shall be replaced at the Contractor's expense.

1.8 VERIFICATION OF DIMENSIONS AND LOCATIONS

- A. The Contractor shall visit the facility and become thoroughly familiar with all details of the work, working conditions, dimensions and clearances.
- B. Notify the Engineer of any discrepancy between actual conditions and conditions indicated on the contract documents that could cause changes, other than minor ones, to the installation of any systems or equipment.

1.9 EQUIPMENT CONNECTIONS

- A. The contract documents may indicate specific electrical, duct, and piping connection locations to equipment. Each manufacturer approved for bidding may have different connection arrangements. The Contractor is responsible for the modifications to and the extension of connecting components as required for the equipment provided.
- B. The Contractor shall bear all costs for required changes in connection to equipment.

1.10 WORKMANSHIP

- A. Workmen shall be thoroughly experienced and fully capable of installing the work. Work shall be in accordance with the best standard practice of the trade. Work that is not of good quality will require removal and reinstallation at no additional expense to Owner.
- B. All material and equipment to be installed in accordance with manufacturer's printed recommendations using recommended accessories. Retain a copy on job site and submit others for approval when required.

1.11 GUARANTEES AND WARRANTIES

- A. General:
 - 1. Furnish to the Engineer a guarantee form, included in these specifications, signed by the Contractor and Owner agreeing to the start and end dates of all systems and equipment under warranty.
 - 2. All defective materials or inferior workmanship shall be replaced or repaired as directed by the Owner's representative during the guarantee period.
- B. Equipment Warranties:
 - 1. Equipment shall be warranted by the equipment manufacturer. Where labor is included in the warranty, the manufacturer, at their option, may permit the contractor to provide the required repairs on the equipment unless specified otherwise.
 - 2. The equipment manufacturer shall include a written guarantee with the closeout documentation.

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C. Duration Period:

1. For work not otherwise specified, the duration shall be one year from substantial completion including all parts, labor, and other charges.
2. The Contractor is responsible for purchasing from the equipment manufacturers any additional warranties to ensure that the equipment is warranted by the manufacturer through the duration period specified.

D. Extended Warranties:

1. Warranty periods shall be extended where specifically stated in these specifications.
2. The extended warranties shall meet the requirements of the base warranty unless specifically noted otherwise.
3. The extended warranty time listed is time in addition to the base warranty period.
4. The following systems or equipment shall be extended warranties:
 - a. The environmental control system shall have a one-year extended warranty.
 - b. The building automation system shall have a one-year extended warranty.
 - c. Variable frequency drives shall have a one-year extended warranty.
 - d. All air conditioning compressors shall be provided with an extended 4-year warranty, including parts and delivery charges. Centrifugal and rotary compressors shall include motor, impeller or screw, and drive train.

E. Non-Warranted Items:

1. Nondurable replaceable items such as air filter media do not require replacement after the date of acceptance.

F. Warranty Repair:

1. Repair shall take place as soon as possible but not later than the following:
 - a. Items not essential for facility operation - 7 days.
 - b. Items that have a minimal impact on facility operation - 2 days.
 - c. Items that have a significant impact on the facility operation - immediately begin repairs or work necessary to minimize operational impact to Owner.
2. The determination of the impact on the facility is solely that of the Owner and Engineer.
3. Where life safety issues are impacted, the contractor shall take all steps necessary to ensure the facility can continue to function in a safe manner.
4. If repairs cannot be made in the required time period, temporary systems shall be installed until repairs can be completed.
5. All costs associated with warranty work shall be borne by the contractor.

1.12 EXISTING FACILITIES

- A. The location of existing duct, pipe, fixtures, equipment and appurtenances are shown on plans to indicate the extent of work required. Exact conditions shall be field verified by the contractor.
- B. Work shall be performed above existing ceilings except where removal of existing ceilings is specifically identified. Where working above existing ceilings, remove existing tile/grid and reinstall existing tile/grid as necessary. Any damaged tile/grid shall be replaced at the contractor's expense.

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1.13 PROJECT COMMUNICATIONS

- A. Where it is indicated that communication is with the Engineer or documents are to be transmitted to the Engineer, this is intended that this be done through the prime design professional. If the Architect is the prime design professional, all communication and documentation shall be sent via the Architect.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRIOR CONDITIONS

- A. Prior to the installation of any equipment or system component, the Contractor shall review any prior work that has been completed to accommodate the equipment or system component to be installed.
- B. If the prior work does not make a proper installation of any equipment or system component possible, notify the Engineer prior to installation of any equipment or system component.

3.2 INSTALLATION

- A. Install all equipment and appurtenances in strict accordance with the manufacturer's recommendations and the manufacturer's shop drawings.
- B. If any equipment cannot be installed in accordance with Codes, contract documents, manufacturer's recommendations and accepted practices, notify the Engineer in writing prior to installation of equipment.
- C. If any system component cannot be installed in accordance with Codes, contract documents and accepted practices, notify the Engineer in writing prior to installation of the system component.

3.3 PROTECTION OF SYSTEMS AND EQUIPMENT

- A. Protect all materials and equipment from damage during storage at the Site and throughout the construction period. In the event of damage prior to final inspections, repair or replace damaged items as determined by the Engineer, at no cost to the Owner.
- B. Store equipment on elevated supports and cover them on all sides with securely fastened waterproof coverings. All equipment openings shall be securely sealed.
- C. Piping shall be protected by storing it on elevated supports and capping the ends.
- D. During construction, all open ends of pipe, etc. which could collect construction debris shall be properly capped.

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3.4 CLEANING OF SYSTEMS AND EQUIPMENT

- A. All equipment and systems shall be cleaned of all extraneous materials to leave equipment and system finish in a new condition.
- B. Where equipment and systems cannot be properly cleaned, take all measures necessary to replace or repair equipment and systems to bring back to a "like new" condition. All costs shall be borne by the Contractor.
- C. All extraneous materials shall be removed on the site on a regular basis to provide access to all work as well as a safe working environment.

3.5 SUPPORT OF SYSTEMS

- A. Hanging duct, conduit, piping, or equipment from metal decks (i.e., metal roof deck w/o concrete), wood decks, etc. is not permitted.
- B. The following methods of support are not permitted:
 - 1. Wire hangers unless specifically indicated
 - 2. Perforated straps
 - 3. Vinyl or plastic straps

END OF SECTION

SECTION 23 05 02 - COMMON HVAC MATERIALS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of the mechanical systems shown on the drawings and specified hereinafter.

B. Description:

1. Rooftop curbs shall include all supports for rooftop equipment, pipe, duct, air handling equipment and accessories.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE

- A. All work shall meet or exceed the standards and procedures (latest edition) of the following:

1. AISC Steel Handbook

- B. All work shall be applicable by mechanics normally employed in the trade. All work shall be installed in accordance with the manufacturer's recommendations.

C. Manufacturers:

1. The following paint manufacturers are acceptable:
 - a. Glidden
 - b. Sherwin-Williams
 - c. Devoe Paints
2. The following caulking manufacturers are acceptable:
 - a. TREMCO
 - b. Sonneborn - Contech
 - c. W. R. Meadows
3. The following acoustical sealant (gypboard) manufacturers are acceptable:
 - a. USG
 - b. Approved equal

PART 2 - PRODUCTS

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2.1 GENERAL

- A. Unless specifically indicated otherwise, the following products or product accessories shall be provided with the indicated equipment:
 - 1. Filters shall be provided on all air systems to protect heat transfer components from outside air, building return air or other airstreams that could foul heat transfer surfaces and elsewhere as indicated. Refer to Particulate Air Filtration specification.
- B. Seacoast construction shall be provided where specified for a product. Refer to Special Coating specification.

2.2 PAINT

- A. General:
 - 1. Painting shall be in strict accordance with the paint manufacturer with regards to surface preparation, priming, and finish painting.
 - 2. High temperature paint, chemical resistant paint, and similar special paints shall be provided as required for specific application.
 - 3. Color shall be selected by Engineer. Color can be any available color from manufacturer.
 - 4. In addition to prime coat, two finish coats shall be applied.
 - 5. Refer to Identification for HVAC Piping and Equipment specification for additional materials to be painted.
- B. The following items shall not be painted unless specifically specified otherwise:
 - 1. Concealed Supports and Accessories
 - 2. Hot Dipped Galvanized Steel
 - 3. Stainless Steel
 - 4. Aluminum
 - 5. Threaded Rods
 - 6. Factory Painted Items
- C. In addition to equipment and materials specified elsewhere to be painted, the following shall be painted (except where excluded elsewhere in this section of specifications):
 - 1. Supports and accessories where not located in concealed locations.
 - 2. Exposed ductwork
- D. Basis of design paint shall be:
 - 1. Glidden Industrial Enamel
 - 2. Sherwin-Williams Industrial Enamel
 - 3. Devoe Paints Industrial Enamel
- E. PVC jacket:
 - 1. When PVC jacket is specified to be painted, the jacket shall be primed with a plastic primer by Rustoleum.

2.3 FLASHING

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A. General:

1. Provide flashing and counter flashing on all pipes, ducts, flues, conduits, and other mechanical system components which penetrate exterior walls or roofs.
2. Flashing sizes shown are minimum sizes but in no case shall they be less than size required by roofing manufacturer.

B. HVAC Ducts and Flues:

1. See detail on plans.
2. Flashing of duct shall be fabricated from 20-gauge stainless steel sheets.

2.4 HOUSEKEEPING PADS

A. General:

1. Housekeeping pads shall be constructed of concrete and shall meet the requirements of the Concrete specifications.
2. Concrete shall develop a minimum strength 3000 psi at 28 days or as specified in the concrete specification, whichever requirement is greater.
3. Housekeeping pads shall extend six inches past equipment and supports in all direction.

B. Pads (exterior):

1. All equipment installed on grade and on the exterior of buildings shall be provided with a reinforced concrete housekeeping pad.
2. Pad shall be minimum six inches thick and four inches above finished grade.

2.5 DRAINS

A. General:

1. Drain shall be full size of connections, size indicated on drawings, or 3/4" minimum, whichever is largest.

B. Equipment and Miscellaneous Drains:

1. Provide drains with deep seal p-trap for all equipment provided with drain connections, where drain connections are indicated on the drawings, and when drains required for proper operation of a system.

2.6 FASTENERS, ANCHORS, AND ACCESSORIES

A. Unless indicated otherwise, all fasteners, anchors, and accessories shall be metallic and manufactured in the United States.

B. Materials provided shall be considered industry standard for commercial or industrial use.

C. All materials shall be installed in accordance with the manufacturer's recommendations for the intent use and application.

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- D. Materials installed outdoors, in attics, in crawl spaces, in tunnels and other areas exposed to ambient temperature or humidity shall be stainless steel or hot dipped galvanized.
- E. Unless otherwise specified or required by the manufacturer, bolts shall meet or exceed the following strengths:
 - 1. Proof Load: 74 ksi
 - 2. Yield Strength: 81 ksi
 - 3. Tensile Strength: 105 ksi

2.7 SEALANT

- A. Exterior joint sealant shall be polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding.
- B. Penetrations of fire rated assemblies shall meet the requirements of the Firestopping and Smokestopping specification.
- C. Color shall be approved by Engineer.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION (SLABS NOT ON GRADE)

- A. Submit to the Engineer a detailed description and sketches indicating the method of transporting heavy equipment within the building to its final installed location.
- B. The submittal shall indicate maximum point loading on the structure, method to distribute load, and shoring of structure.

3.2 PAINTING

- A. All vapor barriers shall be sealed as specified elsewhere in the appropriate sections before painting.
- B. All painting shall be completed prior to adding any pipe labels to piping.
- C. All conditions that prohibit proper application of paint shall be reported in writing to the Engineer.
- D. Submit manufacturer of paint, type, and paint color samples to the Engineer for review.

3.3 EQUIPMENT STORAGE

- A. Facilities for storing materials and equipment shall be provided by the Contractor.

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- B. All equipment and materials shall be protected from ambient conditions including freezing and exposure to sunlight when these conditions could affect the product.
- C. All stored items shall be elevated off slab or grade.

3.4 HOUSEKEEPING PADS

- A. All exposed surfaces shall be steel troweled smooth with beveled edges.
- B. Pad shall be level within 1/16 inch for the length and width of the pad.
- C. Provide all required foundation bolts, washers, sleeves, plates, templates, etc., for mechanical equipment. Foundation bolts shall be embedded in concrete, set in place before concrete is poured and securely held in place with templates.
- D. Furnish shop drawings showing all required hanger bolts and other appurtenances necessary for the proper installation of this equipment. All such work shall be shown in detail on the shop drawings, showing the complete details of all foundations including necessary concrete and steel work, fasteners and vibration isolation devices.
- E. Set all equipment on their foundations and shim level with steel shims and grout up under base for uniform bearing.
- F. Equipment shall be fastened to housekeeping pads as required by seismic design.
- G. Housekeeping pad shall be anchored to the structural slab as required by seismic design or as indicated by structural or mechanical details; whichever requirement is greater.

3.5 DRAINS

- A. General:
 - 1. All horizontal gravity drain piping shall be installed with a uniform grade of not less than 1/8" per foot of fall in direction of flow except as noted otherwise.
 - 2. All drain lines installed at floor in mechanical rooms shall be supported by threaded rods and pipe clamps. Rod shall be anchored into the floor slab.
- B. Equipment and Miscellaneous Drains:
 - 1. Run drain to roof drain, janitor sink, equipment room drain, or grade if not indicated otherwise on plans.

3.6 EQUIPMENT AND MISCELLANEOUS VENTS, RELIEFS, AND OVERFLOWS

- A. Run vents and reliefs to location indicated on plans or, if none indicated, to a location where they can discharge safely without presenting a hazard to personnel. Terminate with appropriate fitting.
- B. Run overflow is similar to drain.

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3.7 EXTERIOR SEALANT

- A. Submit color charts to Engineer.

3.8 EQUIPMENT PENETRATIONS

- A. Seal all openings into equipment resulting from installation of equipment such as conduit and flex.

3.9 EQUIPMENT INSTALLATION

- A. Repair all insulation damaged during installation of equipment.

3.10 EQUIPMENT ATTACHMENT

- A. Equipment shall be secured to the roof rails, roof curbs, or structure as indicated on the plans. Where equipment is provided with a method of attachment, that method shall be used to attach the equipment. Where equipment is not provided with a method of attachment, the contractor shall add gussets, angles, or similar material to the unit without affecting the performance or warranty of the equipment, which shall be used to attach the equipment.

END OF SECTION

SECTION 23 05 03 - DEMOLITION, PATCHING AND REPAIR

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the demolition of all mechanical equipment, piping, duct, and appurtenances where indicated or shown on the drawings and specified hereinafter.
2. Furnish all labor, materials, tools and equipment and perform all operations in connection with the patching and repair of building structure, finishes and building asse COMMON HVAC MATERIALS mbliies as specified hereinafter.
3. All existing utilities, water, steam, chemical treatment, controls, etc. shall be reconnected to new systems as required to maintain the same functions as existed prior to new work.

B. Descriptions:

1. Cut openings thru the existing building walls, roof, floors, and finishes to accommodate the installation of Division 23 equipment, controls, piping, and appurtenances.
2. Remove and dispose of existing HVAC equipment, piping, and appurtenances.
3. Patch and repair all building finishes, structural components, or other appurtenances that are removed or damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
4. All penetrations thru exterior walls, floors, and roof systems shall be sealed watertight.
5. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

PART 2 - EXECUTION

2.1 GENERAL

- A. Post tensioned slabs, beams, columns and other load bearing structures shall not be drilled, cut, or otherwise modified without written approval by the engineer.

2.2 PROTECTION

- A. Provide barricades and take all other precautionary measures necessary to protect personnel and property.

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- B. The Contractor shall be responsible for any damages to adjacent areas to the construction area.
- C. Areas not included in the scope of work, areas where work is minimal, and, in the case of a phased contract, areas which remain inactive for long periods shall be protected from the area in which the work is being performed by a slab to slab barrier acceptable to engineer and local authorities.
- D. Protect the roof at all times. Provide planking, plywood, supports, and other materials and means to ensure damage is not incurred.
- E. At no time shall required means of egress be blocked by equipment, materials, permanent or temporary barriers.

2.3 COORDINATION

- A. All demolition work which will interrupt building utilities or cause the disruption of the normal environment in areas of the building not within the scope of this project will be performed at other than the Owner's normal working hours.

2.4 PENETRATIONS

- A. All round penetrations shall be core drilled. All other penetrations shall be saw cut. Openings shall not be larger than required for proper installation of pipe or duct.

2.5 MATERIAL REMOVAL

- A. The Owner shall retain first right of refusal on all existing equipment, piping, and appurtenances which are to be removed as a result of this contract.
- B. Coordinate demolition work with Owner using extreme care not to damage existing equipment which Owner elects to retain.
- C. Remove Owner retained equipment from existing location and store equipment at a location on the site where specified by Owner.
- D. All material, equipment, supports, and appurtenances not required as the result of demolition to or renovation of the building systems shall be removed from the project site and disposed of properly unless retained by Owner.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of mechanical identification on all mechanical equipment, systems, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work furnished and installed shall comply with all local codes and ordinances and shall meet or exceed the standards and procedures (latest editions) of the following:
 - a. ANSI A13.1 for the identification of piping systems.
 - b. ANSI/NEMA Standard Z535.1.

B. Manufacturer:

1. The following band, tag, nameplate, and identification marker manufacturers are acceptable:
 - a. Seton Name Plate Corporation
 - b. T&B/Westline Products
 - c. Brady
 - d. MSI
 - e. Brimar

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. General:

1. Nameplates shall be black plastic with white engraved lettering.
2. All information shall be provided on a single nameplate per device if practical.

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3. Nameplates shall have screw holes and screws for mounting unless screws would damage the intended use of the product to which it is attached (i.e., NEMA4 panel, etc.). In that case, provide stick-on nameplates.
4. Nameplates shall be 1/16" thick.

B. Size:

1. Three-quarter inch (3/4") high nameplate when located on a lay-in ceiling grid.
2. Two inch (2") high nameplate when located on outdoor HVAC equipment.
3. Three-quarter inch (3/4") high nameplate when located on control devices such as switches, sensors, etc.
4. Three-quarter inch (3/4") high nameplates when located on starter, drives, and panels.
5. Size as indicated on plans or detail.

2.2 SWITCHES, THERMOSTATS, AND OTHER SIMILAR DEVICES

A. Devices to be identified include:

1. Control panels
2. Flat plate sensors
3. Similar equipment

B. Nameplate shall include (example):

1. Equipment description: HV #1, etc.
2. Switch position as required: Summer/Winter, On/Off, etc.

2.3 MECHANICAL EQUIPMENT

A. Devices to be identified include all mechanical equipment.

B. Where equipment is located above a lay-in ceiling, a nameplate shall also be provided on the metal grid in close proximity to the equipment.

C. Nameplate shall include (example):

1. Equipment description: EF #1, etc.
2. Owner's identification number

2.4 CEILING LOCATION MARKERS

A. Provide nameplates to indicate location of equipment and devices located above the ceiling.

B. Equipment shall include:

1. VAV terminal units
2. Fans

PART 3 - EXECUTION

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3.1 CEILING LOCATION MARKERS

- A. After Engineer approval, attach nameplate to ceiling grid as close to device as practical.

3.2 NAMEPLATES

- A. Submit listing of all nameplates with associated information to the Engineer for approval before fabrication.
- B. Coordinate method of attachment and location of nameplate with contractor who is responsible for the installation of the device (i.e., control panel, air handler, etc.).

END OF SECTION

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SECTION 23 05 92 - SYSTEM START-UP

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the start-up of all building mechanical systems where shown on the drawings and specified hereinafter.

B. Description:

1. These systems shall include:
 - a. Air systems (heating, ventilating, air conditioning, exhaust and recirculation)

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following (latest edition):
 - a. AABC National Standards
 - b. SMACNA

B. Start-up of equipment shall be by manufacturer's representative unless noted otherwise.

C. Tests, in addition to those specified herein, required to prove code compliance, to meet insurance requirements, and to verify proper installation by the Engineer, owner, or authorities having jurisdiction shall be provided by the Contractor.

D. All tests, instruments, and procedures shall be in accordance with the AABC National Standards and system test and balance specifications.

PART 2 - PRODUCTS

2.1 GENERAL

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- A. All concealed work must remain uncovered until required tests have been completed. Sections of the system may be tested prior to concealing as outlined hereinafter.
- B. The Owner and the Engineer shall be notified in writing a minimum of three working days prior to any tests being performed.
- C. Local, state and federal authorities having jurisdiction shall be notified in writing with sufficient time to schedule inspection as required by the authority.
- D. In no case shall a system be started or operated in such a manner that the system or component pressure or temperature ratings, or the pressure or temperature to which a system or component has been tested, be exceeded.

2.2 START-UP

- A. Systems shall be started up by the Contractor except as required in specific portions of the mechanical specifications.
- B. The following systems shall be started up by a factory certified technician:
 - 1. Heating and air conditioning equipment
 - 2. Air handlers
 - 3. Dust collection equipment
- C. The following systems shall be started up by a factory technician:
 - 1. 100% Outside air equipment

2.3 AIR DISTRIBUTION SYSTEMS

- A. General:
 - 1. Cleaning and leakage testing are not required for existing duct systems unless indicated otherwise.
- B. Cleaning of Duct System:
 - 1. Upon completion of duct and before installation of any outlets, the contractor shall clean entire duct system of all rubbish, plaster, dirt, etc.
- C. Leakage Tests for systems 2-inch w.g. and less:
 - 1. Verify, by use of air monitoring devices and pitot tube traverse, that the total air quantities measured at all outlets and the air quantity handled by the fan differ by no more than $\pm 5\%$.
 - 2. Where leakage is determined to exceed 5% in accordance with the above testing procedure, the Contractor shall locate and repair the duct to reduce the leakage to acceptable levels.
 - 3. Where excessive leakage is noted at any location, whether the entire system meets the 5% leakage rate or not, the Contractor shall repair the duct to minimize the leakage at the location identified.
 - 4. Leakage includes all connected components of the system.

5. Leakage tests shall be repeated until the duct is proven to be within the limits of leakage specified herein.

D. Leakage tests for systems greater than 2-inch w.g.:

1. Duct shall be tested in accordance with SMACNA Duct Leakage Test Procedures.
2. The duct leakage class for rectangular duct and round flexible duct is Class 6.
3. The duct leakage class for round and flat oval duct is Class 3.
4. The duct leakage permitted for welded duct is 0.5% maximum.
5. Leakage testing shall be provided on all risers and all concealed ducts. Testing shall also be provided on a minimum of 25%, by length, of all other duct on each system.
6. Leakage tests shall be repeated until the duct is proven to be within the limits of leakage specified herein.

E. Leakage tests for systems used in smoke control:

1. In addition to the requirements in this section, refer to Smoke Control System specification for additional requirements.

2.4 SYSTEM START-UP

A. General:

1. System shall be started and checked to ensure safe and proper operation.
2. Minimum requirements are listed for each system and are in addition to manufacturer start-up requirements and the requirements stated in the specific sections of the specifications.
3. Control systems installed complete and operable.
4. Proper thermal overload protection in place for electrical equipment.

B. Air Systems:

1. Verify proper fan rotation.
2. Verify full load amps are below nameplate amps.
3. Verify control dampers operating.
4. Verify balance dampers and fire and smoke dampers are open.
5. Remove all duct restrictions.
6. Verify clean filters are installed.
7. Verify access doors are closed, and duct end caps are in place.
8. All outlets shall be installed and connected.

2.5 SYSTEM PRESSURES

- A. Observe the start-up of systems to verify that no dangerous conditions exist as the result of high (supply) or low (return/exhaust) pressure. If excessive pressures are observed, report the observed condition and shut down or modify system operation to avoid damage.

PART 3- EXECUTION

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3.1 SUBMITTALS

- A. Submit to the Engineer all test results including a minimum of the following information:
 - 1. System tested
 - 2. Location of test
 - 3. Date, time, and ambient temperature at test startup and completion
 - 4. Persons present for test
 - 5. Duration of test
 - 6. Test equipment
 - 7. Test results

- B. Partial system may be done at the Contractor's option except tests shall be completed:
 - 1. For each phase designated by contract documents
 - 2. In accordance with building construction schedule for completion
 - 3. As required to turn over portions of the system for the Owner's use

- C. Reports shall include but not be limited to:
 - 1. Tests during construction
 - 2. Manufacturer's factory test reports
 - 3. Equipment start-up reports

- D. Reports shall be submitted within ten days of test completion.

3.2 ENGINEER REVIEW

- A. The Engineer shall, at his discretion, recheck any or all of the test work. Provide ample number of technicians and test equipment to perform the tests required.

- B. All systems not accepted shall be retested.

- C. Systems shall be retested and rechecked until accepted by all parties.

3.3 DUCT LEAKAGE

- A. Where leakage is determined to exceed the allowable rate, locate and repair the duct to reduce the leakage to acceptable levels.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the testing and balancing of all mechanical systems shown on the drawings and specified hereinafter.

B. Description:

1. Systems shall include all equipment, operators, controls, accessories, and appurtenances.
2. These systems shall include:
 - a. Air systems (heating, ventilating, air conditioning, exhaust and recirculation distribution systems)
 - b. Hydronic systems (heating and cooling systems)
 - c. Domestic water systems
 - d. Condensate systems
 - e. Vibration isolation systems
 - f. Cooling tower airflow
3. Air inlets and outlets shall include:
 - a. Exhaust
 - b. Relief
 - c. Outside Air
 - d. Supply
 - e. Return

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0592 - System Start-Up

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following (latest editions):
 - a. AABC National Standards
 - b. NEBB Standards

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c. NBC Standards

2. Testing and balancing shall be performed by an agency certified by the AABC, NEBB, or the National Balancing Council.
3. All technicians shall have a minimum of three years testing and balancing. Each test and adjustment shall be under the direct supervision of a qualified technician.
4. Testing and balancing shall be performed by one agency.

PART 2 - PRODUCTS

2.1 GENERAL BALANCING PROCEDURES

- A. All recorded data shall represent a true, actually measured, or observed condition.
- B. Any abnormal conditions in the mechanical systems or conditions which prevent total system balance, as observed by the Test and Balance Agency, shall be reported as soon as possible to the Engineer.
- C. If, for any reason, a system cannot be properly balanced, it shall be reported to the Engineer by the Test and Balance Agency as soon as observed.
- D. Should additionally, balancing devices be required, the Test and Balance Agency shall bring it to the attention of the Contractor as quickly as possible.
- E. The Test and Balance Agency shall leave all system components in proper working order including:
 1. Replace belt guards.
 2. Close access doors.
 3. Close doors to electrical switch boxes.
 4. Restore thermostats to specified settings.
- F. The Test and Balance Agency shall permanently mark the settings of all valves, dampers, and other adjustment devices in a manner that will allow the settings to be restored. If a balancing device is provided with a memory stop, it shall be set and locked.
- G. Systems shall be tested in each specified mode of operation. See equipment Sequence of Operation.

2.2 INSTRUMENTS

- A. All Test and Balance work shall be performed using the required instrumentation to obtain proper measurements.
- B. Instruments shall be properly maintained and transported in such a manner as to provide protection against damage due to vibration, impact, moisture or any other condition that may render them inaccurate.
- C. Instruments shall have been calibrated within a period of six months prior to starting the project.

- D. Proof of calibration shall be maintained with the instruments.
- E. Instruments shall be calibrated upon completion of the work when required by the client to prove reliability.

2.3 AIR SYSTEMS

A. General Requirements:

1. Total system balance shall not begin until the Test and Balance Agency has verified that start-up procedures have been performed, and filters have been changed.
2. The Test and Balance Agency shall measure the amperes of all fan motors before total system balance is started and shall take proper steps to correct and report any overloads.
3. The Test and Balance Agency shall not continue total system balance if any conditions are observed that are hazardous to the air system. This shall be reported and corrected before proceeding further.
4. The Test and Balance Agency shall verify all outlets for compliance with design requirements and shall report any variations before starting total system balance.
5. If during total system balance, the Test and Balance agency detects any inlet or outlet conditions that will not allow proper balancing to be performed, the Engineer shall be notified immediately.
6. Reports shall indicate airflow measured at unit and inlet and outlet totals.

B. Air Outlets:

1. The systems shall be balanced so that the total supply air quantity to each space shall be within -5% to +5% of the design amount.
2. The pattern for all adjustable outlets shall be adjusted for proper distribution to minimize drafts.
3. Outlet dampers shall not be used to provide proper branch airflow to space.
4. The test and balance contractor shall indicate on the test and balance report that the grilles provide the proper directional throw where direction throws are indicated.

C. Air Inlets:

1. Inlets on systems shall be adjusted to the required quantities with a tolerance of $\pm 5\%$.
2. At completion of total system balance, at least one inlet of every branch shall be fully open and at least one branch balancing damper in the system shall be fully open.
3. Return air inlets installed in ceilings where the space above the ceiling is used as a return air plenum are to be fully opened and are not to be measured or adjusted except where a specific airflow is indicated.

D. Zone Dampers:

1. Dampers installed in main trunks and branches and dampers required for system control shall be balanced within -5% to +5% of the design amount.

E. Filters:

1. Under final balanced conditions, the Test and Balance Agency shall measure and record static pressure entering and leaving each filter bank.

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F. Fans:

1. The Test and Balance Agency shall set the fan RPM to provide design total CFM and the required static pressure to operate the system.
2. If proper airflow is not achieved, the Contractor shall change the belts and drives. The new drives shall be calculated by the Test and Balance Agency. The Test and Balance Agency shall reset the fan RPM to provide design total CFM.
3. Fan speed shall not exceed the maximum allowable RPM as established by the fan manufacturer.
4. The final setting of fan RPM shall not result in overloading the fan motor in any mode of operation. Dampers shall be modulated, and the amperes of the supply fan motor shall be measured to ensure that no motor overload can occur. The amperes shall be measured in the full cooling, heating, dehumidification, and economizer modes to determine the maximum brake horsepower.
5. After total system balancing, the following values shall be recorded:
 - a. Fan RPM
 - b. Motor voltage and amperes
 - c. Entering static pressure
 - d. Leaving static pressure
6. Final RPM of the constant volume supply fan shall be set to supply the required CFM with filters artificially restricted to simulate 100% loading. The Test and Balance Agency shall verify that the fan motor will not be overloaded when the system is operating with unrestricted, clean filters in place.
7. When applicable, final supply fan settings shall be based on rated wet cooling coil resistance.
8. Final RPM of the supply fan in systems having mixed air dampers shall be set to provide required CFM with the system in a logical non-modulating mode, for example, minimum outside air.

G. Coils:

1. Under final balanced conditions, the Test and Balance Agency shall measure and record static pressure entering and leaving each coil bank.

H. Temperature Control Dampers (Automatic):

1. All temperature control dampers shall be verified by the Test and Balance Agency for proper shut-off when driven closed by the controller. Dampers shall also be verified to be in the same position as indicated by the controller.

I. Mixed Air Control:

1. The Test and Balance Agency shall observe or test mixed air plenums for possible stratification. If freeze-up or other serious problems are likely, the condition shall be reported to the Architect/Engineer at once.
2. The Test and Balance Agency shall set the minimum outside air quantity to the required value. If this airflow quantity cannot be properly measured, the Temperature Method as specified in the AABC National Standards shall be utilized.

J. Static Pressure Readings:

1. Static pressure leaving the fan shall be taken as far downstream from the fan as is practical but shall be upstream of any restrictions in the duct (such as duct turns).

2. No reading shall be taken directly at the fan outlet or through the flexible connection.
3. Static pressure entering a fan shall be measured in the inlet duct upstream of any flexible connection and downstream of any duct restrictions.

K. Drum Louvers:

1. Louvers shall be adjusted (rotate drum, adjust louver position) to provide maximum coverage of (exterior glass) (area served).

2.4 TEMPERATURE CONTROL SYSTEM

A. In the process of Total System Balance, the Test and Balance Agency shall:

1. Work with the temperature control contractor to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding to intended control performance.
2. Verify that all control devices are properly connected.
3. Verify that all dampers, valves, and other controlled devices are operated by the intended controller.
4. Verify that all dampers and valves are in the position indicated by the controller (open, closed, or modulating).
5. Verify the integrity of valves and dampers in terms of tightness of close-off and of full-open position. This includes dampers in multizone units, mixing boxes and VAV terminals.
6. Check that all valves are properly installed in the piping system in relation to direction of flow and location.
7. Check the calibration of all controllers.
8. Verify the proper application of all normally open and normally closed valves.
9. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
10. Check the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media.
11. Check that the sequence of operation for any control mode is in accordance with approved shop drawings. Verify that no simultaneous heating and cooling occurs except where specified. Observe that heating cannot take place at VAV reheat terminals until the unit is at minimum CFM.
12. Verify that all controller set points meet the design intent.
13. Check all dampers for free travel.
14. Verify the operation of all interlocked systems.
15. Perform all system verification to assure the safety of the system and its components.

2.5 EXISTING SYSTEMS

A. General:

1. All hydronic and air systems which are to remain but are modified in any manner or are listed to be tested shall be tested before demolition begins.
2. The test and balance contractor shall utilize an ultrasonic meter to measure existing water flows where existing water flows are to be measured. If there are proper flow measuring devices installed, the test and balance contractor may use the installed devices.

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3. Where ultrasonic meters are used on existing insulated systems, the contractor shall remove insulation as needed and repair insulation and finish to match existing when testing is completed.

B. Balancing Requirements

1. The Engineer shall provide direction on any changes to be made to the existing equipment's air or water balance. After renovation work is completed, the existing equipment shall be rebalanced or, if no changes are required, equipment shall be retested.

C. Locations shall include, but not be limited to, the following:

1. Equipment airflows indicated on the plans.
2. Fan total flow and pressure.
3. Air flow at points where new duct ties in.
4. Other requirements where indicated on the plans or elsewhere in the specifications.

D. Reports:

1. A test and balance report shall be submitted before demolition and after renovation is completed for all systems which are required to be measured.

2.6 TEMPERATURE MEASUREMENT

A. General:

1. Air and water temperatures at hydronic coils must be taken in the same relative timeframe. For example, when measuring coil entering and leaving air temperatures, the coil entering and leaving water temperature must be taken in close timeframe to the measurement of the air.
2. Where outside air temperature is a variable affecting other readings (such as a mixed air temperature), the outside air reading shall be given at the time of the mixed air reading.

B. Air Temperatures:

1. Provide entering and leaving air temperatures for each cooling coil, heating coil, energy recovery and heat transfer device.
2. Temperatures shall be measured in heating, cooling, dehumidification, and neutral modes of operation.
3. Temperature measurements at the following devices shall be provided only downstream of the device:
 - a. Terminal units
 - b. Laboratory supply valves
 - c. Heaters (non-ducted)

PART 3 - EXECUTION

3.1 SUBMITTALS

- A. The Contractor shall submit to the Engineer the following information within thirty days after the award of the contract:

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1. The name of the Test and Balance Agency.
 2. Name and registration number of the certified testing technician.
- B. The Contractor shall submit to the Engineer the following information within ninety days after the award of the contract.
1. Detailed testing procedures including list of instruments, task performed, model and serial number and date last calibrated.
 2. Agenda including schedule of work with approximate duration of each phase, approximate date of field inspections, and required start date to meet scheduled completion date.
 3. Report forms.
- C. An approved copy of each submittal must be received by the Test and Balance Agency before work is begun.
- D. If complete submittals are not received by the Engineer within the specified times, the Engineer reserves the right to select the Test and Balance Agency with any additional costs incurred by the Contractor.

3.2 REPORT SUBMITTALS

- A. Provide a preliminary typed report for engineers' review.
- B. After receiving Engineers' review comments and address issues, submit three copies of the Test and Balance report. Report shall have systems, subsystems, and individual readings in a sequential format.
- C. Reports can be submitted in phases such as air systems, water systems, vibration, etc.
- D. Reports shall be submitted after all modifications required by these specifications to balance system (i.e., replacing impellers, belts, drives, dampers) have been made. Reports will not be accepted with comments such as damper missing, new drive required, etc.

3.3 DRAWING SUBMITTALS

- A. Test and Balance Agency shall submit plans indicating:
 1. All traverse locations referencing values shown in reports.
 2. Locations of all required sound and vibration measurements.

3.4 COORDINATION OF WORK

- A. Test and Balance Agency shall not begin work on a system until system is started as required in SYSTEM START-UP specifications.

3.5 CONTRACTOR REVIEWS AND INSPECTIONS

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- A. The Test and Balance Agency shall perform one pre-construction plan check and submit comments to Engineer.
- B. The Test and Balance Agency shall perform construction inspections at the following stages of each construction phase and submit comments to Engineer:
 - 1. 50% completion
 - 2. 90% completion

3.6 BELTS, DRIVES, IMPELLERS AND DAMPERS

- A. If it is determined by the Test and Balance Agency that drive changes are required, the Contractor shall change belt and drive.
- B. Drives for constant volume air handlers shall be selected for a minimum of 100% filter loading.
- C. Drives for variable volume air handlers shall be selected for a minimum of 100% filter loading.
- D. If it is determined by the Test and Balance Agency that impeller changes are required, the Contractor shall change impellers.
- E. If it is determined by the Test and Balance Agency that additional balance dampers are required, the Contractor shall install additional dampers.
- F. The Test and Balance Agency shall rebalance system after changes have been made.

3.7 ENGINEER REVIEW

- A. The Engineer shall, at their discretion, recheck any or all of the test and balance work within 120 days of receipt of report. The Test and Balance Agency shall provide ample number of technicians and test equipment to perform the tests required.
- B. Upon completion of the Engineer's recheck, the testing and balancing report, or portions thereof, shall be accepted or rejected. All parts not accepted shall be retested and rebalanced.
- C. Systems shall be tested, rebalanced and rechecked until accepted by all parties.

3.8 EXISTING SYSTEMS

- A. Pre-demolition test report shall be submitted before demolition begins.
- B. Balance systems as directed by Engineer after renovation work is completed and provide renovation test report.

3.9 MOTOR CAPACITY

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- A. At no time shall the motor exceed full load amps. Motor shall load into service factor only if written permission is received from the engineer.

END OF SECTION

SECTION 23 09 00 - INSTRUMENTATION AND CONTROLS FOR HVAC (GENERAL)

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of the building environmental controls shown on the drawings and specified hereinafter.

B. Description:

1. Control and instrumentation work shall include:
 - a. Temperature control
 - b. Humidity control
 - c. Airflow control
 - d. Equipment interlock and controls
 - e. Wiring for automatic controls

1.2 RELATED DOCUMENTS

- A.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

- B.** All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:

1. Section 23 0904 - Building Automation System

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All environmental controls shall comply with all local codes and ordinances, and meet or exceed the following standards:
 - a. Underwriters Laboratories
 - b. NEMA Standards
 - c. National Electrical Code
 - d. Scientific Apparatus Makers Associates Standard PMC 20.1 for Process Measurement and Control Terminology
 - e. Scientific Apparatus Makers Associates Standard PMC 20.2 for Process Control Performance
 - f. NFPA 90A
 - g. NFPA 72E Standard for Automatic Fire Detectors

- B.** Control circuit wiring shall meet NFPA Standard 70, Article 725, for remote control, low energy power, low voltage power and signal circuits.

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- C. All control equipment shall be the product of one manufacturer whenever practical.
- D. Manufacturers:
 - 1. The following Building Environmental Controls Contractors are acceptable:
 - a. Trane, Columbia, SC
 - 2. The following control manufacturers are acceptable:
 - a. Trane

PART 2 - PRODUCTS

2.1 GENERAL

- A. The building environmental controls shall be provided by the Building Environmental Controls Contractor.
- B. The Building Environmental Controls Contractor shall have a local office within a 75-mile radius of the job site, staffed with factory trained engineers. The engineers shall be capable of providing instructions and maintenance service on all system components.
- C. The Building Environmental Controls Contractor shall have a 5-year successful history in the design and installation of building systems and automatic temperature controls similar in performance to that specified herein and shall be prepared to evidence this history as condition of acceptance and approval prior to bidding.
- D. The Building Environmental Controls system shall be installed by competent controls mechanics who are full-time employees of the Building Environmental Controls Contractor.
- E. The Building Environmental Control Contractor shall be responsible for the quality and satisfactory operation of the devices within the system and for the overall performance of the specified air flow control system.

2.2 SYSTEM

- A. Provide all thermostats, humidistats, sensors, transmitters, controllers, actuators, control panels, conduit, wiring, accessories and appurtenances for a complete building environmental control system.
- B. Provide switches, fuses, disconnects and all other devices necessary for protection and convenient operation of system.
- C. The contractor shall be responsible for providing power wiring, conduit, breakers and final connections for all control devices, panels, components, and the following equipment unless specifically shown on electrical plans:
 - 1. Control devices
 - 2. Motorized dampers
- D. The control system shall be on normal power.

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2.3 CONDUIT

A. General:

1. All control conduit shall be furnished and installed under this division except where specifically indicated otherwise.
2. All line voltage and control wiring in new construction shall be run in conduit.
3. All control wiring in existing construction shall be run in conduit.
4. Conduit shall be provided in accordance with the Electrical Division of this specification unless noted otherwise in these specifications.
5. Outdoor conduit shall be GRC.
6. Indoor conduit shall be EMT.
7. Conduit shall be 3/4".

B. Below slab or below grade conduit:

1. Metallic conduits installed in or below slabs or below grade shall be galvanized rigid steel or IMC and shall be protected against corrosion with two field coatings of asphaltum black varnish or approved equal.
2. All metallic conduits installed below slab or below grade shall be provided with watertight couplings.
3. Conduits passing through concrete foundation walls or floor slabs below grade or below ground water level shall be provided with waterproof conduit entrance sealing sleeves.

C. Exposed Conduit (Indoor):

1. All exposed conduit shall be prepainted conduit.
2. Conduit shall be prepainted color to be selected by Owner.

2.4 CONTROLS WIRING

- A. Wiring for low voltage circuits generally shall be No. 18B and S gauge or larger RSH-2 heat resistant.
- B. Cables of two or more conductors, not smaller than 22 B and S gauge if shielded or No. 18 B and S gauge if not shielded, may be used for low voltage d-c and electronic circuits carrying less than 1.50 amperes, in lieu of individual wires.
- C. Cables carrying a-c circuits sensitive to external fields shall be shielded.
- D. Cables having fewer than 12 conductors shall have thermoplastic or rubber insulation for 300 volts or more and a heavy outer braid or thermoplastic sheath. Shields shall be grounded to building's grounding system, using wire not smaller than No. 14 B and S gauge. Shields shall not be grounded to conduit systems or building piping.
- E. Cables shall terminate in solder or screw type terminal strips. All terminal strips shall be numbered.
- F. Cables shall not be tapped at intermediate points.
- G. All wires, whether individual or in cables, shall be color coded and numbered for identification in accordance with the National Electrical Code.

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- H. Wire, where specifically permitted to be installed without conduit, shall be plenum rated.

2.5 TRANSFORMERS

- A. Transformers shall be furnished and installed for supplying current to control equipment as required.
- B. Transformers shall conform to NEMA standards, shall be capable of supplying 125 percent the connected load, shall be enclosed in U.L. listed cabinets, ventilated, with conduit connections, and provided with fused disconnect switches on primary side and on secondary side.

2.6 CONTROL VOLTAGE

- A. Voltage shall not exceed 24V.

2.7 SPEED SWITCHES

- A. Speed switches, rheostats, and other fan speed control devices may be furnished by either the equipment manufacturer or the controls contractor.

2.8 THERMOSTATS AND HUMIDISTATS

- A. Thermostats:
 - 1. Thermostats shall have minimum adjustable operating range of 20 degrees F above and below design setpoint.
 - 2. Wall mounted room thermostats shall be (with) (without) thermometer and (with) (without) setpoint indicator.
 - 3. Thermostat shall (not) have external adjustments with internal stops for minimum and maximum settings.
 - 4. Thermostats shall be 24V.
- B. Humidistats:
 - 1. Humidistats shall have minimum adjustable operating range of 15 percent above and below design setpoint.
 - 2. Control setting shall be accessible by removal of locking cover.
- C. Remote Thermostats:
 - 1. Remote bulb type shall have liquid filled capillary and bulb.
 - 2. Provide sensor well in all piping.

2.9 DDC THERMOSTATS

- A. General:
 - 1. The electronic thermostat shall allow the following functions:

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- a. Temperature setpoint adjustment.
 - b. Override switch (from unoccupied to occupied).
2. The electronic thermostat shall allow the following to be programmed from the building control system:
 - a. Space occupied and unoccupied temperatures.
 - b. Space occupied and unoccupied times.
 - c. Allowable space setpoint adjustment.
 - d. Length of override duration.
 3. The electronic thermostat shall have the following features:
 - a. Digital display.
 4. Thermostats shall connect to unit controller via communication cable with a standard jack. The thermostat shall also have a connection available for field monitoring.
 5. Devices installed in duct system shall be specifically designed for duct systems.
- B. Construction:
1. Device shall be polymer construction.
 2. Circuit boards shall be coated.
- C. Technical Specifications:
1. Ambient Operating Conditions: 32 deg F to 140 deg F, 0 to 100% RH
 2. Accuracy: $\pm .34$ deg F @ 70 deg F (thru film nickel)

2.10 DDC HUMIDISTAT

- A. General:
1. Provide electronic humidistat without setpoint adjustment.
 2. Humidistat shall connect to unit controller via communication cable with a standard jack. The humidistat shall also have a connection available for field monitoring.
 3. Devices installed in duct system shall be specifically designed for duct system.
 4. Where humidistat and thermostat are located adjacent to each other and both are providing input for the same piece of equipment, a combination humidity transmitter and temperature sensor may be provided at the contractor's option.
 5. The humidistat shall be a separate device from other control sensors/devices when input is not used to control one specific piece of equipment.
- B. Construction:
1. Devices shall be polymer construction.
 2. Circuit boards shall be coated.
- C. Technical Specification (@ 77 deg F):
1. Ambient operating conditions: 32 deg F to 140 deg F, 0 to 100% RH
 2. Accuracy: $\pm 3\%$ RH for 20-80% RH
 $\pm 5\%$ RH for 5-20% and 80-95% RH
 3. Temperature Coefficient: $.12\%$ RH/deg F
 4. Response: less than 120 sec between 50-90% RH

5. Offset Adjustment: ± 5

2.11 SENSORS, TRANSMITTERS, AND OTHER CONTROL DEVICES

A. General:

1. Provide the type device specified for the specific application. Where the device is not specifically indicated, provide the device best suited to provide the control specified.

B. Location of device:

1. Device shall be located as indicated on the drawings or as stated in the specifications.
2. Where no device location is indicated or specified, the device shall be located as recommended by the manufacturers to provide the best practical results.
3. Where the location indicated on the drawings or stated in the specifications does not provide the best practical results, the manufacturers shall provide recommendations for relocating the device.
4. It shall be the responsibility of the contractor to identify all conflicts between indicated device locations and manufacturers recommended locations prior to installation of any related components (i.e., sensor wells, conduit, etc.).

2.12 SAFETY DEVICES

A. General:

1. Safety devices including, but not limited to, the following shall be hard wired to perform their required function:
 - a. Freezestat
 - b. Condensate overflow switch
 - c. Duct high (and low) pressure switch(es)
 - d. Smoke alarm, via unit duct detector, where shutdown sequence is specified to be by mechanical.
2. Status, where specified, shall be monitored by the building automation controls system and initiate other sequences where required.

2.13 CONTROL PANELS

A. General:

1. All controllers, relays, switches, etc., for equipment shall be mounted in enclosed control panels with key lockable, piano hinged door.
2. Location of each panel shall be indicated on plans, approved by Engineer, and convenient for adjustment and service.
3. Label each panel properly identifying function or service of panel and all surface mounted devices.
4. Control panels shall be extruded or formed, cold-rolled steel, enamel surfaced, with full length mounting brackets, drilled wall mounting holes.
5. The control panel shall be key lockable.
6. Provide a 24V control transformer.

2.14 FLOAT SWITCH

- A. General:
 - 1. Float switch shall include a sealed, waterproof reed/magnet float switch with no exposed electrical contacts.
 - 2. Float shall be prewired with 6 ft. long, 18 ga. lead cables.
 - 3. Switch shall be tested to UL 508 and UL listed for 24V AC.
 - 4. Float shall attach to drain pan with stainless steel clips.
- B. Locations:
 - 1. All drain pans.
- C. Basis of design manufacturers shall be:
 - 1. SMD Research Safe-T-Switch Model SS3.

2.15 EQUIPMENT STATUS

- A. Equipment status shall be provided by solid state current sensors.
- B. Sensor shall have non-polarity sensitive outputs, trip point adjustment, trip LED, and power LED.

2.16 THREE PHASE VOLTAGE MONITOR

- A. Monitor shall be autoranging type that detects single phasing, low voltage, phase reversal or voltage unbalance. When a harmful condition exists, the output relay shall deactivate. When the harmful condition is removed, the relay shall reactivate.
- B. The three phase voltage monitor shall be field or factory installed on all three phase equipment.
- C. If three phase protection is already provided with the equipment via the VFD or other means, the control contractor does not have to provide additional three phase protection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. The (Building Environmental Controls Contractor (mechanical contractor) shall be responsible for a complete operational system.
 - 2. The installation shall include:
 - a. Drawings
 - b. Supervision
 - c. Interlocks
 - d. Adjustments
 - e. Verification

3. Location of sensing elements shall be the responsibility of the installer.

B. Wiring splices shall not be permitted in electrical panelboards, junction boxes and switchgear.

3.2 THERMOSTATS, HUMIDISTATS AND SWITCHES

A. General:

1. Install all devices as recommended by manufacturer.
2. When device is provided by the control contractor, the control contractor shall be totally responsible for all coordination with the equipment supplier to ensure compatibility of components to meet the requirements of the equipment manufacturer and the control sequence.

B. Installation:

1. Mount thermostats, sensors, and switches 4'-0" above finished floor to the top of the device's control mechanism unless noted otherwise.
2. Mount humidity sensors 7'-0" above finished floor unless noted otherwise or when a combination temperature and humidity sensor is permitted.
3. Thermostats mounted on exterior walls shall be mounted on a thermally insulated sub-base.
4. When location is not shown, Contractor shall assume the most remote location served by unit. Coordinate exact location with Engineer.
5. Contractor shall coordinate location of thermostat, humidistats, and switches with final architectural plans and actual field conditions to avoid locating them inside cabinets, bookcases, casework, chalkboards, tackboards and behind door swings and similar obstructions that would limit access or limit the ability to properly sense space conditions.

3.3 REMOTE THERMOSTATS

A. Thermostats not shown on plans shall be mounted in convenient locations on duct, in mechanical space or on equipment. Provide access doors for sensor and for thermostat.

3.4 WIRING

- A. All control wiring within starters (and motor control centers) shall be installed in a workmanlike manner and neatly laced.
- B. All wiring installed in manholes, below grade, or below ground water level shall be made up with waterproof connections.
- C. Wiring in manholes shall be continuous thru manholes.

3.5 CONDUIT

A. Conduit sleeves thru non-waterproofed walls and floors shall be grouted and caulked on both sides of the wall and floor. See detail for fire rated or smoke tight assemblies.

- B. After installation, any painted pipe which is damaged shall be touch-up painted.

3.6 EXISTING CONSTRUCTION

- A. Control wiring and conduit shall be installed in existing walls, slabs, and ceilings.
- B. Where conditions do not permit installation of conduit and wiring in existing walls, slabs, and ceiling; and, when approved by the engineer, wire mold and similar finished enclosures may be provided.
- C. Conduit and wiring shall be installed above existing ceilings except where removal of existing ceilings is specifically identified in other dimensions of work (if any). The Contractor shall be responsible for removal of all other existing tile/grid and replacement of the tile/grid as necessary. Any damaged tile/grid shall be replaced by the Contractor at the Contractor's expense.

3.7 DEVICES ON EXTERNALLY INSULATED DUCTS

- A. Devices mounted on externally insulated ducts shall be mounted on standoff brackets to allow proper installation of duct. If device must be mounted directly to duct for proper operation, standoff bracket may be deleted.

3.8 SPEED SWITCHES

- A. If switch is not factory installed on the unit, the control contractor shall field install the switch.

3.9 FLOAT SWITCH

- A. Secure bracket to drain pan with screw.
- B. Verify float is properly positioned.

END OF SECTION

SECTION 23 09 04 - BUILDING AUTOMATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of the building automation system shown on the drawings and specified hereinafter.

B. Description:

1. The work shall include, but not be limited to, the following:
 - a. Field programmable digital system controller(s).
 - b. Digital transmission system.
 - c. Field programming to perform monitoring and control functions specified herein and on point schedule.
2. All sensors, actuators, transducers, solenoids, transformers, wiring and appurtenances shall be provided for a complete building automation system.
3. Digital controller shall include the distributed microprocessors.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0900 - Instrumentation and Control for HVAC (General)

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All equipment and components shall comply with all local codes and ordinances, and meet or exceed the following standards:
 - a. American Society for Testing and Materials ASTM
 - b. Institute of Electrical and Electronic Engineers IEEE
 - c. National Electrical Manufacturers Association NEMA
 - d. Underwriters Laboratory, UL (UL 916)
 - e. FCC Regulation, Part 15, Section 156
 - f. National Fire Protection Association NFPA

- B. All the equipment shall have the UL label.

- C. Manufacturers shall be:

1. Trane

PART 2 - PRODUCTS

2.1 GENERAL

- A. The control system shall consist of high-speed, peer-to-peer network of DDC controllers and a web-based operator interface. Operators shall be able to perform all normal operator functions through the web browser interface including downloading memory, parameters, and schedules to any module. The system shall be capable of interfacing with Wireless Access Protocol (WAP) enabled cellular telephone or personal digital assistant (PDA).
- B. The system shall support Wb services data exchange with any other system that complies with XML (extensible markup language) and SOAP (simple object access protocol) standards specified by the Web Services Interoperability Organization (WS-I) Basic Profile 1.0 or higher.
- C. The system shall be capable of future expansion to include monitoring of occupant card access, fire alarm, lighting control systems, cameras and security systems.
- D. The control algorithm shall be proportional and integral. Derivative functions are required where stability of the controller is not likely with PI algorithms.
- E. A control panel used to control equipment on a floor shall typically not be used to control equipment on any other floor (i.e., panel for terminal units for first floor terminal units shall not be used to control second floor terminal units).

2.2 BACnet COMMUNICATION PROTOCOL

- A. The system shall use the BacNet protocol for communication to the operator workstation or web server and for communication between control modules. Schedules, setpoints, trends, and alarms shall be BACnet objects and shall conform to ANSI/ASHRAE Standard 135-2004, BACnet.

2.3 DIGITAL CONTROLLER COMPONENTS

- A. General:
 1. Each controller shall consist of the following:
 - a. Enclosure with keyed hinged door and mounting brackets
 - b. Power assembly
 - c. System microprocessors
 - d. Communications board
 - e. Field termination board
- B. Power Assembly:
 1. The power assembly shall consist of :

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- a. Transformer
- b. Filter to eliminate transients
- c. Power regulator/surge suppresser
- d. Battery charging circuit
- e. Battery with 24-hour backup for RAM

C. Display:

1. The digital display shall be programmed to display analog variables, binary conditions, off normal scans and other analog and binary information required for analysis and adjustment of the system being controlled.

2.4 COMMUNICATIONS

A. General:

1. All digital devices shall be assigned a numeric address.
2. Communications, commands and responses shall be digital.
3. Communications hardware shall include all encryption, filtering, amplifications diagnostics and error lodging.
4. Provide surge suppresser.

2.5 DIGITAL CONTROLLER CAPABILITIES

A. Field Programmable:

1. The controller shall contain all necessary mathematics, logic, utility functions and all standard energy calculations and control functions in ROM to be available in any combination for field programming the unit. These routines shall include but not be limited to:
 - a. Math routines:
 - 1) Basic arithmetic
 - 2) Binary logic
 - 3) Relational logic
 - 4) Fixed formulas for psychrometric calculations
 - b. Utility routines for:
 - 1) Process entry and exit
 - 2) Keyboard functions
 - 3) Variable adjustments and output
 - 4) Alarm indication
 - c. Control routines for:
 - 1) Signal compensation
 - 2) Loop control
 - 3) Energy conservation
 - 4) Timed programming
2. Final field programs shall be stored in battery backed up RAM.

B. Calibration Compensation:

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1. The digital controller shall sense the voltage being supplied to the resistance sensing element and through firmware and shall compensate for power supply changes due to ambient temperature changes at the power supply.
- C. Diagnostics:
1. The digital controller shall continuously perform self diagnostics. All malfunction shall alarm the front-end system.
- D. Default Operating Procedure and Alarms:
1. All variables shall be identified as being reliable or unreliable. When a calculation is required to use a value (sensed or calculated), which is identified as being unreliable, the unreliable data value will flash. The calculation will use a default value programmed into the unit.
 2. All alarms shall be indicated at the digital controller and at the front-end system.
- E. Energy Management Functions:
1. The controller shall be capable of performing the following energy management functions:
 - a. Time of day scheduling
 - b. Start/Stop optimization
 - c. Peak demand limiting
 - d. Duty cycling (temperature compensated)
 - e. Economizer control
 - f. Enthalpy changeover
 - g. Chilled water reset
 - h. Hot water reset
 - i. Occupied/Unoccupied mode
 - j. Chiller optimization
- F. User Specified Programs:
1. The controller shall be capable of generating programs specified by the user including:
 - a. Intermediate season control (dead zone)
 - b. Trending of variables
 - c. Historical data storage
 - d. Totalizing
 - e. Holiday and event programming
- G. Control Loop Compensation:
1. Control loop compensation shall include:
 - a. Hysteresis correction
 - b. Limited control output
 - c. Ramp output
 - d. Anti-reset windup
- H. Access Levels:
1. The controller shall have a minimum of three levels of passwords as follows:
 - a. Level One - Read all setpoints
 - b. Level two - Program occupied periods
 - c. Level Three - Program all setpoints and programs

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2.6 GRAPHICS

- A. Graphics shall operate thru the microprocessor and shall be dynamic and animated.
- B. The graphic software shall display and update current control point data.
- C. Notification of alarms from the panels must be provided on the graphic display while the system is in graphics mode.
- D. A library of HVAC symbols shall be provided for use in generating custom displays. The graphic symbols shall include fans, pumps, valves, chillers, air handlers, cooling towers, rooftop units and boilers.
- E. The graphic display shall indicate alarm conditions for each air handling unit.
- F. The graphic display shall display a global graphic for each building which shall include status of air handling units, smoke exhaust fans, exhaust fans, dampers and alarm conditions.
- G. Fireman's Smoke Control Panel (FSCP) graphics and points to be displayed at the control operator's terminal in a similar graphic layout as on the FSCP face.
- H. The following graphics shall be generated and installed under the contract:
 - 1. Site location
 - 2. Building sites
 - 3. Floor plan
 - 4. Equipment rooms
 - 5. Chiller/condenser water systems
 - 6. Boiler system
 - 7. Each heating and cooling unit
 - 8. Each 100% outside air system
 - 9. Each terminal unit
 - 10. Each exhaust fan
 - 11. Ambient conditions
 - 12. Smoke zones
 - 13. Fireman's Smoke Control system

2.7 SURGE PROTECTION

- A. Surge suppression shall be provided on communications lines and power sources at each control panel.
- B. Surge suppression shall be type recommended by manufacturer to provide maximum protection of system components.

2.8 OWNERS WITH EXISTING BUILDING AUTOMATION SYSTEMS

- A. When this facility is brought on-line, the existing software and hardware shall be upgraded as necessary to support the graphics, sequences and other functions of the building automation system.

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- B. The data, information and graphical representations of the systems at this facility shall be equal to or greater than that installed for other facilities (in the District) or as indicated in these specifications, whichever is greater.

2.9 VARIABLE FREQUENCY DRIVE (VFD) COMMUNICATION

- A. Building automation system must be able to fully communicate and change setpoints with variable frequency drives. Communication must be direct without gateway or other external translating devices.

2.10 CHILLER COMMUNICATION

- A. Building automation system must be able to fully communicate and change setpoints with chillers. Communication must be direct without gateway or other external translating devices.

2.11 BACK-UP POWER

- A. Provide an UPS for all panels in this specification.

2.12 SETPOINT CHANGES

- A. Setpoints shall be changed on function blocks. User must also be able to change setpoints without having to go to the function blocks. Acceptable methods include changing setpoints on a "Properties Page" or on the system graphics.

PART 3 - EXECUTION

3.1 OPERATION

- A. Upon restoration of power, equipment shall be sequentially started and shall at no time exceed last demand limit setting.

3.2 CONSTANT AND VARIABLE AIR VOLUME TERMINAL UNITS

- A. The control contractor shall ship the controllers required for operation of the terminal units to the terminal unit manufacturers facility for factory installation of the controllers on to the terminal unit.
- B. The control contractor shall be responsible for all costs to package, insure, and ship the controllers to the location required by the terminal unit manufacturer.

3.3 EXISTING EQUIPMENT

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- A. The tags (name) of existing equipment have been changed to be consistent with other District projects. See the existing equipment schedules.

3.4 SYSTEM COMMISSIONING

- A. This project will include system commissioning by the District's commissioning agent. A major component of this commissioning will include a detailed review of system operation.
- B. The controls contractor shall fully support the commissioning work on this project. See specification 01 9113 for additional requirements.

END OF SECTION

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SECTION 23 09 93 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS AND POINTS LIST

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of controls system shown on the drawings and specified hereinafter.

B. Description:

1. Points shown for equipment shall be for each item of equipment except:
 - a. When noted otherwise.
 - b. When exhaust fans are grouped together.

1.2 RELATED DOCUMENTS

- A.** Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

- B.** All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:

1. Section 23 0900 - Instrumentation and Control for HVAC (General)
2. Section 23 0993.1 - Sequence of Operation (Central Air Handling Equipment)
3. Section 23 0993.2 - Sequence of Operation (Air Handling Equipment)
4. Section 23 0993.3 - Sequence of Operation (Hydronic Systems)
5. Section 23 0993.4 - Sequence of Operation (Electric Heaters)
6. Section 23 0993.5 - Sequence of Operation (Hydronic Heaters)
7. Section 23 0993.6 - Sequence of Operation (Single Zone Packaged Equipment)
8. Section 23 0993.7 - Sequence of Operation (Water Source Heat Pump Systems)
9. Section 23 0993.8 - Sequence of Operation (100% Outside Air Equipment)
10. Section 23 0993.9 - Sequence of Operation (Various Systems)
11. Section 23 0993.10 - Sequence of Operation (Water Heaters/Domestic Water Systems)
12. Section 23 0993.11 - Sequence of Operation (Self-Contained Water-Cooled Equipment)
13. Section 23 0993.12 – Sequence of Operation (Energy Recovery Ventilation Equipment)
14. Section 23 0993.13 – Sequence of Operation (Steam Systems)
15. Section 23 0993.14 – Sequence of Operation (Laboratory Systems)

PART 2 - SEQUENCE OF OPERATION

2.1 GENERAL:

- A.** These sequence descriptions and definitions shall apply to all sequences unless sequence specifically indicates otherwise.

2.2 SETPOINTS

- A. In general, the specification indicates setpoints or range of setpoints for most devices.
- B. Temperatures shall be field settable to any temperature.
- C. Time of day operations shall be field settable to any time.
- D. Time delays shall generally be field settable as follows:
 - 1. 0-60 second delay: settable from 0-300 seconds.
 - 2. 0-5-minute delay: settable from 0-60 minutes.
- E. The contractor shall adjust setpoints in the following manner:
 - 1. As required to start-up, test, debug and otherwise ensure equipment and system is operating as intended.
 - 2. Dampers, actuators, and similar devices should be left in their optimum operating position.
 - 3. Thermostats, humidistats, and similar devices should be left as indicated on drawings or in specifications. If no value is indicated, contractor should set at a reasonable value.
 - 4. Equipment and system schedules should be reviewed with the Owner and Engineer prior to initiating the schedule.

2.3 MORNING COOL-DOWN

- A. This mode is the mode between night setback and normally occupied mode and is used to bring area served from unoccupied conditions to conditions required for occupancy.
- B. This mode will operate with outside air systems closed or de-energized.
- C. The start time of this mode shall be determined by the building automation system based upon space temperatures, building characteristics, outside temperature, and historical ability of each system to cool down the building.

2.4 MORNING WARMUP

- A. This mode is the mode between night setback and normally occupied mode and is used to bring area served from unoccupied conditions to conditions required for occupancy.
- B. This mode will operate with outside air systems closed or de-energized.
- C. The start time of this mode shall be determined by the building automation system based upon space temperatures, building characteristics, outside temperature, and historical ability of each system to warm up the building.
- D. Where acceptable to the Engineer, morning warmup may be based upon indoor and outdoor temperatures as follows:
 - 1. Outdoor temperature 0-15 degrees below space occupied setpoint, morning warmup start 30 minutes before occupied time.

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2. Outdoor temperature 16-25 degrees below space occupied setpoint, morning warmup start 60 minutes before occupied time.
3. Outdoor temperature 26-35 degrees below space occupied setpoint, morning warmup start 90 minutes before occupied time.
4. Outdoor temperature is more than 35 degrees below space occupied setpoint, morning warmup start 120 minutes before occupied time.

2.5 NIGHT SETBACK

- A. This mode is the unoccupied mode.
- B. This mode is a timed function of adjustable duration.
- C. This mode typically will operate with outside air systems closed or de-energized and is used primarily to maintain unoccupied space temperature (adjustable) or space humidity level (adjustable).
- D. All HVAC equipment required to maintain space conditions shall be energized in this mode.

2.6 OVERRIDE

- A. When override is activated, the system shall operate with that zone, equipment, or system in the occupied mode.
- B. At the end of the override time period, the zone equipment or system shall return to the mode scheduled at that time.

2.7 OUTSIDE AIR CONTROL

- A. Where motorized dampers are specified, the dampers shall open to maintain the airflow quantity indicated on the equipment schedule.
- B. Where airflow measuring stations are provided in the outside air intake, the outside air damper shall maintain airflow measuring station setpoint.
- C. Where airflow measuring stations are provided in the supply and return airstreams, the outside air damper shall modulate to maintain the required differential airflow.

2.8 FAILURE MODES

- A. General:
 1. Initiating devices shall each be hard-wired.
 2. Manual reset of temperature alarm and pressure alarm shall be required. Other alarms shall automatically reset unless manual reset is indicated.

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B. Smoke and Fire Alarm:

1. The fans shall be de-energized and smoke dampers shall shut. The fan shall de-energize as fast as practical and smoke dampers shall begin closing after fan is de-energized.

C. Low Temperature (Recirculating System):

1. A low temperature condition may be caused by coil freeze stat, mixed air low limit or leaving air low limit.
2. Unless sequences specifically identify alternative modes of operation, the following shall be provided:
 - a. The system shall operate in occupied mode.
 - b. Outside air dampers shall be closed or outside air supply fans shall be de-energized.
 - c. Heating system shall energize including heat sources and distribution system.
 - d. Cooling distribution system shall energize.
 - e. Loop water system shall energize.
 - f. (Heating) (Cooling) valves shall fully open to coil.
3. (Alarm shall be indicated at building automation system.) (Building freeze alarm shall sound.)

D. Low Temperature (Outside Air System):

1. A low temperature condition may be caused by coil freeze stat, mixed air low limit or leaving air low limit.
2. Unless sequences specifically identify alternative modes of operation, the following shall be provided:
 - a. The system shall operate in recirculation mode (if one is specified) or shall de-energize.
 - b. Outside air dampers shall be closed.
 - c. Heating system shall energize including heat sources and distribution system.
 - d. Cooling distribution system shall energize.
 - e. Loop water system shall energize.
 - f. (Heating) (Cooling) valves shall fully open to coil.
3. (Alarm shall be indicated at building automation system.) (Building freeze alarm shall sound.)

E. High Condensate Level:

1. Upon a rise in condensate level in the condensate pan, the float switch shall de-energize the unit.

F. Duct Pressure:

1. Discharge, (exhaust) (and return) air static pressure sensors shall de-energize fans.

2.9 SPACE HEATING DEVICES

- A.** Unless stated otherwise, all devices not utilized for reheat shall be scheduled off by any of the following means:

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1. Night setback thermostat
2. Timed schedule
3. Outside air temperature setpoint

2.10 STARTER "HAND-OFF-AUTO"

- A. When in "HAND" position, equipment shall be able to run.
- B. When in "OFF" position, equipment shall not be able to run.
- C. When in "AUTO" position, equipment shall be able to run if commanded by sequence of operation.

2.11 EQUIPMENT ON EMERGENCY POWER

- A. When building operates on emergency power, the following HVAC systems shall continue to operate (see individual system sequences for changes in operation, if any, from normal power to emergency power):
 1. Control associated with:
 - a. Building heating system and steam system
 - b. Glycol water system
 - c. Laboratory supply and exhaust air flow
 - d. Vivarium supply
 - e. Exhaust air flow
 - f. Tower basin heater
 2. Chillers:
 3. Pumps:
 4. Condensate pumps:
 5. Boiler feed system:
 6. Ventilation fans (EF-# and SF-#) and associated dampers:
 7. Stair pressurization systems:
 8. Smoke control system:
 9. Laboratory exhaust fans:
 10. Vivarium exhaust fans:
 11. Air handlers:
 12. Cooling tower basin heater:

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13. Controls air compressor and refrigerant dryer:
14. Vivarium control system:
15. Laboratory control system:
16. Other devices and equipment where indicated on plans or specifications:
17. Heat Tape:

2.12 SYSTEM OPTIMUM START

- A. The building automation control system shall provide an optimum start sequence for the HVAC system.
- B. Optimization shall be determined by a comparison of indoor and outdoor environmental conditions and system capacities.
- C. At the completion of optimum start, the building shall be at design temperatures. This is not necessary, and in most cases will not be, the same time as the start of the occupied period. For example, the completion of optimum start could be set at 7 am and the occupied mode set at 9 am. The occupied mode is typically when ventilation air would be energized.

2.13 ALARMS

- A. In addition to the alarms indicated, all temperatures and other monitored or sensed conditions that fall above or below the normal range shall be alarmed.
- B. Alarms shall be assigned a level of alarm (minimum three levels - low (maintenance), high (important), and critical).

2.14 REMOTE NOTIFICATION

- A. Critical alarms shall be sent via text and/or email to up to six (6) Owner identified recipients.

2.15 TWO SPEED MOTORS

- A. Sequence shall include a time delay on two speed motors when changing from high speed to low speed.

PART 3 - POINT SCHEDULE

3.1 DEFINITION OF POINTS

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- A. Binary Output:
 - 1. Control Relay - Energize/de-energize
 - 2. Solenoid - Steam Valve
Gas Valve
 - 3. Hand/Off/Auto - Starter

- B. Analog Output:
 - 1. Cooling - Control Valve
 - 2. Heating - Control Valve
SCR Heater
 - 3. Humidification - Control Valve
 - 4. Economizer - Dampers
 - 5. Position Adjust - Fan Drives
Pump Drives
Dampers
VAV Damper

- C. Binary Input:
 - 1. Differential Pressure - Fan Status
Pump Status
 - 2. Pressure Switch - Pressure
 - 3. Flow Switch - Fan Status
Pump Status
 - 4. Fire/Smoke - Smoke Detector
Fire Sensor
 - 5. Freeze - Low Limit
 - 6. Filter - Filter Pressure
 - 7. Setback Override - Night Setback
Override

- D. Analog Input:
 - 1. Humidity - Humidity
 - 2. Temperature - Temperature
 - 3. Static Pressure - Static Pressure
 - 4. Fan Speed/Load - Fan Drives
 - 5. Air Flow - Air Flow

END OF SECTION

SECTION 23 09 93.2 - SEQUENCE OF OPERATION (AIR HANDLING EQUIPMENT)

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of controls system shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections
 1. Section 23 0993 - Sequence of Operation for HVAC Controls and Points List

PART 2 - SEQUENCE OF OPERATION

2.1 TERMINAL BOXES

A. Terminal Box Controls

1. The terminal boxes shall be controlled by a unit mounted direct digital controller.

B. Airflow

1. A pressure independent controller shall modulate air valve to maintain airflow set point.
2. Two position boxes shall maintain a minimum CFM when switch is in "Unoccupied" position.
3. Heating Airflow
 - a. When air handler is in cooling mode and space heating is required, the terminal unit shall provide minimum scheduled heating airflow.
 - b. When the air handler is in heating mode and no terminal unit is in cooling mode, the terminal unit shall provide the maximum scheduled heating airflow. If a maximum heating airflow is not indicated on the schedule, airflow shall be 80% (adj.) of cooling airflow or minimum heating airflow, whichever is greater.

C. Temperature Control

1. General
 - a. Space temperature control shall be by a space sensor with adjustable set point. Provide a night setback override.
 - b. When the terminal unit is in heating mode and the space temperature has been satisfied, the electric heat shall proportionally energize to maintain the supply air at

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- a temperature equal to the space setpoint (i.e., supply air at a neutral temperature).
 - c. Occupied space setpoint shall be 72 degrees F (adj.).
 - d. Unoccupied space setpoint shall be 80 degrees F (adj.) in cooling mode and 55 degrees F (adj.) in heating mode.
2. Shutoff Terminal Units
- a. Airflow shall modulate to minimum or full shut off position when space temperature decreases below set point.
 - b. Electric heating coil shall proportionally energize upon a further drop in space temperature.
- D. Override
- 1. When terminal unit is in override setback mode, the primary air system and terminal units shall operate in occupied mode.
- E. Morning Warm-up
- 1. When system operates in morning warm-up mode, the primary air system shall energize.
 - 2. The non-fan powered terminal units shall operate at maximum heating airflow if space requires heating and minimum airflow if heating is not required for the space.
 - 3. Fan powered terminal units shall operate with primary air closed and in heating mode.
 - 4. When space temperature is satisfied, and the building is in occupied mode, the terminal unit shall revert back to normal operating sequence.

2.2 EXHAUST FANS

- A. Fans shall be controlled as shown on the schedule.

END OF SECTION

SECTION 23 09 93.6 - SEQUENCE OF OPERATION (SINGLE ZONE PACKAGED EQUIPMENT)

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of controls system shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0993 - Sequence of Operations for HVAC Controls and Points List

PART 2 - SEQUENCE OF OPERATION

2.1 GENERAL

A. Unit Operation:

1. The indoor fan, exhaust fan, compressors, heating coil, reheat coil, and outside air damper shall be controlled independently of each other by the direct digital controller.
2. Cooling and heating shall not operate simultaneously except where specifically specified otherwise.
3. Electric heat shall be disabled until air flow switch proves proper air flow.
4. When system is in occupied or override modes, the system shall operate in occupied mode.

B. Heating Control (Heat Pump):

1. Upon a demand for heating, the reverse cycle unit shall load compressor.
2. If additional heat is required or the compressor fails to energize, the auxiliary heat shall be energized.
3. Electric heat shall be energized during the defrost cycle.
4. Electric heat shall stage (single or multiple) or proportionally energize as indicated on equipment schedule or specifications to maintain sensor setpoint.

C. Cooling Control:

1. Upon a demand for cooling, the unit cooling sequence shall energize.
2. The compressors shall load to maintain sensor setpoint.

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D. Indoor Fan Operation:

1. The fan shall run continuously when the unit is energized except where noted otherwise.

E. Morning Warm-Up:

1. Unit shall operate in heating to bring space to design temperature.

F. Outside Air Damper:

1. The outside air damper shall be closed during unoccupied mode.
2. The outside air damper shall be closed during morning warm-up mode.
3. The outside air damper shall be open during occupied mode.

G. Unoccupied Mode:

1. When space temperatures drop below the night low limit setpoint, the unit shall energize in heating.
2. When space temperatures rise above the night high limit setpoint, the unit shall energize in cooling.
3. When the space humidity rises above setpoint, the system shall operate in dehumidification mode.

H. Failure Mode:

1. High condensate level
2. Smoke detection
3. Freezestat
4. Others indicated with equipment or required by manufacturer.

2.2 PACKAGED COOLING AND HEATING UNITS (WITH HOT GAS REHEAT)

A. Unit Operation:

1. The units shall be controlled by a (space) thermostat, (space humidistat) and direct digital controller.

B. Dehumidification Mode:

1. The unit shall operate in cooling mode when humidity level exceeds setpoint.
2. The hot gas reheat valve shall modulate to maintain the space temperature setpoint.

END OF SECTION

SECTION 23 31 12 - MECHANICAL DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of mechanical duct, accessories, and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 23 Specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 3300 - Duct Accessories
 2. Section 23 3313 - Dampers
 3. Section 23 3346 - Flexible Duct

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. Mechanical duct systems shall be fabricated and installed in accordance with the manufacturer's recommendations and meet or exceed the standards and procedures (latest editions) of the following:
 - a. SMACNA, Balancing and Adjustment of Air Distribution
 - b. SMACNA, High Velocity Duct Construction Standards
 - c. SMACNA, Low Pressure Duct Construction Standards
 - d. SMACNA, Fire Damper and Heat Stop Guide
 - e. SMACNA, Ducted Electric Heat Guide
 - f. SMACNA, Duct Cleanliness for New Construction Guidelines
 - g. SMACNA, HVAC Duct Construction Standards
 - h. NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems
 - i. ASHRAE Handbook of Fundamentals and ASHRAE Systems and Equipment Handbook
 - j. International Building Codes
2. Duct shall be Class 0 in accordance with UL Standard 181. Where permitted by Code, Class 1 duct shall be allowed.
3. All duct system components including insulations, adhesives, mastics, cements, tapes, coverings, connectors and appurtenances shall have a maximum UL flame spread of 25 and a smoke development rating of 50 as tested by ASTM E-84.

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4. Duct sealants shall meet UL 181A and UL 181B.

B. Manufacturers:

1. The following duct sealant manufacturers are acceptable:
 - a. AirSeal McGill
 - b. Ductmate
 - c. Hardcast

PART 2 - PRODUCTS

2.1 GENERAL

- A. Dimensions shown on the plan are finished inside dimensions. The sizes of internally lined ducts shall be increased accordingly. The size of dampers, security bars and accessories shall also be increased in size.
- B. Ducts shall be smooth on inside.
- C. The general location of ducts shall be as shown on the contract drawings. Exact location of ductwork shall be determined by the Contractor.

2.2 SEALING DUCTS

- A. General:
 1. Sealants shall be water-based. Solvent based sealants are not acceptable.
 2. Sealants shall be UV, water and mildew resistant.
 3. Sealants shall be suitable for low, medium and high-pressure applications up to 15" WG.
 4. Sealants shall have a mild odor, no flashpoint, and not require a respirator for application.
- B. All ducts shall be sealed in accordance with Seal Class A. Seal all joints (longitudinal and traverse) and all penetrations. The following shall not require sealant:
 1. Spiral lockseams
 2. Gasketed connections
- C. Basis of design sealant (not exposed to weather) shall be:
 1. McGill AirSeal United Duct Sealer (Water Based).
- D. Basis of design sealant (exposed to weather) shall be:
 1. McGill AirSeal Uni-Weather.

2.3 DUCT SHIPMENT

- A. Intermediate Level (SMACNA):
 1. Ducts leaving the place of fabrication shall be kept clean and dry.

- B. Advanced Level (SMACNA):
 - 1. Ducts leaving the place of fabrication shall be wiped clean (interior) and have all ends capped.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall provide additional bends and offsets as may be required to bring ductwork into proper relation with other equipment and features of the building.
- B. Where changes are made in shape of ducts, full area shall be maintained, and changes shall be gradual to minimize pressure drop.
- C. Ducts terminating at grilles and registers shall be provided with suitable means of attachment.
- D. All ductwork shall operate without chatter and vibration and shall be free from pulsation.
- E. The following work shall be performed under direction of the System Test and Balance Contractor.
 - 1. Installing all automatic dampers.
 - 2. Provide necessary blank-off plates (safing) required to install dampers that are smaller than duct size.
 - 3. Assemble multiple section dampers with required number of shafts through duct for external mounting of damper motors.
 - 4. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation and affix and seal permanently in place after stratification problem has been eliminated.
 - 5. Provide access doors to adjust, maintain, or service equipment sensors, controllers and all other devices.

3.2 DUCT STORAGE

- A. Duct shall be protected by storing on elevated supports.
- B. All ducts shall have ends capped during storage.
- C. The area used for storage shall be kept dry and clean.

3.3 PROTECTION AND CLEANING DURING INSTALLATION

- A. During construction, all open ends of duct installed shall be capped.
- B. Prior to capping, all interior duct surfaces shall be wiped clean.

3.4 HANGING

- A. Hanging and support systems shall be in accordance with SMACNA Duct Construction Standards and drawing details.
- B. Vertical ducts shall be supported by extending bracing angles to rest firmly on floors or shall be bolted to walls, columns or other construction.
- C. Where duct is supported by threaded rods, see Mechanical Sound, Vibration, and Seismic Control specifications for threaded rod requirements and attachment requirements.
- D. Where duct is supported by sheetmetal straps, the strap shall attach to the duct with two #10 sheetmetal screws located within 2 inches of the top of the duct.

3.5 ACCESSORIES

- A. Doors, coils, dampers, registers, grilles, diffusers, air turning vanes, air volume extractors, and other accessory items shall be installed as detailed in the SMACNA Duct Construction Standard with adequate reinforcement and support to accommodate additional weight without damage to the duct.

3.6 COMPLETION AND DEMONSTRATION

- A. Upon completion of the duct system installation, and before the Engineer has inspected the system operation, open all system dampers and turn on fans to blow all scraps and other loose material out of the duct system. Allow for a means of removal of such material.
- B. Check the duct system to ensure there are no excessive air leaks through joints, at reinforcement locations, seams, points of connection with fire dampers, coils, or other duct accessories. Where there are unacceptable leaks, the leakage shall be repaired and shall be done so in the manner of a new installed system. Excessive air leaks shall be leaks that exceed industry standards, cause higher than acceptable noise, or where leakage exceeds reasonable expectations.

END OF SECTION

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SECTION 23 31 13.1 - METAL DUCT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of all metal duct where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 3112 - Mechanical Duct

1.3 QUALITY ASSURANCE

- A. Codes and Standards: All work shall meet or exceed the standards and procedures (latest editions) of the following:
 1. ASTM A527 Galvanized Steel Spiral Lock Seam Duct
 2. Underwriter Laboratories, UL 103
 3. ANSI Z223.1
 4. NFPA 96
- B. Material shall be free from blisters or other mechanical defects. Material shall be galvanized prime sheet steel unless noted otherwise.
- C. Sheet metal thickness, cross joints, seams, slip-connections, cross-breaking, bracings, duct supports, and reinforcing shall be in accordance with the more stringent requirements of ASHRAE Guide and SMACNA Duct Construction Manual for system pressure classifications. Minimum gauge thickness is 26 unless thicker gauges are indicated.
- D. Grease duct doors shall be UL 1978 listed.
- E. Manufacturers:
 1. The following round and flat oval duct manufacturers are acceptable:
 - a. United McGill
 - b. Semco
 - c. Turnkey Duct Systems
 - d. Eastern Sheet Metal
 - e. Lindab

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- f. Hamlin
 - g. BHV Sheet Metal Fabricators
 - h. Spiral Pipe of Texas
 - i. Patton Industries
2. The following grease duct cleanout door manufacturers are acceptable:
- a. Ductmate Industries, Inc.
 - b. Approved equal
3. The following surface mounted duct support manufacturers are acceptable:
- a. Mifab
 - b. MIRO
 - c. Approved Equal

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials:

- 1. Duct shall be galvanized or as indicated elsewhere on the plans or in these specifications.
- 2. Plenums, collars, flashing, etc. are located on roofs, exterior of the building, or other locations where exposed to the weather shall be stainless steel.
- 3. The dryer vent system located outdoors shall be stainless steel.
- 4. The fume hood exhaust duct shall be stainless steel.
- 5. The kiln exhaust duct located outdoors shall be stainless steel.

B. Closure:

- 1. Transverse joints and seams in sheet metal duct shall be of the types and sizes recommended by SMACNA and the ASHRAE Handbook for the specific duct pressure classification.

2.2 ROUND SINGLE WALL SUPPLY

A. Duct:

- 1. Duct shall be constructed with spiral lockseams or spiral lock seam/standing rib.

B. Fittings:

- 1. All fittings are to have continuous welds along all seams. All divided flow fittings are to be manufactured as separate fittings, not as saddle taps, tap collars, or similar duct components.
- 2. All 90-degree tees and 45-degree laterals (wyes) up to and including 12-inch diameter size shall have a conical entrance into the fitting, produced by machine or press forming. The entrance shall be free of weld build-up, burrs, or irregularities.
- 3. Elbows in diameters 3 inches through 12 inches shall be two section stamped elbows. All other elbows shall be gored construction with all seams continuously welded. Elbows shall be fabricated to a center-line radius of 1.5 times the cross-section diameter.

4. Pipe to pipe joints in diameters to 50 inches are by the use of sleeve couplings, reinforced by rolled beads.
5. Pipe-to-fitting joints in diameters to 50 inches are by slip fit of projecting collar of the fitting into the pipe. Insertion length of sleeve coupling and fitting collar is 2 inches for diameters through 9 inches and 4 inches for diameters 10 inches and up.

2.3 ROUND AND FLAT OVAL DUCT (DUAL WALL)

A. Duct:

1. Duct shall be constructed with spiral lockseams or spiral lockseams/standing rib.
2. Dual wall shall be:
 - a. Indoor supply and return: 2"
 - b. Outdoor supply: 3"
 - c. Outdoor return: 2"

B. Materials:

1. Outer wall galvanized (indoor)
2. Outer wall stainless steel (outdoor)
3. Inner wall galvanized

C. Fittings:

1. Fittings shall be constructed similar to fittings specified for single wall duct except that they shall be dual wall.

D. Liner:

1. Round and flat oval dual wall duct shall have perforated liner.
2. Fittings shall have solid liner.

E. Insulation:

1. Insulation shall be .27K @ 75 degrees F.
2. Insulation shall be thickness of the dual wall.
3. A 1 mil (min.) polyester film shall be provided between the fiberglass insulation and airstream to prevent fibers from contacting the airstream where perforated liners are provided.
4. The insulation and film shall have a flame and smoke spread of less than 25/50.

F. Location:

1. Dual wall duct shall be provided in the following locations:
 - a. As indicated on plans.

2.4 RECTANGULAR DUCT (DUAL WALL)

A. Duct:

1. Dual wall shall be:
 - a. Indoor supply and return: 2"
 - b. Outdoor supply: 3"

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c. Outdoor return: 2"

B. Materials:

1. Outer wall galvanized (indoor)
2. Outer wall stainless steel (outdoor)
3. Inner wall galvanized

C. Fittings:

1. Fittings shall be constructed similar to fittings specified for single wall duct except that they shall be dual wall.

D. Liner:

1. Fittings shall have solid liner.
2. Dual wall duct shall have (perforated liner) (solid liner).

E. Insulation:

1. Insulation shall be .27K @ 75 degrees F.
2. Insulation shall be thickness of the dual wall.
3. A 1 mil (min.) polyester film shall be provided between the fiberglass insulation and airstream to prevent fibers from contacting the airstream where perforated liners are provided.
4. The insulation and film shall have a flame and smoke spread of less than 25/50.

F. Location:

1. Dual wall duct shall be provided in the following locations:
 - a. As indicated on plans.

2.5 DUST COLLECTION SYSTEM

- A. All duct accessories and supports used for dust collection systems, rectangular and round, shall be 14-gauge type 304L stainless steel.
- B. Exterior joints shall be heliarc welded, grounded, and polished to match the finish on the duct.
- C. Fittings to make connections to duct or equipment shall be custom-made to meet field conditions.
- D. Provide stainless steel flanges to terminate duct or to connect to source capture duct.
- E. Stainless steel ducts shall be used on the following systems:

2.6 EXPOSED DUCT

- A. All exposed galvanized duct (in non mechanical room spaces) shall be factory or shop paint grip duct.

2.7 LOW PRESSURE RUNOUTS

- A. Where concealed, single wall, low pressure runout ducts are indicated, they may be snap lock duct provided all of the following conditions are met:
1. Ducts 12" round or 12" x 12" and smaller.
 2. Runout to a single air distribution device.
 3. Less than 15 feet in length.
 4. No other specific type of duct is specified.
 5. Duct shall be 26 gauge minimum.
 6. Snap lock duct free area is equal to or greater than duct specified.
 7. Duct does not run through a wall or partition.
 8. Duct is not exposed.

2.8 ROUND DUCT FITTINGS (FOR EXPOSED DUCTS)

- A. General:
1. Exposed ducts shall have gasket fittings.
 2. Seal shall be a triple lipped EPDM rubber gasket.
 3. The finish shall match the round duct.
- B. Gasket:
1. SMACNA Class 3 leakage for -2" WG to +10"WG
 2. Temperature rating from -20 degrees F to 212 degrees F
 3. Smoke and flame spread rating of 0/0 per ASTM E84

2.9 GRILLE BOXES (FOR EXPOSED DUCTS)

- A. General:
1. Grille boxes shall be suitable for approved grille and size to be minimum size of the overall grille dimension.
 2. Grille boxes shall be factory installed on the duct.
 3. Grille boxes shall match the duct finish.
 4. Spacing of supports shall be no greater than specified for duct supports or as indicated on plans, whichever is less.

PART 3 - EXECUTION

3.1 ROUND AND FLAT OVAL DUCT

- A. Submittals shall include:
1. Duct gauges and general construction
 2. Fitting gauges and general construction
 3. Liner gauges and general construction
 4. Friction loss
 5. Sound attenuation of straight duct sections
 6. Thermal conductivity factors defining the insulation characteristics

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3.2 EXPOSED DUCT

- A. Prepare exposed duct as recommended by the paint manufacturer for field painting in the following locations:

3.3 PLENUMS

- A. Fabricate plenums connecting to louvers only after review of acceptable louver shop drawings.
- B. Fabricate plenums connecting to equipment only after review of acceptable equipment shop drawings.
- C. Fabricate plenums connecting to existing louvers only after field verification of existing louver size.

3.4 DUCT DRAWINGS

- A. Provide 1/4" scale CADD drawings indicating layout of all dual wall duct.
- B. Where new duct ties into existing duct, existing duct must also be shown based upon field verified dimensions.

3.5 WELDED DUCTS

- A. All joints shall be electro welded by the heliarc process unless noted otherwise.
- B. Joints shall be free from cracks and shall be smooth and flush without the use of solder or other types of filler.
- C. All exterior welds shall be ground and polished without burrs and projections. Where exposed, weld to have a number 4 commercial finish.
- D. Interior joints of prechloric acid or radioisotope hoods shall be ground smooth similar to exterior duct weld. Weld shall not have pits.
- E. Provide submittal including all materials, welding equipment and supplies, and welder qualifications.

3.6 SUBMITTALS

- A. Provide a list of all duct materials and systems in which they are to be installed for the entire project.

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3.7 CUTTING DUCTS

- A. Ducts shall be cut with a handheld plasma cutter whenever practical. This shall include, but not be limited to, cutting openings for access doors, duct taps, cutting into existing ducts, and similar applications.

3.8 ROUND DUCT FITTINGS (FOR EXPOSED DUCT)

- A. Secure fittings per SMACNA requirements or #10 TEK screw minimum.

END OF SECTION

SECTION 23 33 00 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor and materials and perform all installation of duct accessories and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS:

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 3112 - Mechanical Duct

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. Duct accessories shall be fabricated and installed in accordance with the manufacturer's recommendations and meet or exceed the standards and procedures (latest editions) of the following:
 - a. UL Standard 214 for Fire Retardancy
 - b. NFPA 90A and 90B
 - c. SMACNA
 - d. ASTM E84
 - e. AMCA Standard 500
2. Duct accessories shall have AMCA Certified Rating Seal when specified.

B. Manufacturers:

1. The following flexible duct connector manufacturers are acceptable:
 - a. Ventfabrics
 - b. Ductmate
 - c. Approved Equal
2. The following test cap manufacturers are acceptable:
 - a. Ventlok
 - b. Approved equal
3. The following strap hanger clamp manufacturers are acceptable (for use where seismic restraints are not required):
 - a. Caddy
 - b. Approved equal

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PART 2 - PRODUCTS

2.1 FLEXIBLE CONNECTORS

A. General:

1. Flexible connectors shall consist of two strips of 24-gauge metal and a coated fabric.
2. Fabric used in indoor applications shall meet NFPA 90A and 90B.
3. Fabrics shall meet NFPA 701.
4. Connectors shall be unaffected by mildew, resistant to weather and have a fire-retardant coating on a noncombustible fabric.
5. Connector shall be suitable for -40-degree F to 180-degree F.
6. Where duct has roll formed mating flange, metal strips shall be roll formed.

B. Indoor Applications:

1. Characteristics:
 - a. Fabric: glass cloth
 - b. Weight: 30 ± 2 oz/sq. yd.
 - c. Tongue Tear: 40/30 lbs.
 - d. Tensile Strength: 395/255 lbs.
2. Metal strips shall be galvanized or aluminum.
3. Metal strips shall be 3" minimum, and fabric shall be 5" minimum.
4. Basis of design manufacturer shall be:
 - a. DuctMate Proflex Neoprene

C. Locations:

1. Inlet and outlet of each duct at all equipment with a fan except grease exhaust fans.
2. Outlet of nonfan powered terminal units where required by seismic design.
3. Other locations where indicated.

2.2 DUCT ACCESS DOORS (LOW PRESSURE)

- A. Low pressure access doors shall be provided in duct systems with static pressures up to 2 inches W.G. and for velocities up to 2400 FPM except where low leak duct access doors are required.
- B. Frame and door shall be 20-gauge galvanized steel in galvanized duct (and stainless steel in stainless duct). Door shall be dual wall with 1/2" insulation minimum.
- C. Door shall be removable cam type with two cams for doors less than 16" and four cams for door 16" and larger.
- D. Polyurethane foam seals shall be provided between frame and duct and between door and frame.

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2.3 AIRFLOW TEST CAPS

- A. Provide 304L stainless steel test ports and cap on each main fume exhaust duct and each runout to a fume hood, equipment or grille in the fume exhaust system where airflow cannot easily or accurately be measured at the equipment or device.

2.4 STRAP HANGER CLAMPS

- A. This product is acceptable only where seismic restraints of duct are not required.
- B. Duct straps shall be attached to steel beam, joist structure, or purlins by means of a manufactured product.
- C. Basis of design clamps shall be:
 - 1. CADDY Strap Hanger Clamps or similar

PART 3 - EXECUTION

3.1 FLEXIBLE DUCT CONNECTORS

- A. Installed length of material shall be 50% flat length.

3.2 AIR FLOW TEST CAP

- A. Coordinate with Test and Balance Agency the required location for each test port.
- B. If duct surface is not flat or test port is not available in the duct radius, weld a test port extension to the duct.

END OF SECTION

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SECTION 23 33 13 - DAMPERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, and perform all operations in connection with the installation of dampers and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. All sections of Division 23 Specifications apply to this section. In addition, refer to these specification sections:
 - 1. Section 23 3112 - Mechanical Duct

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Dampers and appurtenances shall be fabricated and installed in accordance with the manufacturer's recommendations and meet or exceed the standards and procedures (latest editions) of the following:
 - a. UL Standard 555, 555S (smoke), and 555C (ceilings)
 - b. NFPA 90A
 - c. AMCA Standard 500
 - d. SMACNA Standards
- B. Manufacturers:
 - 1. The following balancing damper manufacturers are acceptable:
 - a. Ruskin
 - b. Air Balance, Inc.
 - c. Nailor-Hart
 - d. Louvers and Dampers, Inc.
 - e. NCA
 - f. Airline Products
 - g. Arrow
 - h. Leader Industries
 - i. Pottorff
 - j. United Enertech
 - 2. The following positive locking damper manufacturers are acceptable:
 - a. Rossi
 - b. Ventfabrics
 - c. Durodyne

PART 2 - PRODUCTS

2.1 BALANCING DAMPERS

A. General:

1. Bolts, screws or rivets shall not be used in construction of damper assembly.
2. Damper shall be opposed to blade for dampers 14 inches and higher.
3. Bearings shall be non-corrosive, non-stick type and shall be molded synthetic Cyclooy 800, stainless steel, or Zytel.
4. Damper manufacturer shall provide a complete damper assembly including linkage for connection to actuator, mullions, and jack shafts.
5. All dampers with shafts extending through the ducts with exterior insulation shall have 2-inch standoff brackets or shaft extensions.

B. Materials:

1. Dampers material shall match the duct material in which it is installed unless noted or specified otherwise.

C. Positive Locking Damper Mechanism:

1. The damper mechanism for all manual dampers shall lock the damper in position.
2. The locking mechanism shall not release the damper position due to vibration. Wing nuts are not acceptable.
3. Basis of design manufacturer:
 - a. Rossi Everlock Damper Handle

D. Manual Dampers:

1. Low Pressure (Rectangular):
 - a. Frame shall be 5" x 1" x 16 gage galvanized steel channel. Blades shall be 8" wide, maximum, 16 gage galvanized steel.
 - b. Dampers 36" W x 12" H and smaller shall have a frame 3" x 22 gauge and 22-gauge blades.
 - c. Basis of design manual balance dampers manufacturer:
 - 1) Ruskin MD15
2. Low Pressure (Round):
 - a. Frame shall be 20 gage galvanized steel, 7 inches in length, minimum. Blades shall be 20 gage.
 - b. Maximum velocity shall be 1500 FPM.
 - c. This damper shall not be required in flex runouts except where concealed regulators required.
 - d. Basis of design low pressure manual balancing damper (round) manufacturer:
 - 1) Ruskin MDRS25
3. Medium Pressure (Round and Oval):
 - a. Frame and blades shall be galvanized steel construction. Frame shall be minimum 14 gage for dampers with largest dimensions under 24 inches. Dampers with any dimension greater than 24 inches shall be 3/16" steel. Blades up to 18 inches shall be 12 gage. Blades greater than 18 inches shall be 10 gage.
 - b. Maximum pressure differential shall be 4 inches W.G.
 - c. Basis of design medium pressure manual balance dampers (round) manufacturer:

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- 1) Ruskin CDR25
- d. Basis of design medium pressure manual balance dampers (oval) manufacturer:
 - 1) Ruskin CDO25

PART 3 - EXECUTION

3.1 SUBMITTALS

A. Fire and Smoke Dampers:

1. Indicate system static pressure and damper dynamic rating (static pressure and airflow) for airflow direction required.

3.2 BALANCE DAMPERS:

A. General:

1. Dampers shall be installed with blades horizontal unless shown otherwise on drawings. Manufacturer shall provide proper damper for installation in non-horizontal ducts.
2. Dampers shall be installed square and without racking. Damper installations shall not allow twisting, torquing or distortion. Provide proper clearances for operation of damper blades.

B. Installation:

1. Multiple damper sections shall be braced at every horizontal mullion and braced 8 feet O.C., maximum, vertically.
2. Damper actuator shall be installed on duct or fixed structure. Mounting on gypsum walls or similar structures is not permitted.
3. Join multiple damper assemblies or fasten damper to duct with Number 10 screws, or 1/2" long welds staggered on both sides 8" on center and maximum of 2" from damper corner or end of joining section. Screws shall not impede performance of the blade seals.

END OF SECTION

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SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of air terminal units and appurtenances where shown on the drawing and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. AMCA 300 - Certified Ratings for Sound and Airflow
 - b. AMCA 210 - Test Code for Air Moving Devices
 - c. Insulation - NFPA 90A and UL 181

B. Manufacturers:

1. The following variable and constant volume air terminal manufacturers are acceptable:
 - a. Trane
 - b. Tempmaster
 - c. Envirotec
 - d. Metal Aire
 - e. JCI
 - f. EH Price
 - g. Nailor
 - h. Titus
 - i. Warren

PART 2 - PRODUCTS

2.1 VARIABLE AND CONSTANT VOLUME AIR TERMINALS

A. General:

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1. Provide single duct terminal units with capacities as scheduled on drawings.
- B. Construction:
 1. Terminals shall be constructed of 22-gauge zinc coated steel casings.
 2. Insulation characteristics:
 - a. Insulation shall have an R value of 3.5 minimum.
 - b. Rigid fiberglass insulation shall be 2.0# density minimum.
 - c. Closed cell insulation shall be 4# density.
 3. Insulation shall be one of the following:
 - a. Closed cell insulation.
 - b. Aluminum foil faced rigid fiberglass with taped edges.
 - c. Metal liner (dual wall). Internal insulation shall be rigid fiberglass insulation or closed cell type.
 4. Terminals shall be complete with inlet and outlet collars.
- C. Electrical:
 1. Electric heater disconnect with fuse
 2. Control power transformer
- D. Heating:
 1. Heaters shall be listed by the manufacturer as an SCR heater.
- E. Accessories:
 1. Air flow switch
 2. Factory hanger brackets

PART 3 - EXECUTION

3.1 VARIABLE AND CONSTANT VOLUME AIR TERMINALS

- A. Shop drawing submittals shall include sound ratings on all boxes. Submit data on 2nd through 7th octave bands based upon 2" W.G. and specified maximum CFM.
- B. Orders for equipment shall not be processed by the manufacturer until the contractor verifies LH/RH configuration based upon contractor coordination drawings.

3.2 TERMINAL UNIT CONTROLS

- A. The variable and constant volume air terminal unit manufacturer shall factory install the DDC controller furnished by the control vendor. The control vendor shall be responsible for shipping the controllers to the location required by the air terminal unit vendor.

3.3 SUBMITTALS

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- A. If a field installed filter rack is provided, submit the filter rack shop drawing.
- B. Based upon duct coordination drawings, the contractor shall submit shop drawings indicating left hand or right-hand configuration to provide maximum clearance to control and power panels.

END OF SECTION

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SECTION 23 37 13 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of air distribution equipment and appurtenances where shown on the drawing and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. AMCA 300 - Certified Ratings for Sound and Airflow
 - b. AMCA 210 - Test Code for Air Moving Devices
 - c. Insulation - NFPA 90A and UL 181
 - d. NAAMM Metal Finishes Manual

B. Manufacturers:

1. The following air distribution manufacturers are acceptable:
 - a. Krueger
 - b. Metal Aire
 - c. J and J Register
 - d. Titus
 - e. Carnes
 - f. Tuttle and Bailey
 - g. E.H. Price
 - h. Nailor

PART 2 - PRODUCTS

2.1 AIR DISTRIBUTION UNITS (GENERAL)

A. General:

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1. Furnish and install where shown on the plans, air distribution units in accordance with the air distribution schedules on the drawings and as specified hereinafter.
2. Return air and exhaust air units in same space with supply shall match supply in style and type.
3. All supply, return, and exhaust air units shall be provided with opposed blade volume damper. Where return grilles are not ducted, the damper may be omitted.
4. Provide round to square adapter for flex duct connecting to square neck.
5. All supply air distribution units not installed in return air stream shall have factory installed insulation with FSK vapor barrier on all surfaces above conditioned space. Insulation shall be 1-1/2" minimum, and all edges sealed with duct tape to the grille.

B. Material:

1. General purpose use: steel or aluminum unless other material indicated.
2. Shower areas, drying areas, lockers, janitor rooms, group toilets, kitchens, mechanical spaces, utility spaces, and similar spaces subject to high humidity: aluminum.
3. Fire rated assemblies: steel.
4. Special applications as noted or indicated on schedules.

C. Finish:

1. All air distribution units shall be furnished with manufacturer's standard off-white baked enamel finish unless specifically noted otherwise on plans or in specifications.
2. Finish on bar grilles shall be (anodized aluminum) (dark bronze) (white) unless specifically noted otherwise on plans or in specifications.

D. Frame Style:

1. Frame style shall be suitable for surface in which air distribution unit is to be installed. Manufacturers or contractor shall provide all accessories such as plaster rings, etc., as necessary for a complete, finished installation.
2. Air distribution units shall typically be supplied with frame style as follows:
 - a. Units installed in sheetrock, plaster, or other hard finish shall have surface mounted frame style or plaster rings.
 - b. Units installed in acoustical ceilings shall have frame style to match ceiling system type.

2.2 ACOUSTICAL CEILING UNITS (LOUVERED FACE)

- A. Acoustical ceiling air distribution units shall have a louvered face with frame style compatible with ceiling type. Throw shall be 4 way unless other throws indicated.
- B. Surface mounted units shall have a panel face equal or less than the duct connection dimension plus 7".
- C. Lay-in ceiling units shall be nominal 24" x 24" with 18" x 18" (min.) louver face unless specified otherwise.
- D. Faceplate shall be removable from the frame with concealed hinges and latches.

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2.3 HARD OR MONOLITHIC CEILING UNITS (LOUVERED FACE)

- A. Hard or monolithic ceiling air distribution units shall have a louvered face as scheduled with surface mount frame style. Throw shall be 4 way unless other throws indicated.
- B. Surface mounted units shall have maximum dimensions as follows:
 - 1. Space required for installation - maximum of duct connection dimension plus 4".
 - 2. Panel face - maximum of duct connection dimension plus 7".
- C. Faceplates shall be removable from frame with concealed hinges and latches.

2.4 ACOUSTICAL CEILING UNITS (PLAQUE DIFFUSERS)

- A. Acoustical ceiling air distribution units shall be plaque diffusers with 360-degree radial diffusion and removable face panel.
- B. Face panel shall have smooth edges and rounded corners.
- C. Back cone shall be one piece without corner joints.
- D. Frame style shall be compatible with ceiling type.
- E. Surface mounted panels shall be 12" x 12" for 8" round or 8" x 8" neck sizes and smaller.
- F. Unit for lay-in ceiling shall be 24" x 24" unless specified otherwise.

2.5 HARD OR MONOLITH CEILING UNITS (PLAQUE DIFFUSERS)

- A. Hard or monolithic ceiling air distribution units shall be plaque diffusers with 360-degree radial diffusion and removable face panel.
- B. Face panel shall have smooth edges and rounded corners.
- C. Back cone shall be one piece without corner joints.
- D. Frame style shall be compatible with ceiling type.
- E. Surface mounted panels shall be 12" x 12" for 8" round or 8" x 8" neck sizes and smaller.

2.6 SIDE WALL UNITS

- A. Side wall air distribution units shall have a removable-reversible four position louvered core, closely spaced horizontal face deflecting vanes, and vertical rear deflecting vanes individually adjustable.
- B. Vanes shall be 14 gauge.

2.7 DRUM LOUVERS

- A. Drum louver shall be heavy gauge aluminum construction suitable for mounting directly to round spiral duct without the use of transitions or taps.
- B. Drum rotation shall be 25 degrees (min.) either side of the louver centerline.
- C. Louver vanes shall be spaced at three (3) inches (max.).
- D. Accessories include:
 - 1. Mounting screws
 - 2. Gasket
 - 3. Damper

2.8 DIFFUSERS FOR ROUND DUCT:

- A. Grilles shall be designed to be installed directly on round spiral duct.
- B. Grille shall be curved to match the radius of the round duct.
- C. Adjustable blades with 3/4" spacing.
- D. Construction:
 - 1. Aluminum
 - 2. .03" minimum blade thickness
 - 3. .05" minimum frame thickness with countersunk holes
- E. Accessories:
 - 1. Curved end caps
 - 2. Foam gasket

2.9 PERFORATED DIFFUSERS

- A. Perforated grilles shall have blades located in the neck of the unit.
- B. Blades shall have adjustable 2, 3, or 4-way ceiling pattern, with high anti-smudge characteristics and center aspiration.

PART 3 - EXECUTION

3.1 AIR DISTRIBUTION UNIT

- A. Adjust operable deflection vanes to 30 degrees.
- B. All plenums and duct visible thru face of air distribution units and bar grilles shall be painted flat black.

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- C. See DAMPERS specifications for additional requirements.
- D. Add mastic to duct tape on insulated grilles.

END OF SECTION

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SECTION 23 37 14 - AIR DISTRIBUTION SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of air distribution specialties equipment and appurtenances where shown on the drawing and specified hereinafter.

B. Description:

1. The full extent of operating room and laboratory diffusers shall be coordinated with architectural reflected ceiling plan.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the Standards and procedures of the following as referenced (latest editions):
 - a. AMCA Certified Ratings for Sound and Airflow
 - b. AMCA 210 - Test Code for Air Moving Devices
 - c. Insulation - NFPA 90A and UL 181
 - d. ASHRAE 52 Test Standard for Filter Efficiencies
 - e. UL Standard 900 for Filter Flame and Smoke Rating
 - f. NAAMM Metal Finishes Manual

B. Manufacturers:

1. The following dust collector manufacturers are acceptable:
 - a. Provent
 - b. Torit-Day
 - c. Car-Mon
 - d. Approved Equal

PART 2 - PRODUCTS

2.1 DUST COLLECTOR (CYCLONE TYPE)

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A. General:

1. Dust collector shall be cyclone type constructed of 16-gauge steel.
2. Efficiency shall be 99% for steel grindings and sawdust and 94% for baking flour by weight.

B. Fan:

1. Motor shall be end mounted and shall be adjustable at 45-degree intervals.
2. Motor shall be rated for industrial duty.

C. Inlet:

1. Inlet shall be adjustable at 90-degree intervals.

D. Accessories:

1. Support stand
2. 55 Gallon collection drum
3. Weatherproof cover

E. Duct System:

1. Duct shall be welded steel. Prime and paint.
2. Flexible hose shall be:
 - a. Torit flexible metal hose
3. Dust collection fitting shall be custom designed for each piece of equipment and shall be similar in construction to:
 - a. Torit Dust Nozzle. Attach fitting to each piece of equipment.
4. Cutouts shall be:
 - a. Torit
 - b. Car-Mon BG

F. Submittals:

1. Include duct and equipment layout, fittings and accessories, and attachment detail to equipment.

2.2 SOURCE CAPTIVE (POINT OF USE) EXHAUST SYSTEM (TYPE 1 - GENERAL PURPOSE)

A. General:

1. System provided shall be suitable for corrosive fume and dust collection. System shall include flexible hose and support, fan (where specified or scheduled), hood, and mounting supports.
2. System shall be capable of 360-degree rotation.

B. Hose and Support:

1. Arms, hoods, and accessories shall be 304L stainless steel.
2. Ceiling support frame where exposed shall be 304L stainless steel. Frames shall be suitable for welding to field installed support angles.
3. Positioning system shall utilize any of the following:
 - a. Gas cylinder and tension discs

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- b. Spring loaded, ball bearing friction joint
 - 4. Hose shall be constructed of a neoprene coated fiberglass cover, corrosion resistant spring steel helix neoprene coated fiberglass cord and a liner of coated fiberglass fabric.
 - 5. Hose shall meet UL 94V-0 flame rating and be suitable for -65 degrees F. to 250 degrees F. (continuous).
- C. Fan:
 - 1. Fan shall be suitable for installation in ceiling position.
 - 2. Entire fan assembly shall have an epoxy coating. See special Coating specifications.
- D. Accessories:
 - 1. Provide 304L stainless steel fume receptor with (18" x 24" inlet).
- E. Source Captive shall be:
 - 1. Ammerman PosiLock Flex-O-Way
 - 2. Carmon Series EX

PART 3 - EXECUTION

3.1 SOURCE CAPTIVE (POINT OF USE) EXHAUST SYSTEM:

- A. Coordination:
 - 1. Contractor shall prepare shop drawings indicating exact hose drop location and maximum hose radius at 2 feet above floor and 4 feet above floor.
 - 2. Contractor shall adjust location, if indicated, on reviewed shop drawings.
- B. Install:
 - 1. Provide support frame system to support system as high as practical in areas without ceilings.
 - 2. Provide support frame system to support system at ceiling line or as indicated on plans or details in areas with ceilings.
 - 3. Attach support frame system to structure for a rigid installation.

END OF SECTION

SECTION 23 41 00 - PARTICULATE AIR FILTRATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of air distribution equipment and appurtenances where shown on the drawing and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section.

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. AMCA 300 - Certified Ratings for Sound and Airflow
 - b. AMCA 210 - Test Code for Air Moving Devices
 - c. Insulation - NFPA 90A and UL 181
 - d. ASHRAE 52 Test Standard for filter efficiencies
 - e. UL Standard 900 for filter flame and smoke rating
 - f. Institute of Environmental Services Standard IES-RP-CC-DDI-86 for HEPA filters

B. Manufacturers:

1. The following filter manufacturers are acceptable:
 - a. Camfil Farr
 - b. American Air Filter
 - c. Airguard
 - d. Flanders Precisionaire
 - e. Glasfloss
 - f. Airflow, Inc.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Equipment with filters 4" or less in depth requires the following filters:

1. First set shall be installed before initial start-up.
2. Second set shall be installed for testing and balancing.
3. Third set shall be turned over to the Owner at final inspection.

2.2 TWO INCH (2") PLEATED PANEL FILTERS

A. MERV 13A Filters:

1. Panel filters shall be flat throwaway type constructed of high strength moisture resistant board forming a double wall around the filter media.
2. A metal support grid is bonded to the leaving air side of the pleated media.
3. The filters shall be UL Class 2 approved and listed.
4. Filter shall have a maximum initial pressure drop of 0.41 inches WG at 500 FPM and 15 pleats per linear foot for 2-inch filters.
5. Filter shall not have an electrostatically enhanced media.
6. Filter media and frame shall be from 100% recyclable material.

2.3 TEMPORARY FILTERS

- A. During start-up, preliminary testing of system, operation of system prior to system being ready for testing and balancing, or operation of a system prior to final building cleaning, the contractor shall protect all equipment, coils, and the entire duct system with filters.
- B. Filters shall be MERV 8 minimum and contain an antimicrobial biocide to control the growth of mold, mildew, algae, and fungi on the filters (i.e., fibers shall not support microbial growth). Biocide shall not offgas, migrate, or leach into the airstream.
- C. Basis of design filter shall be:
 1. Fiberbond Dustlok

2.4 EQUIPMENT REQUIREMENTS

- A. Filters shall be provided on all equipment to protect heat transfer components from outside air, building exhaust air or other airstreams that would foul heat transfer surfaces.
- B. Where no other filtration is indicated or scheduled, air handling equipment shall have a 2" pleated panel filter. The 2" filter shall be MERV 13A.

PART 3 - EXECUTION

3.1 TEMPORARY FILTERS

- A. The contractor shall install temporary filter media on all negative pressure openings if the system is to be operated prior to the final cleaning of all spaces served by a system. These openings include open return ducts, exhaust ducts, and grilles. All filters shall be replaced as often as necessary.

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- B. All temporary filters shall be held securely in place and with minimum bypass. Filters shall be changed as needed.
- C. Systems shall not be operated without filters equaled to specified filters in place to protect coils and other heat exchanger devices.

END OF SECTION

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SECTION 23 90 05 - HEAT TRANSFER (ELECTRIC COOLING)

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of heat transfer equipment and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.
- B. All sections of Division 23 specifications apply to this section. In addition, refer to these specification sections:
 1. Section 23 0502 - Common HVAC Materials

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All work shall meet or exceed the standards and procedures of the following as referenced (latest editions):
 - a. ARI Standards 210/240, 340, and 360
 - b. ANSI Z21.47/UL - Unitary Air Conditioning Standard for Safety Requirements
 - c. Underwriter's Laboratory
 - d. NFPA 90A
 - e. AMCA 210 Test Code For Air Moving Devices
 - f. National Electrical Code
 - g. ASHRAE 15 - Safety Code for Mechanical Refrigeration
- B. All motors and equipment shall be U.L. labeled.
- C. All insulation and materials shall have a flame spread rating of less than 25 and smoke developed of less than 50.
- D. All heating and cooling equipment shall bear the ARI seal.
- E. All coils shall be ARI certified.
- F. All electric heaters shall have impedance protection per UL519.
- G. Burner assembly, including the gas train, shall be FM and IRM approved.

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- H. All outdoor cabinets shall meet or exceed the 500-hour salt spray test unless more stringent tests are specified.
- I. Manufacturers:
 - 1. The following single zone VAV packaged heating and cooling unit manufacturers (with hot gas reheat) are acceptable:
 - a. Trane
 - b. Daikin
 - c. JCI
 - d. AAON
 - e. Valent
 - f. Addison

PART 2 - PRODUCTS

2.1 GENERAL

A. General:

- 1. Equipment shall meet or exceed the scheduled efficiencies or ASHRAE 90.1, whichever is greater.
- 2. Furnish and install heating and cooling units in accordance with the drawings and as specified hereinafter.
- 3. Units shall be air conditioning or heat pump as shown on equipment schedules.
- 4. Unit shall be factory assembled and tested.
- 5. Standard operating range for cooling shall be 55°F to 120°F outdoor ambient except where low ambient controls are required. See equipment schedule.
- 6. Provide all controls and accessories for a complete operating system including but not limited to:
 - a. Crank case heater
 - b. Start capacitor kit (single phase condensers)
- 7. Refrigerant shall be R410A.
- 8. Motors shall be premium efficiency.

B. Outdoor Cabinets:

- 1. Unit shall be designed for outdoor installation.
- 2. Cabinet shall be insulated and constructed of heavy duty galvanized steel. Frame and panels shall be 18 gauge minimum. They shall be zinc coated or epoxy coated with a baked-on finish.
- 3. Prewired control panel.
- 4. Hinged access doors with quick release handles shall be provided as follows:
 - a. On all access sections on units 3 tons and larger.
 - b. On filter sections for all units smaller than 3 tons.
- 5. Single wall cabinets shall be thermally and acoustically insulated with a minimum of R4 fiber insulation. Provide a foil, sprayed neoprene, or mat faced finish.
- 6. Dual wall cabinets shall be finished with a baked acrylic finish.

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C. Refrigerant Circuits:

1. All units shall have factory installed liquid line filter dryer, liquid line sight glass, pressure tap ports, check valves, and suction and liquid service valves.
2. Heat pump units shall also have reversing valve, suction line accumulator, and discharge muffler.
3. Where low ambient control is required, electronic head pressure control shall be provided.

D. Compressors (up to 7 tons):

1. Compressor shall have centrifugal oil pump.
2. Motor shall have internal temperature and current sensing motor.
3. Compressor shall have totally dipped hermetic motor windings.
4. Compressor shall be resiliently mounted and seismically isolated.

E. Compressors (7-1/2 tons to 30 tons):

1. Compressors shall have centrifugal oil pumps.
2. Motor shall be suction gas-cooled with internal temperature and current sensing motor overloads.
3. External high and low pressure cutout devices shall be provided.
4. Compressor shall be resiliently mounted and seismically isolated.
5. Minimum of two compressors for units larger than 120 MBH (nominal capacity).

F. Outdoor Coil:

1. The outdoor coil shall be constructed of aluminum spine fin mechanical bonded to seamless aluminum or copper tubing with all joints brazed.
2. Surface shall be engineered to facilitate defrost water runoff.
3. Louvered panels.

G. Indoor Coil:

1. The indoor coil shall be constructed of aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed.
2. Coil shall include factory installed refrigerant metering device and refrigerant line fittings.

H. Outdoor Fans:

1. Fan motors shall be permanently lubricated, weatherproof motors suitable for outdoor use.
2. Motor shall have built-in current and thermal overload protection.
3. Fans shall be resiliently mounted and seismically isolated.
4. Fans shall be statically and dynamically balanced.
5. Provide PVC coated fan guard.

I. Indoor Fan:

1. Indoor fan shall be direct drive plenum fan with ECM motor and speed adjustment feature or inverter duty motor with a variable frequency drive.
2. Fan shall be seismically isolated.
3. The fan shall be mounted on spring isolators with a minimum 1" deflection.

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J. Safeties:

1. Heat pumps shall have a solid state defrost control. Defrost shall occur only when coil saturated suction temperature indicates freezing temperatures. Defrosting shall be limited to a maximum of 10 minutes over a 90 minute period.
2. Provide a time-guard device to prevent compressor recycling by requiring a 5-minute delay before restarting.
3. Three phase protection.
4. Drain pan float switch.

K. Electrical (Outdoor Unit):

1. Provide control voltage transformer.
2. Provide an unswitched GFI service receptacle on all three phase outdoor units. Receptacles shall have metal covers.
3. Provide transformer for motor or heaters as required.
4. Transformers shall be factory mounted and wired.
5. Power to the packaged unit shall be through the interior of the unit curb.

L. Electric Heaters:

1. Heaters shall have a total output as scheduled on drawings.
2. Each heater assembly shall include power supply fusing if over 48 amps, automatic resetting limit switches and heat limiters for thermal protection.
3. Heaters shall be provided with polarized plug for quick connection to unit low voltage wiring.
4. Electric heaters factory furnished and installed capacity not to exceed scheduled capacity at rated voltage.
5. If larger heaters are supplied, they shall not be large enough to require larger supply wiring or disconnects.
6. Heaters shall have SCR control except where staged heaters are scheduled.

M. Refrigerant Circuit (Units with Hot Gas Reheat):

1. Provide full modulating control of hot gas reheat.
2. Reheat control shall maintain space setpoint to ± 2 degrees F.
3. Discharge air temperature shall be adjustable from the building automation control system.

N. Energy Recovery (Units with Heat Wheels):

1. Heat wheel shall be installed in a rigid frame with wheel motor drive, drive belt, wheel seals and bearing.
2. Energy recovery option shall include exhaust fan with adjustable belt drive, backdraft damper and 2" throwaway filters.
3. Wheel shall be constructed of a lightweight polymer with permanently bonded desiccant coating, wheel shall be total energy wheel.

O. Drain Pan:

1. Provide dual slope insulated noncorrosive drain pan.

P. Filters:

1. Provide flat filter rack for 2-inch pre filter.

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2. Where additional filters are specified, additional filter racks shall be provided for the additional filters.

Q. Outside Air Intake:

1. Provide outside air intake hoods with birdscreen when outside is specified directly from outdoors.
2. Settable low leak, motorized, outside air dampers.
3. See Instrumentation and Control for HVAC specification for airflow measuring requirements.

R. Provide BACnet communication card on all equipment.

S. Controls:

1. The unit shall be provided with digital controls to provide the specified sequence of operation. See the Sequence of Operations specification.
2. Space temperature and humidity sensors shall be capable of controlling the unit in cooling, heating, and dehumidification modes.
3. The space sensor shall have an override button.
4. The unit controller shall have a built-in schedule maintained in non-volatile memory. As a minimum, the schedule shall include:
 - a. 16 holidays up to 5 days each.
 - b. One start/stop per day.
5. The unit controller shall provide as a minimum:
 - a. Space cooling setpoint
 - b. Space heating setpoint
 - c. Space humidity setpoint
 - d. Supply air reheat setpoint

2.2 PACKAGED OUTSIDE AIR DEHUMIDIFICATION UNITS

A. Unit:

1. Unit shall be dual wall construction.

B. Compressors:

1. Units over 7-1/2 tons shall have a minimum of 2 compressors.
2. At least one compressor in each unit shall be a variable speed compressor.

C. Hot Gas Reheat:

1. Hot gas reheat coil with full modulation.

D. Units with Recirculation Mode:

1. Units shall have a recirculation damper that allows the unit to operate in 100% recirculation mode (i.e., zero outside air).

E. Controls:

1. Controls shall be factory mounted to provide the sequence of operation required.

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2. Fan airflow measuring station.

F. Electrical:

1. Factory mounted circuit breaker.

PART 3 - EXECUTION

3.1 CONDENSATE DRAIN LINES

A. Provide a weather seal grommet where drain penetrates casing and wall sleeve.

3.2 WARRANTY

A. Compressors shall have five (5) year parts and labor warranty:

B. Compressor Failure:

1. When a compressor fails within the warranty period, the compressor shall be replaced.
2. If the system has multiple compressors on a single refrigerant circuit, and one compressor fails, all compressors shall be replaced during the warranty period.

END OF SECTION

SECTION 26 05 00 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL CONDITIONS

1.1 WORK INCLUDED

- A. The work covered under these sections of the specifications consists of furnishing all labor, equipment, supplies and materials, and of performing all operations, including cutting, channeling, chasing, excavating and backfilling necessary for the installation of complete wiring systems, raceways, wiring, and electrical equipment in accordance with this section of the specifications and the accompanying drawings.
- B. The Electrical Work shall include, but not be limited to, the following:
 - 1. Electrical distribution system
 - 2. Wiring devices
 - 3. Raceway systems
 - 4. Conductors and cables
 - 5. Lighting and lighting controls
 - 6. Electrical work associated with Fire alarm system.

1.2 RELATED WORK

- A. Related work to Division 26:
 - 1. Division 1
 - 2. The provisions, conditions, and requirements preceding and including general and supplemental conditions apply to and are a part of Divisions 26, 27 and 28.

1.3 DEFINITIONS

- A. Provide: Furnish and install completely ready for use, including all accessories required for operation.
- B. Furnish: Purchase and deliver to the project site complete with every necessary appurtenance, support and accessories required for operation.
- C. Install: Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project.

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1.4 DESCRIPTION OF SYSTEMS

- A. Furnish and install all materials for systems, resulting upon completion, in functioning systems in compliance with performance requirements specified. The omission of express reference to any parts necessary for or reasonably incidental to a complete installation shall not be construed as a release from furnishing such parts.
- B. The wiring specified and shown on the drawings is for complete and workable systems. Any deviations from the wiring shown due to a particular manufacturer's requirements shall be made at no cost to either the contract or to the Owner. Changes in electrical service to equipment due to substitutions of equipment by any Divisions of this specification shall be at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. All equipment and materials required for installation under these specifications shall be new and without blemish or defect. All equipment shall bear labels attesting to Underwriters Laboratories approval where subject to Underwriters Laboratories label service.
- B. Equipment and material which are not covered by UL Standard will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe will be considered, if inspected or tested in accordance with national industrial standards, such as NEMA, ICEA or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- C. All equipment of one type (such as panelboards, breakers, etc.) shall be the products of one manufacturer.

1.6 REQUIREMENTS OF REGULATORY AGENCIES/CODE COMPLIANCE

- A. Contractors shall submit all items necessary to obtain all required permits to the appropriate Regulatory Agencies, obtain all required permits, and pay all required fees.
- B. All work shall conform to the following Building Codes:
 - 1. National Electrical Code (NEC-2020)
 - 2. South Carolina Building Code (SCBC 2021)
- C. All work shall conform to all federal, state and local ordinances.
- D. References to the National Electrical Code and National Fire Protection Association (NFPA) are a minimum installation requirement standard. Design drawings and other specification sections shall govern in those instances where requirements are greater than those specified in the NEC and NFPA.

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PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. All products shall be new (except where noted) and unused and without blemish or defect.

2.2 SUBSTITUTIONS

- A. Products included in the specifications and drawings indicate a basis-of-design. Where less than (3) manufacturers are indicated for a product, equal substitutions will be considered provided that adequate information is provided to demonstrate compliance with the design intent of the specifications and drawings.
- B. Submittals shall be concise and clear. Submittals which include manufacturer's catalog data on other products or non-applicable options do not satisfy this requirement.
- C. Submittals shall be accompanied by samples, descriptive literature and engineering information, as necessary, to fully identify and appraise the product.
- D. Items approved shall not be construed as authorizing any deviations from the plans and specifications unless such deviations are clearly indicated in the form of a table of compliance that is enclosed with the submittals. The table of compliance shall clearly identify all deviations from the specifications with clear proof of equality for each case of deviation. Each item in the table of compliance shall be marked to show specification reference including the section and paragraph numbers.
- E. Contractor shall be responsible for verifying all dimensions with available space conditions (with provisions for proper access, maintenance, part replacement, and for coordination with other trades--electrical, plumbing, structural, etc.) for proper services, and construction requirements. Contractor to bear any additional cost for required changes in associated items which are directly or indirectly related to a substituted unit.
- F. The Contractor shall furnish drawings showing all installation details, shop drawings, technical data and other pertinent information as required.
- G. Approval of the equipment does not relieve the contractor of the responsibility of furnishing and installing the equipment at no additional cost.
- H. Where Contractor substitutes equipment manufactured by an alternative vendor, the Contractor shall become responsible for the operation of the product in the intended system, including all related costs required to make the design work, function, and fit in the allocated space.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 26 05 01 - ELECTRICAL COORDINATION

PART 1 - GENERAL CONDITIONS

1.1 INTERPRETATION OF CONTRACT DOCUMENTS

- A. This section of the specifications and related drawings describe general provisions applicable to every section of Division 26.
- B. Attention is directed to Instructions to Bidders and to Division 1, General Conditions, which are binding in their entirety on this portion of the work in particular to paragraphs concerning materials, workmanship and substitutions.
- C. The drawings of necessity utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed, in accordance with the intent diagrammatically expressed on the drawings, and in conformity with the dimensions indicated on final architectural and structural working drawings and on equipment shop drawings. No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.
- D. Certain details appear on the drawings which are specific with regard to the dimensioning and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not eliminate the requirement for field coordination for the indicated work.
- E. Information as to the general construction shall be derived from structural and architectural drawings and specifications only.

1.2 EXISTING CONDITIONS

- A. The Contractor shall visit the premises and thoroughly familiarize himself with details of the work, working conditions, verify dimensions in the field, advise the Architect/Engineer of any discrepancy, and submit shop drawings of any changes he proposes to make, in quadruplicate for approval, before starting the work. Contractor shall install equipment in a manner to avoid building interference.

1.3 SHOP DRAWINGS

- A. The Contractor shall not purchase any materials or equipment prior to receipt of approved shop drawings.
- B. Prior to assembling or installing the work, prepare and submit shop drawings for the following items electrical equipment as specified in subsequent sections.
- C. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements.

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- D. Shop drawing sets shall be suitably bound and indexed. Loose sheets are not acceptable.
- E. Catalog cuts submitted for approval shall be legible and shall clearly identify equipment being submitted. Items of the submittal that have been "faxed" are not acceptable.
- F. Before preparing drawings, Contractor shall consult contract drawings and specifications in detail, obtain manufacturer's recommended installation instructions, and have shop drawings prepared based on specific equipment and material intended for installation. A principal of the contracting firm shall sign the shop drawings (indicating conformance with plans and specifications) before submission.
- G. Approval on shop drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing (and in letter form) called attention to such deviations at the time of submission and secured written approval; nor shall it relieve him from responsibility for errors in shop drawings or schedules.
- H. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

1.4 AS-BUILT DRAWINGS

- A. The Contractor shall keep a record set of drawings on the job and, as construction progresses, shall show the actual installed location of items, material, and equipment on these record set drawings.
- B. At the time of final inspection, two corrected sets of drawings shall be delivered to the Architect. Drawings costs to be by the Contractor.
- C. Corrected sets shall be made by obtaining a sepia of the applicable contract drawings. Sepia prints shall be corrected deleting incorrect locations and showing installed locations in accordance with information transferred from job drawings.
- D. Provide an additional set of corrected drawings in a moisture proof storage tube and mount the tube in the main electrical room.

1.5 OWNER'S MANUAL

- A. The Contractor shall submit to the Architect six identical manuals that contain manufacturer's brochures of items installed by the Electrical Contractor.
- B. The cover of the manual shall state the following information:
 - 1. Project Name
 - 2. Location
 - 3. Owner
 - 4. Architect
 - 5. Electrical Engineer
 - 6. Electrical Contractor (name, address, phone number)
 - 7. General Contractor

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8. Project Supervisors (general and electrical)
9. Date Of Project Completion

1.6 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. After final tests and adjustments have been completed, a competent employee of the Contractor shall be provided to instruct the Owner's Representative in the details of operation and maintenance for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time to assure that Owner's Representative is qualified to take over operation and maintenance procedures. Instruction periods shall be as designated by the Owner and shall not necessarily be consecutive.

1.7 MAINTENANCE MATERIALS

- A. All special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner's Representative and a receipt requested for the same.
- B. Where specified, provide Owner's Representative with spare parts, equipment and materials and request a receipt for same.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the National Electrical Code, install an identification sign which will clearly indicate information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchgear and motor control assemblies, control devices and other significant equipment.
- B. Nameplates shall be laminated black phenolic resin with a white core and engraved lettering, a minimum of 1/4-inch high. Nameplates that are furnished by manufacturer, as a standard catalog item, or where other methods of identification are herein specified, are exceptions.
 1. Nameplates shall be attached with screws or rivets.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 1. Prior to any Work, the Contractor shall carefully inspect the installed Work of other Trades and verify that such Work is complete to the point where his installation may properly commence.

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2. Verify that equipment may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect Engineer.
2. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

C. Return to original (pre-construction) condition any paved areas, sidewalks, planting, etc., disturbed during electrical system installation.

3.2 INSTALLATION

A. Install equipment in strict accordance with the manufacturer's recommendations and the shop drawings approved by the Engineer.

B. Secure equipment using fasteners suitable for the use, materials, and loads encountered. If requested, submit evidence proving suitability. Do not attach electrical materials to roof decking, removable or knockout panels, or temporary walls and partitions, unless indicated otherwise.

C. Coordinated electrical systems, equipment and materials complete with auxiliaries and accessories shall be installed. Remove, modify, relocate and reinstall the existing electrical equipment and materials as shown.

D. Equipment location: Shall be as close as practicable to locations shown on drawings.

E. Working spaces shall be not less than specified in the National Electrical Code for voltages specified.

F. Inaccessible Equipment:

1. Where the Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and duct work.

G. Equipment and Materials:

1. New equipment and materials shall be installed unless otherwise specified.
2. Equipment and materials shall be designed to assure satisfactory operation and operating life for environmental conditions where being installed. NEC and other code requirements shall apply to the installation in areas requiring special protection such as explosion-proof, vapor-proof, watertight and weatherproof construction.

3.3 COORDINATION WITH OTHER TRADES

- A. Coordinate work of each section with work of other sections to avoid interference. Bidders are cautioned to check their equipment against space available as indicated on drawings and shall make sure that proposed equipment can be accommodated. If interferences occur, Contractor shall bring them to the attention of Architect/Engineer, in writing, prior to signing of contract; or Contractor shall, at his own expense, provide proper materials, equipment, and labor to correct any damage due to defects in his work caused by such interferences.

3.4 WORK PERFORMANCE

- A. Arrange, phase and perform work to assure uninterrupted electrical service for other buildings. See General Methods of Procedure under Section GENERAL REQUIREMENTS.
- B. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior condition.
- C. Coordinate location of equipment and conduit with other trades to minimize interferences.
- D. Cutting of Holes:
 - 1. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills shall not be allowed.
 - 2. Holes shall be located so as not to affect structural sections such as ribs or beams.
 - 3. Holes shall be laid out in advance. The Architect shall be advised prior to drilling through structural sections, for determination of proper layout.
- E. Where conduits, wireways, busduct, and other electrical raceways pass through fire partitions, fire walls or walls and floors, install a UL listed firestop assembly that matches the rating and is intended for the penetrated construction to provide an effective barrier against the spread of fire, smoke and gases. Penetrations shall be made, and the fire-stopping installed in accordance with manufacturers written instructions and UL details.

3.5 PROTECTION AND CLEANING 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, moisture, cold and rain.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering them with securely fastened protective rigid or flexible waterproof coverings.
- C. Conduit shall be protected by storing it on elevated supports and capping the ends with suitable closure material to prevent dirt accumulation in the piping.
- D. During construction cap the top of conduits and raceway installed vertically.

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- E. During installation, equipment, controls, controllers, circuit protective devices, etc., shall be protected against entry of foreign matter on the inside; and be vacuum cleaned both inside and outside before testing, operating and painting.
- F. Damaged equipment shall be placed in first class operating condition or be returned to source of supply for repair or replacement.
- G. Painted surfaces shall be protected with removable heavy kraft paper, sheet vinyl or equal, installed at the factory, and removed prior to final inspection.
- H. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with same quality of paint and workmanship as used by manufacturer so repaired areas are not obvious.

3.6 DISPOSITION OF EXISTING MATERIAL AND EQUIPMENT

- A. Material and equipment which is noted, specified, or required by the Owner to be salvaged and which is not scheduled to be reused or relocated shall be carefully removed and shall be delivered to the Owner and stored where directed on the site.
- B. Carefully remove and store on the site material and equipment noted or specified to be reused or relocated. Thoroughly clean this equipment prior to installation.
- C. Remove other materials or debris resulting from demolition operations from the site.

3.7 EXCAVATING, TRENCHING, BACKFILLING AND RESURFACING

- A. Perform work as required, indicated, and in compliance with site work. Excavation depths indicated are below finished grade.
- B. Do not excavate below required depth except as necessary for removal of unstable soil. Unless indicated otherwise, pitch electrical conduit runs downward away from buildings.
- C. Where backfill compaction is critical (e.g. under floor slabs, roadways, sidewalks, trenches deeper than four feet), test the degree of compaction each 75 linear feet of trench and each two feet of depth.
- D. Repair the excavated area to original pre-excavation condition. Repair and replace sidewalks, roadways, etc.

3.8 IDENTIFICATION

- A. Upper case letters of uniform height; centered on device, cover plate, or enclosure; engraved letters filled with a contrasting color; and characters made clearly and distinctly.
- B. Use abbreviations defined in the contract documents whenever possible. Use plan designations for labeling, unless indicated otherwise. Indicate loads served using designations from electrical schedules and designations from the trade furnishing the equipment served.

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- C. Label inside covers in exterior locations and outside covers in unfinished areas of the following with a permanent ink marking pen:
 - 1. Junction boxes or portions of junction boxes with 277- or 480-volt wiring.
 - 2. Communications system pull and junction boxes.
 - 3. Pull, junction boxes, and raceway installed above ceilings and for future use.

- D. Label feeder conductors and branch circuit conductors with self-adhesive, numbered labeling tapes, Brady Co. or equal. Indicate feeder numbers on feeders and terminal numbers for control conductors. Label conductors at origin and destination points and at junction boxes where two or more feeder or control circuits are present.

3.9 ACCESS TO EQUIPMENT

- A. All equipment shall be installed in location and manner that will allow for convenient access for maintenance and inspection.

3.10 CONNECTION OF EQUIPMENT FURNISHED AND INSTALLED UNDER OTHER DIVISIONS OF THE WORK

- A. This Contractor shall rough-in and make final electrical connection to equipment requiring electrical connections with such equipment being furnished and installed under other Divisions of the Work.

- B. Installations shall be functional and code complying.

- C. This Contractor shall provide whatever incidental devices are necessary for final connection, such as, but not necessarily limited to outlet boxes, receptacles, connectors, clamps and switches.

- D. Connection of Kitchen/Food Service Equipment shall be as follows:
 - 1. Furnish and install conduit and wiring for Food Service Equipment, including junction boxes and receptacles at walls.
 - 2. Coordinate with equipment supplier for specific types of receptacles required for plug-in equipment. Receptacles shown on electrical plans are symbolic only and are not intended to indicate exact types of connection.
 - 3. Furnish and install disconnect switches between rough-in points and final connection points on equipment.

- E. Connection of elevator equipment shall be as follows:
 - 1. Rough-ins and connections vary between elevator manufacturers. Rough-ins shown on electrical plans are symbolic and do not represent rough-ins specific to each elevator manufacturer specified for use within the contract documents. Coordinate necessary rough ins with elevator equipment supplier/installer. See architectural specifications for elevator manufacturers, coordinate rough ins with elevator equipment provider.
 - 2. Furnish and install rough-ins, conduit and conductors for elevator power, controls and maintenance in accordance with the NEC and elevator manufacturer's specific requirements.

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3. Furnish and install additional lighting required to meet manufacturer's shaft lighting requirements.
4. Furnish and install disconnect switches, fused and non-fused, with necessary interface contacts between rough-in points and final connection points on equipment.
5. Furnish and install conduit, conductors, contactors, relays, shunt trip breakers, and miscellaneous equipment required to perform the following functions associated with elevator operation:
 - a. Connection to automatic transfer switch(es) pre-transfer interfaces.
 - b. Shunt trip circuit breakers where required.
 - c. Interface with building fire alarm and communications systems.
 - d. Rough-in and connection of sump pumps, oil separators, oil detection systems and other systems necessary for elevator operation furnished by other trades of work.

3.11 GENERAL COMPLETION AND DEMONSTRATION

A. Results expected:

1. Systems shall be complete and operational, and controls shall be set and calibrated.
2. Testing, start-up and cleaning work shall be complete.

B. Demonstration:

1. Upon notification by the Contractors, the Engineer will visit the project for a demonstration of the building system and an inspection of the completed work.
2. Items which do not comply with the Contract Documents, or which function incorrectly will be listed, and the list will be submitted by the Engineer to the Contractors for repairs.
3. After corrections have been made the Contractors shall notify the Architect/Engineer who will recheck the systems for compliance of items listed.

3.12 COORDINATION WITH COMMISSIONING AGENT

A. Contractor shall coordinate their work with the Owner's Commissioning Agent. Provide necessary labor, materials, test equipment, etc. Attend meetings with the Commissioning Agent and participate in the development and implementation of the Commissioning Plan.

B. Perform necessary corrective work to comply with deficiencies noted by the Commissioning Agent.

3.13 CLEANING

A. Periodically during construction and prior to Owner acceptance of the building, Contractor shall remove from the premises and dispose of packing material and debris.

B. Clear away debris and surplus material resulting from electrical work. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

END OF SECTION

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SECTION 26 05 03 - CUTTING, PATCHING AND REPAIR

PART 1 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

- A. Cutting: Furnish all labor, materials, tools and equipment and perform all operations in connection with the cutting of new and existing building structure, finishes and building assemblies as specified hereinafter.
- B. Patching: Furnish all labor, materials, tools and equipment and perform all operations in connection with the installation of watertight sealant as required to seal voids or gaps around Division 26000 equipment at penetrations through exterior floors, walls, and roof systems.
- C. Repair: Furnish all labor, materials, tools and equipment required to repair all existing or new building components and finishes, outside components, landscaping, utilities, or other appurtenances that are damaged as a result of the performance of this contract.
- D. All existing utilities, feeders, branch circuits, signal wiring, control wiring, etc. shall be reconnected to new or existing systems as required to maintain the same functions as existed prior to new work.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include but not be limited to, the following:
 - 1. Division 1
 - 2. All other Division 26 sections
 - 3. All Division 27 and 28 sections

1.3 QUALITY ASSURANCE

- A. Sealants shall equal or exceed all requirements of ASTM E-814.
- B. All applicable codes as stated elsewhere in these specifications for the type of work performed.

PART 2 - PRODUCTS

2.1 WATERPROOFING

- A. Exterior joint sealant shall be Polyurethane base, multi-component; self-leveling type for application in vertical joints; capable of withstanding movement of up to 50% of joint width and satisfactorily handled throughout temperature of 4 to 27 degrees C.; uniform, homogeneous, and free from lumps, skins and coarse particles when mixed; Shore "A" hardness of minimum 15 and maximum 50; non-staining; non-bleeding; colors selected by Architect/Engineer.

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B. The following waterproofing sealant manufacturers are acceptable:

1. TREMCO
2. Sonneborn - Contech
3. W. R. Meadows

PART 3 - EXECUTION

3.1 GENERAL

- A. Patch and repair all building finishes, structural components, or other appurtenances that are damaged as a result of the performance of this contract. Patch and repair work shall include finishes, components, substructure and materials required for the installation of such work in accordance with standard practices.
- B. Replace all building components, outside components, shrubbery, or other appurtenances which are damaged beyond repair. Replacement item(s) shall be of equal or higher quality than the original item(s).
- C. All penetrations thru exterior floors, walls, and roof systems shall be sealed watertight.
- D. All roof penetrations shall be patched in accordance with roofing manufacturers' recommendations.
- E. Patched and repaired work shall be finished to match existing or adjacent construction and conditions.

3.2 INSTALLATION OF SEALANT MATERIALS

- A. Install materials in accordance with manufacturer's recommendations for installation of these materials.
- B. Clean and prepare joints for sealant application in accordance with manufacturer's recommendations. Ensure that joint forming materials are compatible with sealant. Use joint filler to achieve required joint depths. Apply primers as recommended by sealant manufacturer.
- C. Openings larger than required for proper installation of electrical raceways or conduits shall be patched or repaired.

END OF SECTION

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SECTION 26 05 19 - WIRE AND CABLE - BUILDING WIRE (600 VOLTS AND BELOW)

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes the furnishing, installation, and connection of the building wire for power and lighting circuits.
- B. Unless otherwise specified in other sections of these specifications, control wiring shall be provided, installed, and connected to perform the functions specified in other sections of these specifications.
- C. Unless otherwise specified in other sections of these specifications, communication and signal wiring shall be provided, installed, and connected to perform the function specified in other sections of these specifications.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. All other Division 26000 sections

1.3 WORK INCLUDED

- A. The work under this section consists of furnishing materials and equipment, performing labor and services necessary for the installation of the electrical cable and wiring system shown on the drawings and hereinafter specified.

1.4 APPLICABLE PUBLICATIONS

- A. The following specifications and standards, except as hereinafter modified, are incorporated herein by reference and form a part of this specification to the extent indicated by the references thereto. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. In text such specifications and standards are referred to by basic designation only.
 - 1. National Fire Protection Association (NFPA) Publications
 - No. 70 National Electrical Code (NEC)
 - 2. Underwriters' Laboratories, Inc. (UL) Publications:
 - No. 44 Rubber-Insulated Wire and Cables
 - No. 83 Thermoplastic-Insulated Wires
 - No 493 Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables

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No. 486. Wire Connectors and Soldering Lugs

PART 2 - PRODUCTS

2.1 MATERIALS

A. Building Wire (Power and Lighting):

1. Cable and wire shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.
2. Conductors:
 - a. Shall be annealed copper.
 - b. Shall be stranded for sizes No. 8 and larger. Sizes No. 10, and smaller shall be solid.
 - c. Size shall be not less than shown on the drawings. Minimum size shall be No. 12 AWG.
3. Insulation: Unless otherwise shown on the drawings, insulation shall be as follows:
 - a. THHN - THWN – Dry, Damp, Wet Locations
 - b. XHHW – Dry, Damp, Wet Locations.

4. Color Code:

- a. All secondary service, feeder, and branch circuit conductors shall be color coded as follows:

<u>208/120 Volt</u>	<u>Phase</u>	<u>480/277 Volt</u>
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray

- b. All No. 12 and No. 10 branch circuit conductors shall have solid color compound or solid color coating.
- c. No. 8 AWG and larger phase conductors shall have either:
 - 1) Solid color compound or solid color coating.
 - 2) Stripes, bands, or hash marks of colors specified above.
 - 3) Colored pressure-sensitive plastic tape. Tape shall be applied in half overlapping turns for a minimum of three inches for all terminal points, and in all junction boxes, pull boxes, troughs, manholes, and handholes. Tape shall be 3/4-inch wide with colors as specified above. The last two laps of tape shall be applied with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
- d. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.

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- B. Splices and Joints:
1. Shall be in accordance with UL and NEC.
 2. Branch circuits (No. 10 AWG and smaller):
 - a. Connectors shall be solderless, screw-on, pressure cable type, 600-volt, 105 degree C, with integral insulation. They shall be approved for copper conductors and shall be reusable.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors as listed on the manufacturers packaging shall be strictly complied with.
 3. Feeder Circuits:
 - a. Connectors shall be indent, hex screw, or bolt clamp-type. Material shall be high conductivity and corrosion resistant.
 - b. Connectors for cable sizes 250 MCM and larger shall have not less than two compression indents.
 - c. Splices and joints shall be insulated with materials approved for the particular use, location, voltage, and temperature. Insulation shall be not less than that of the conductors being joined.
 - d. Plastic electrical insulating tape:
 - 1) Tape shall be flaming retardant, cold and weather resistant.
- C. Control Wiring:
1. Unless otherwise specified in other sections of these specifications, control wiring shall be as specified for power and lighting wiring.
 2. Wire size shall be large enough so that the voltage drop under inrush conditions will not adversely affect operation of the controls.
- D. Wire Lubricating Compound shall be suitable for the wire insulation and conduit it is used with and shall not harden or become adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, as shown on the drawings, and as hereinafter specified.
- B. All wiring shall be installed in raceway systems, except where direct burial is shown on the drawings.
- C. Cables and wires shall be spliced only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.
- D. Cable supports shall be installed for vertical feeders in accordance with the NEC. They shall be of the split wedge type which firmly clamps each individual cable and tightens due to cable weight.

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- E. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, train, and tie the cables in individual circuits.
- F. Cable and wire entering a building from underground shall be sealed between the wire and conduit, where the cable exits the conduit, with a nonhardening approved compound.
- G. Wire Pulling:
 - 1. Suitable installation equipment shall be provided to prevent cutting or abrasion of conduits during pulling of feeders.
 - 2. Ropes used for pulling feeders shall be made of suitable nonmetallic material.
 - 3. Pulling lines for feeders shall be attached by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 4. All cables to be pulled in a single conduit shall be pulled in together.

3.2 FIELD TESTING

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Test shall be performed by megger and conductors shall test free from short-circuits, grounds, and opens.
- C. Conductors shall be tested phase-to-phase and phase-to-ground.

END OF SECTION

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SECTION 26 05 26 - GROUNDING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounding systems.
- B. The term ground, as used in this specification, shall mean any or all of the grounding types specified.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. All other Division 26 sections

1.3 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC requirements as applicable to materials and installation of electrical grounding systems, associated equipment, and wiring. Provide grounding products which are UL listed and labeled.
- B. UL Compliance: Comply with applicable requirements of UL Standards Nos. 467 and 869 pertaining to electrical grounding and bonding.
- C. IEEE Compliance: Comply with applicable requirements of IEEE Standard 142 and 241 pertaining to electrical grounding.

PART 2 - PRODUCTION

2.1 GENERAL

- A. Provide electrical grounding systems with assembly of materials, including cables/wires, connectors, terminals, solderless lugs, grounding rod/electrodes, bonding jumper braid and additional accessories needed for complete installation. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards.

2.2 GROUNDING CONDUCTORS

- A. Shall be UL and NEC approved types, copper, with insulation color identified green, except where otherwise shown on the drawings, or specified.

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- B. Wire size shall not be less than #12 AWG and not less than required by the NEC.

2.3 GROUND RODS

- A. Ground rods shall be copper clad steel, 3/4-inch diameter by minimum ten feet long.

2.4 GROUNDING CLAMPS

- A. Clamps for connection of grounding electrode conductors to metal piping 1" and less in diameter shall be cast brass/bronze and of the single screw type design.
- B. Clamps for bonding of metal piping for 1" through 6" in diameter shall be bronze or brass and of the U-bolt type.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL GROUNDING

- A. General: Install electrical grounding systems in accordance with applicable portions of NEC, with NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
- B. Coordinate with other electrical work as necessary to interface installation of electrical grounding system with other work.
- C. Weld grounding conductors to underground grounding rods/electrodes.
- D. Connection to structural steel building components shall be made utilizing exothermic welding. Bolted connections for bonding to steel building components shall only be used in load bearing masonry construction when connecting to bar joist roofing systems.

3.2 FEEDERS AND BRANCH CIRCUITS

- A. Install green insulated equipment grounding conductors with all feeders and branch circuits. Conductors shall be sized in accordance with NEC Article 250.

3.3 EQUIPMENT GROUNDS

- A. All equipment that has electrical connections (lights, receptacles, panels, and utilization equipment) shall have a ground wire connected that is directly tied to the ground bus of the panel which serves it.
- B. Fixed electrical appliances and equipment shall have a ground lug installed and provided by this contractor for termination of the green ground conductor.

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3.4 CONDUCTIVE PIPING

- A. Bond all conductive piping systems in the building whether furnished and installed by this contractor or not to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.5 GROUND ROD INSTALLATION

- A. Distance: Drive each rod vertically for not less than ten feet.
- B. Multiple Rods: Where required to obtain the specified ground resistance, install multiple rods.
- C. Where ground connections will be permanently concealed, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with clamp type ground connectors.
- D. Where rock prevents the driving of vertical ground rods, installing grounding electrodes in trenches and of suitable length to achieve the specified resistance.

3.6 FIELD QUALITY CONTROL

- A. Upon completion of installation of electrical grounding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground over 3 ohms, take appropriate action to reduce resistance to 3 ohms, or less, by driving additional ground rods and/or by chemically treating soil encircling ground rod; then retest to demonstrate compliance. Ground resistance tests shall be performed utilizing fall-of-potential test method for ground resistance measurements.
- B. Record results of all ground resistance tests and corrective actions and include copies within the Operation and Maintenance Manual.

END OF SECTION

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SECTION 26 05 33 - CONDUITS/RACEWAYS AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems.
- B. Types of raceways in this section include the following:
 - 1. Rigid metal conduit (RMC or GRC)
 - 2. Intermediate metal conduit (IMC)
 - 3. Electrical metallic tubing (EMT)
 - 4. Flexible metal conduit (FMT)
 - 5. Liquid tight flexible metal conduit (LFMC)
 - 6. Rigid PVC conduit (PVC)
- C. The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. All other Division 26000 sections

1.3 QUALITY ASSURANCE

- A. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
- B. UL Compliance and Labeling: Comply with provisions of UL safety standards pertaining to raceways systems and provide products and components which have been UL listed and labeled.
- C. NEC Compliance: Comply with requirements as applicable to construction and installation of raceway systems.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC OR GRC):

- A. Rigid metal steel conduit shall conform to ANSI C80.1 and Underwriter's Laboratories UL-6 specification, ANSI C80.1.

- B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating.
- C. Fittings: Fittings shall be ANSI/NEMA FB 1 threaded type, hot dipped or electronic plated. Threaded conduit to be secured to boxes, cabinets, etc., by means of galvanized threaded bushings on the inside and bond-type locknuts on the inside and outside of such boxes and cabinets. Fittings shall be watertight and the same material as conduit installed with factory manufactured elbows.

2.2 RIGID INTERMEDIATE STEEL CONDUIT (IMC)

- A. Intermediate Metallic Conduit shall conform to ANSI C80.1 and proposed Underwriter's Laboratories UL 1242 specification.
- B. Conduit shall be hot-dipped galvanized to provide a corrosion resistant coating. Intermediate Metallic Conduit (IMC) shall have galvanized/metallized thread protection, and pipe interior shall be protected by corrosion inhibiting coating.
- C. Fittings: Shall be similar to GRC.
- D. Maximum allowable size shall be (4) inches.

2.3 ELECTRICAL METALLIC TUBING (EMT)

- A. Electrical metallic tubing shall conform to ANSI C80.3 and Underwriter's Laboratories UL 797.
- B. EMT shall be hot-dipped galvanized steel with internal coating of silicone epoxy lubricant to assist in wire pulling.
- C. Fittings: Shall be compression type, steel, or malleable iron. Set screw or indentation type of fittings are not acceptable.

2.4 FLEXIBLE METAL CONDUIT (FMC)

- A. Flexible metal conduit shall conform to UL 1.
- B. Flexible conduit to be of hot-dipped galvanized interlocked spirally wound steel strip.
- C. Fittings shall be multiple point type, threading into the internal wall of the conduit convolutions, and shall have insulated throat. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

2.5 LIQUID TIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Liquid-tight flexible metal conduit shall conform to UL 360.
- B. Liquid-tight flexible metal conduit shall consist of flexible galvanized steel tubing over which is extruded a liquid-tight jacket of polyvinyl chloride (PVC). Conduit shall be provided with a continuous copper bonding conductor wound spirally between the convolutions.

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- C. Fittings used shall be reusable type of malleable iron/steel construction, electro zinc plated inside and outside, furnished with nylon insulated throat, and taper threaded hub. Connectors to be galvanized and be suitable for connection to associated boxes and conduits.

2.6 RIGID PVC (PVC)

- A. Conduit shall be UL rated 90°C and to UL-651. Fittings shall conform to UL-514.
- B. Conduit shall be S40 wall thickness made from polyvinyl chloride (recognized by UL) compound which includes inert modifier to improve weatherability and heat distortion. Conduit and couplings shall be homogenous plastic material free from visible cracks, holes, or foreign inclusions. Conduit bore shall be smooth and free from blisters, nicks, or other imperfections which could mar conductors or cables.
- C. Bends: 90° bends shall be made with galvanized rigid steel elbows. Bends other than 90° shall be made from S80 PVC conduit.

2.7 EXPANSION AND DEFLECTION COUPLINGS

- A. UL 467 and UL 514 shall apply.
- B. Shall accommodate, 1.9 cm (0.75 inch) deflection, expansion, or contraction in any direction, and shall allow 30-degree angular deflections.
- C. Shall include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
- D. Shall be watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.
- E. Jacket shall be flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.

2.8 CONDUIT SUPPORTS

- A. Parts and hardware shall be zinc-coated or have equivalent corrosion protection.
- B. Pipe straps: Fed. Spec. FF-S-760, type 1, style A or B.
- C. Individual conduit hangers: Shall be designed for the purpose, and have pre-assembled closure bolt and nut, and provisions for receiving hanger rod.
- D. Multiple conduit (trapeze) hangers shall be not less than 1-1/2 x 1-1/2 inch, 12 gage steel, cold formed, lipped channels. Hanger rods shall be not less than 3/8-inch diameter steel.
- E. Solid masonry and concrete anchors: Fed. Spec. FF-S-325 shall apply. Anchors shall be GROUP III self-drilling expansion shields, or machine bolt expansion anchors GROUP II type 2 or 4, or GROUP VII.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION SCHEDULE

- A. Conduits utilized shall be metallic conduit types listed in this specification. Metallic conduit types shall be applied for specific system types as follows:
1. Power distribution feeders such as feeders for switchboards, panelboard, transformers, etc.:
 - a. Exposed or concealed - RMC or IMC
 - b. Below slabs on grade or underground outside of building - PVC
 2. Feeders to motors: Same requirements as power distribution feeders.
 3. Branch circuits from panelboards (not described above):
 - a. Wet or damp locations exposed or concealed - RMC or IMC
 - b. Dry locations exposed or concealed - EMT.
 - c. Below slabs on grade or underground outside of building - PVC
 4. HVAC equipment feeders 1-1/2" trade size and larger: Same requirements as power distribution feeders.
 5. HVAC equipment feeders smaller than 1-1/2" trade size: Same requirements as branch circuits from panelboards.
 6. Low voltage systems such as building automation and control systems, information technology systems: Same requirements as branch circuits.

3.2 CONDUIT INSTALLATION

- A. Installation shall be in accordance with UL, NEC, as shown on the drawings, and as hereinafter specified.
- B. Contractor shall lay out and install conduit runs to avoid proximity to hot pipes. In no case will a conduit be run within three inches of such pipes, except where crossings are unavoidable and then conduit shall be kept at least one inch from the covering on pipe crossed.
- C. Conduits shall be supported as required to comply with applicable paragraphs of the NEC.
- D. Conduit installation shall be as follows:
1. Installed as complete runs before pulling in cables or wires.
 2. Flattened, dented, crushed, or deformed conduit is not permitted and shall be removed and replaced at no cost to the Owner.
 3. Installed so they will not obstruct head room, walkways, doorways, or work by other trades.
 4. Cut square with a hacksaw, reamed, burrs removed, and drawn up tight.
 5. Mechanically continuous.
 - a. Metallic raceway shall also be electrically continuous.
 6. Supported within one foot of changes of direction, and within one foot of each enclosure to which connected.
 7. Ends of empty conduit to be closed with plugs or caps at rough-in stage to prevent entry of debris until wires are pulled in.

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8. Conduits shall be secured to cabinets, junction boxes, pull boxes, and outlet boxes by bonding type locknuts.
 9. See architectural detail for conduit penetrations of roof membrane.
- E. Conduit Bends:
1. Shall be made with standard conduit bending machines.
 2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
 3. Conduits shall not be bent with a pipe tee or vice.
- F. Conduit shall be securely fastened in place at intervals as specified by the code using suitable straps, hangers, and other supporting assemblies. Strap hangers and supporting assemblies:
1. Shall be of rugged construction capable of supporting weight with a reasonable factor of safety.
 2. Spacers and supporting straps shall be of rugged malleable iron or steel construction hot dipped galvanized.
 3. Shall be adequately protected against corrosion.
- G. In wet locations or in locations where corrosive conditions are present, vertical, and horizontal runs of conduit shall be firmly supported so that there is at least 1/4" air space between the conduit and the wall or supporting surface. Spacers and supporting straps shall be of malleable iron construction, hot dipped galvanized.
- H. Flexible conduit when installed shall have sufficient slack to avoid sharp flexing and straining due to vibration and thermal expansion/contraction. Conduit shall be installed in such a manner that liquids will tend to run off the surface instead of draining towards the fittings.
- I. Concealed work installation:
1. In cast-in-place:
 - a. Conduits may be installed in concrete that is at least than 3 times conduit trade size in thickness but in no case less than 3" thick.
 - b. Conduit shall be run in direct lines.
 - c. Conduit may be installed through concrete beams where shown on the structural drawings or as approved by the Engineer prior to installation.
 - 1) Submit drawings showing locations size, and position of each proposed penetration for review prior to installation.
 - d. Spacing between conduits in slab shall be approximately six conduit diameters apart except one conduit diameter at conduit crossings.
 - e. Conduits shall be installed approximately at the center of the slab.
 - f. Couplings and connections shall be concrete tight. Thread compounds shall be UL approved conductive type to ensure low resistance ground continuity through the conduits.
 2. In CMU (Concrete Masonry Unit) Walls:
 - a. Conduits shall run vertically within CMU walls except where noted on the drawings or as approved by the Engineer prior to construction.
 3. Conduit shall be run parallel or perpendicular to the building lines.
 4. Branch circuit conduits, and conduits feeding ceiling lighting shall be supported independently from suspended ceiling, lighting fixtures, or air conditioning ducts.

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5. Recessed lighting fixtures shall be connected to conduit with not over six feet of flexible metal conduit.

J. Exposed work installation:

1. Conduit shall be run parallel or perpendicular to the building lines.
2. Horizontal runs shall be installed close to the ceiling or beams and secured with approved conduit straps.
3. Horizontal or vertical runs shall be supported at not over eight-foot intervals.

K. Installation underground or below slabs on grade:

1. Tops of conduits shall be:
 - a. Not less than 24 inches and not less than shown on the drawings below finished grade.
 - b. Not less than 30 inches and not less than shown on the drawings below road and other paved surfaces.
2. Conduits shall be installed below power company direct burial primary feeders where encountered. Coordinate spacing below primary feeder with utility company.
3. Underground conduits shall be encased in not less than 3" of red cast-in-place concrete (all around) where run outside of buildings or equipment pads.
4. Seal conduits at building entrances and outdoor terminations for equipment with a suitable compound to prevent the entrance of moisture and gases.

L. Transition from PVC to metallic conduit:

1. Where PVC conduit exits permitted locations, coated rigid galvanized or IMC conduits shall be utilized for the transition. Acceptable coatings are factory applied PVC or field applied spray bituminous, or tape coatings intended for the application.
 - a. Where conduits transition under pad-mounted equipment enclosures such as switchboards, generators or pad-mounted transformers, it shall be acceptable to utilize PVC for the transition.
2. Transition to metallic conduits shall occur minimum 12 times conduit trade diameter prior to exit from permitted locations. Distance shall be measured from point of exit for horizontal transitions and from center of conduit at point of exit for horizontal to vertical transitions.

M. Surface metal raceways:

1. Surface metal raceways shall be used only where shown on the drawings.

3.3 MOTORS AND VIBRATING EQUIPMENT

- A. Flexible metal conduit shall be used for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Flexible metal conduit shall be liquid-tight when installed in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, and locations subject to seepage or dripping of oil, grease, or water. Flexible metal conduit shall be installed with green ground wire.

3.4 EXPANSION JOINTS

- A. Conduits 3 inches and larger, rigidly secured to building construction on opposite sides of a building expansion joint, shall be provided with expansion and deflection couplings. The couplings shall be installed in accordance with the manufacturer's recommendations.
- B. Conduits smaller than 3 inches shall be provided with junction boxes on both sides of the expansion joint and connected by 15 inches of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above may be installed.
- C. Expansion and deflection couplings shall also be installed where shown on the drawings.

3.5 CONDUIT SUPPORTS, INSTALLATION

- A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.
- B. Pipe straps or individual conduit hangers shall be used for supporting individual conduits.
- C. Multiple conduit runs shall be supported by trapeze hangers. Trapeze hangers shall be designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 200 pounds. Each conduit shall be attached by U-bolt or other approved fastener.
- D. Conduit shall be supported independently of junction boxes, pull boxes, fixtures, suspended ceiling T-bars, angle supports, etc.
- E. Solid Masonry and Concrete: Fasteners shall be as follows:
 - 1. New construction: Generally, steel or malleable iron concrete inserts in concrete prior to pouring.
 - 2. Existing construction:
 - a. Steel expansion anchors not less than 1/4-inch bolt size and not less than 1-1/8-inch embedment.
 - b. Power set fasteners shall be approved, and not less than 1/4-inch diameter with depth of penetration not less than three inches.
 - c. Anchors or fasteners attached to concrete ceilings shall be vibration and shock resistant.
- F. Hollow masonry. Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.
- G. Metal structures. Fasteners shall be machine screw or devices specifically designed and approved for the application.
- H. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

3.6 LOW VOLTAGE SYSTEM CONDUIT

- A. Minimum size conduit shall be 3/4", but not less than shown on the drawings.

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- B. Conduit bends and elbows shall be long radius.

3.7 PULL WIRES

- A. Install a # 14-gauge fish wire in empty conduits, except telephone and communications. Install a nylon pull string in telephone and communication conduits.

3.8 PAINTING

- A. Conduits shall be factory painted.
- B. Color Code for conduits shall be as follows:
 - 1. Power distribution – no color
 - 2. Fire alarm systems – red.
 - 3. Information technology systems – blue
 - 4. Intercom, paging, and public address systems - blue
 - 5. CCTV, security – orange
 - 6. Lighting control – blue
 - 7. Building automation and control - green

END OF SECTION

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SECTION 26 05 35 - ELECTRICAL BOXES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section includes the furnishing, installation and connection of all outlet boxes, junction boxes, and floor boxes as shown on the drawings or as required to house the intended wiring, devices, or equipment.
- B. Types of electrical boxes and fittings specified in this section include the following:
 - 1. Outlet boxes
 - 2. Junction boxes
 - 3. Pull boxes.
 - 4. Bushings
 - 5. Locknuts
 - 6. Knockout closures

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. All other Division 26000 sections
- B. Other systems specified in Division 26000 may call for special boxes not covered in section 26 0535.

1.3 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.
- B. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL listed and labeled.
- C. NEMA Compliance: Comply with applicable requirements of NEMA Stds. /Pub No.'s OS1, OS2, and Pub 250 pertaining to outlet and device boxes, covers, and box supports.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS:

- A. Outlet and Device Boxes (dry interior locations): Provide galvanized coated sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as required by particular application, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with conduit size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
- B. Outlet and Device Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations.
 - 1. Plaster rings and device mounting rings shall be of proper depth such that the device mounting surface is flush with the finished wall/ceiling surface.
- C. Outlet and Device Boxes (damp and wet locations): Provide corrosion resistant cast metal raintight outlet and wiring device boxes of types, shapes and sizes required for each application, including depth of boxes, with threaded conduit holes for fastening electrical conduit, and cast metal face plates. Where weatherproof devices are indicated, provide spring hinged watertight caps suitable configured for each application, including face plate gaskets and corrosion resistant plugs and fasteners.
- D. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes, and sizes, to suite each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers.
- E. Bushings, Knockout Closures, and Locknuts: Provide corrosion resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

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- E. Avoid installing boxes back-to-back in walls.
- F. Position recessed outlet boxes accurately to allow for surface finish thickness. Boxes shall be installed such that the device mounting surface is flush with the wall/ceiling finished surface.
- G. Set floor boxes level and flush with finish flooring material. Provide trim flange to match finish floor material.
- H. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.

3.2 GROUNDING

- A. Upon completion of installation work, properly ground electrical boxes, and demonstrate compliance with requirements.

END OF SECTION

SECTION 26 05 48 - SEISMIC SUPPORT OF ELECTRICAL EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

A. General:

1. Furnish all labor, materials, tools, and equipment and perform all operations in connection with the installation of seismic support of electrical equipment systems and appurtenances where shown on the drawings and specified hereinafter.

1.2 RELATED WORK/SECTIONS

A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:

1. Division 1
2. All other Division 26 sections
3. All Division 27 and 28 sections

1.3 QUALITY ASSURANCE

A. Codes and Standards:

1. All seismic equipment and design shall comply with all local codes and ordinances and meet or exceed the standards and procedures (latest editions) of the following:
 - a. South Carolina Building Code 2021

B. Seismic control equipment shall be sized and provided by manufacturer. Seismic bracing shall be a factory manufactured item listed in the manufacturers catalog for the intended use.

C. Manufacturer:

1. The seismic control supports manufacturers shall be manufactured by one of the following or approved equal:
 - a. Mason Industries
 - b. Amber Booth
 - c. Peabody

1.4 SUBMITTALS

A. The manufacturer shall submit drawings including floor plans, sections and elevations showing piping, duct, and equipment. Drawings shall indicate location and type of all components provided.

B. A schedule shall show capacity and load of each component at each location.

C. Design shall be based upon actual installation and not contract drawing schematics.

- D. Submittals shall include:
1. Sketches showing seismic loading, location of bracing and types and sizes of bracing assemblies.
 2. Submit seismic protection ratings in three principle axes certified by an independent laboratory.
 3. Submit calculations for shear, pull-up, primary overturning, and secondary overturning.
 4. Submit drawings indicating auxiliary supports and method of attachment.
 5. Calculations shall be submitted and signed by a licensed professional engineer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and applicable conduit shall be mounted on or suspended from approved foundations and supports as specified herein and as shown on the drawings.
- B. Steel components shall be phosphated and painted. All nuts, bolts, and washers shall be zinc electroplated.

2.2 BRACING HANGERS

- A. Seismic bracing shall be a factory manufactured item listed in the manufacturers catalog for the intended use.
- B. Equipment sway bracing shall be provided for all items supported by off-the-floor structures or structures suspended from floors or roof above.
1. Braces shall consist of angles, rods, bars, or pipes run at 45% angles from the equipment frame to the building structure secured at both ends with bolts 1/2" or larger.
 2. Bracing shall be provided in two planes of direction, 90 degrees apart, for each item of equipment.

2.3 ANCHOR BOLTS AND NUTS FOR PAD-MOUNTED EQUIPMENT

- A. Pad-mounted equipment shall be anchored with a minimum of four (4) bolts. Each bolt shall be a 6" in length or at least 10 times longer than the nominal diameter of the bolt with a 90-degree hook on the non-threaded end.
- B. Nuts shall be heavy duty hexagon nuts.
- C. Minimum bolt sizes are as follows:
1. Equipment up to 500 pounds, 3/8" diameter.
 2. Equipment from 500 to 1000 pounds, 1/2" diameter.
 3. Equipment from 1000 to 5000 pounds, 5/8" diameter.
 4. Equipment from 5000 to 10000 pounds, 3/4" diameter.

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2.4 ELECTRICAL EQUIPMENT

- A. Systems include but are not limited to the following:
1. Electrical switchgear
 2. Electrical conduit 2-1/2" inside trade diameter or greater
 3. Panelboards
 4. Dry Type Transformers
 5. Emergency Lighting Systems
 6. Lighting fixtures:
 - a. Lighting fixtures installed in suspended ceiling systems shall conform to the guidelines of Cisca.
 - b. Recessed lighting fixtures shall be independently supported from the structure. The suspended ceiling system shall not be used to support the fixtures.
 - c. Surface mounted fixtures shall be attached to the ceiling system with positive clamping devices that completely surround the ceiling members. Safety devices shall be attached between the clamping device and the adjacent ceiling hanger or to the structure above.
 - d. Pendant hung lighting fixtures shall be supported directly from the structure above using No. 9 gauge wire without using the ceiling suspension system for direct support.
 7. Fire Alarm Systems
- B. Electrical conduit of any size suspended by individual hangers of less than 12 inches from top of conduit to the supporting structure, do not have to be seismically braced.
- C. Slab or floor mounted equipment not subject to movement or vibration.
1. Equipment shall be direct anchored.
- D. Roof Mounted Equipment:
1. Equipment shall be direct anchored.
 2. Curbs and equipment support shall be attached to roof structure.

2.5 SEISMIC ACCESSORIES

- A. Provide all necessary brackets, bolts, fasteners, predrilled bases, oversized bases, accessory components and materials to install systems in accordance with manufacturer's requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. If the equipment to be mounted is not furnished with integral structural frames and external mounting lugs (both of suitable strength and rigidity), approved structural subbase shall be installed in the field which shall support the equipment to be hung and to which shall be attached the hangers.

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3.2 SUPERVISION

- A. The manufacturer, or his qualified representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Upon completion of the installation and after the system is put into operation, the manufacturer, or his representative, shall make a final inspection and submit his report to the Architects and Engineers in writing certifying the correctness of installation and compliance with approved submittal data.

END OF SECTION

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SECTION 26 09 23 – AUTOMATIC LIGHTING CONTROL

PART 1 - GENERAL:

1.1 SCOPE OF WORK

- A. Furnish, install, and connect all conduit, fittings, boxes, controls, control wiring, and all other devices, whether specified/indicated or not, to produce a complete and functional automatic lighting control system.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1 of the building construction documents.
 - 2. All other Division 26 sections.
 - 3. All Division 27 and 28 sections.

1.3 SUBMITTALS

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 26 05 00 - Electrical General Requirements.
- B. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
- C. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data, and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.
- D. Submit scaled lighting plans clearly marked by manufacturer showing proper product, location, and orientation of each sensor. Scale shall match that used in the Contract Documents.
- E. Submit manufacturers cut sheets, including sensor performance information indicating compliance to the specification.

1.4 AS BUILT DRAWINGS

- A. Section 26 05 00 - Electrical General Requirements shall apply.

1.5 RESPONSIBILITY

- A. All equipment to be the responsibility of the single lighting control manufacturer.

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- B. All variations from the specified equipment must be approved by the Architect, Owner and Engineer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Watt Stopper, Inc. (basis of design) or preapproved Equal. For preapproval, provide all of the information required for review a minimum of ten (10) working days prior to the initial bid date.
- B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors which meet or exceed the specifications included herein.

2.2 PRODUCTS

- A. All products numbers listed are those Watt Stopper. See plans for part numbers and device descriptions. Provide latest version of devices superseding part numbers shown on plans.
- B. Wall switch sensors shall be capable of detection of motion at desk top level up to 300 square feet, and half-step motion up to 1,000 square feet.
- C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1,000 watts at 277 volts and shall have 180-degree coverage capability.
- D. Bi-level wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1,000 watts at 277 volts.
- E. Passive Infrared and Dual Technology sensors shall have fully automatic operation.
- F. All sensors shall be capable of operating normally with electronic ballast, PL lamp systems, and rated motor loads.
- G. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
- H. All sensors shall have tool-less accessible, user adjustable controls for time delay and sensitivity. Controls shall be concealed to limit tampering.
- I. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
- J. Ultrasonic operating frequency shall be crystal controlled to within plus or minus 0.005% tolerance to assure reliable performance and eliminate sensor crosstalk. Sensors using multiple frequencies are not acceptable."
- K. All sensors shall provide a method of indication to verify that motion is being detected during testing and that the unit is working.

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- L. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging, and other control options. Sensors utilizing separate components to achieve this function are not acceptable.
- M. All sensors shall have no leakage current to load in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.
- N. All sensors shall have UL rated, plastic enclosures.
- O. Wall switches shall be provided with oversized stainless steel device plates.

2.3 LOW VOLTAGE CONTROLLED RELAY PANELS

- A. Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall provide total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:
 - 1. Removable, plug-in terminal blocks with screwless connections for all low voltage terminations.
 - 2. Individual terminal block, override pushbutton, and LED status light for each relay.
 - 3. Direct wired switch inputs associated with each relay and group channel shall support two-wire, momentary or maintained contact switches.
 - 4. Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches, digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs, digital IO modules capable of receiving momentary or maintained contact closure inputs, digital photocell modules, and digital occupancy sensors.
 - 5. True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.
 - 6. Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.
 - 7. Group, channel, and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any group of relays can be associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override pushbuttons and LED displays for channels 1-9 or a handheld IR programmer for channels 1-99.
 - 8. Relay group status for each channel shall be provided through red LED indicators for groups 1-9 and via BACnet for groups 1-99. Solid red indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.
 - 9. Isolated low voltage contacts provide for true relay status feedback and pilot light indication.

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- B. Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.
- C. Lighting control panels shall be WattStopper model LMCP8, LMCP24 or LMCP48 as shown on the plans.
- D. Relay panels shall provide functionality as described on plans; however, there shall be a minimum of 8 global control channels for each separate system. See low voltage-controlled relay panel riser diagrams and lighting control schedules for description of system control requirements.
- E. Relay panels shall be provided with number of relays required to accomplish lighting control indicated on plans plus an additional 30% for future use. Each homerun noted to be controlled by a relay panel shall be provided with a dedicated relay for control.
- F. Provide photocontrol package where exterior lighting is to have photocell control.
- G. Relays for lighting control shall be mechanically latched and shall maintain state upon loss of power. Electrically held relays for lighting control are not acceptable.
- H. User Interface:
 - 1. Each lighting control panel system shall be supplied with at least (1) handheld IR remote programming interface consisting of a keypad and associated OLED display screen. The user interface shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following functions as a minimum:
 - 2. Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.
 - 3. Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.
 - 4. Program up to 254 separate scheduled events. Events shall occur on seven-day intervals with each day selectable as active or inactive and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.
 - 5. Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven-day intervals with each day selectable as active or inactive and shall be configurable as to whether the event is active on holidays.
 - 6. Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.
 - 7. Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.

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8. An additional handheld IR remote shall be provided and permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as seen fit by the end user's representative

2.4 CIRCUIT CONTROL HARDWARE

- A. For ease of mounting, installation and future service, control unit(s) shall be able to mount within J boxes and be an integrated self-contained unit consisting internally of load switching control relay and a transformer to provide low voltage power to a minimum of three (3) sensors.
 1. Relay Contacts shall have ratings of:
 - 13A 120 VAC Tungsten
 - 20A 120 VAC Ballast
 - 20A 277 VAC Ballast

2.5 CONTROL WIRING

- A. Control wiring between sensors and controls units shall be Class II, 1824 AWG stranded U.L. Classified, PVC insulated, or Teflon jacketed cable approved for use in plenums, where applicable.
- B. Control wiring shall be installed in conduit, size as required for cabling.

PART 3 - EXECUTION

3.1 GENERAL

- A. It shall be the contractor's responsibility with the manufacturer's assistance to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas. The contractor shall arrange a pre-installation meeting with a factory authorized manufacturer representative to verify placement of sensors to insure proper system operation.
- B. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within in the room(s).
- C. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.
- D. Proper judgment shall be exercised by the contractor in executing the installation, taking into consideration the device installation and to overcome local difficulties due to space limitations or interference with system performance due to building structural, finish and HVAC components.

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- E. The contractor shall obtain factory assistance and guidance in the initial sensor sensitivity adjustments and aiming of the sensors to provide specified system performance.

3.2 TESTING AND START-UP

- A. Upon completion of installation and initial adjustments the Contractor shall notify the manufacturer who shall provide a factory trained engineer to check, program and test the equipment and make adjustments as necessary to comply with the performance requirements specified within.

3.3 OWNER TRAINING

- A. Provide eight (8) hours of training for an Owner representative scheduled at the convenience of the Owner.
 - 1. Person conducting the training shall be a factory authorized representative knowledgeable in the systems specified within.
 - 2. The Contractor shall contact Owner and schedule training with Owner.

3.4 GUARANTEE

- A. Guarantee shall be total and complete and shall be for one (1) year starting with the date of total project acceptance.

END OF SECTION

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SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. This section includes the furnishing and installation, at locations shown on the drawings, of approved panelboards of a type indicated and specified herein.

1.2 RELATED WORK/SECTIONS:

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. All other Division 26000 sections

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in the NEC, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NEC.
- F. Panelboards shall comply with UL 67.
- G. Surge protective devices (SPD) shall comply with:
 - 1. Latest editions of UL 1449 and 96A.
 - 2. IEEE standards C62.45-2002, C62.41.1, C62.41.2
 - 3. NEMA LS1
 - 4. NEC Article 241
 - 5. NFPA 780
- H. Cabinet and boxes shall comply with UL 50.

1.4 SUBMITTALS:

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- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 260500, Electrical General Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.
- C. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Service Conditions: NEMA PB 1.

1.6 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate circuit breakers and fused switch sizes for branch circuit and feeders serving equipment furnished by other trades of work prior to submitting panelboard shop drawings. Note overcurrent protection size adjustments in panelboard submittals.

1.7 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.
- B. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 LABELING:

- A. All panels shall be UL labeled.
- B. All panels used as a service entrance shall be labeled as such.

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- C. A nameplate shall be provided listing panel type and ratings.

2.2 GENERAL PANELBOARD CONSTRUCTION:

- A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials, design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL, and established industry standards for those applications indicated.
- B. Distribution, Lighting, and Appliance Panelboards: Provide dead-front safety constructed factory assembled circuit breaker type panelboards in sizes and ratings as indicated. Construct with rectangular shaped copper or tin plated aluminum bus bars which are securely mounted and braced, and with lugs bolted to main bus bars.
- C. Provide anti-turn solderless pressure type lug connectors approved for copper conductors, and construct unit for connecting feeders at top of panel.
- D. Equip with full-sized neutral bus bar with suitable lugs for circuits requiring neutral connection. Provide suitable lugs on neutral bus for each outgoing feeder required.
- E. Provide main and branch circuit breakers for branch circuit and distribution panelboards. Breakers shall be molded case bolt-in type, heavy-duty, quick-make, quick-break, with toggle handles that indicate when tripped. Where multipole breakers are indicated, provide with common trip so that overload on one pole will trip all poles simultaneously.
 - 1. Circuit breakers for branch circuit panelboards and circuit breakers 125A and smaller for distribution panelboards shall be thermal-magnetic type.
 - 2. Circuit breakers 150A through 800A for distribution panelboards shall be solid state trip LSI type, 80% rated.
 - 3. Circuit breakers 1000A and larger for distribution panelboards shall be solid state trip LSIG type, 100% rated.
- F. Provide bare uninsulated grounding bars suitable for bolting to enclosures.
- G. Load center type panelboards are not acceptable, unless specifically called for in drawings.
- H. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness, with baked gray enamel finish over a rust inhibitor coating. Construct with multiple knockouts and wiring gutters. All panelboard locks shall be keyed alike. Door hinges shall be piano hinges. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed. Equip with interior circuit-directory frame, and card with clear plastic covering.
 - 1. Surface mounted panelboard fronts shall be door-in-door type, with locks and keys for both inner and outer doors.
 - 2. Flush mounted panelboard fronts shall be hinged front type, with lock for inner door and screw fasteners for outer door.

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- I. Panelboard Accessories: Provide panelboard accessories and devices including, but not limited to circuit breakers and fuses as recommended by panelboard manufacturer for ratings and applications indicated.
- J. Panelboards shall be shown in the following schedule, or approved equal, and shall be completely factory assembled. Do not purchase panelboards or cabinets until shop drawings have been approved.
 - 1. Branch Circuit Panelboards (120/208 or 120/240 V Operation). Minimum cabinet width shall be 20":

Siemens (basis of design)	P1
ABB (General Electric)	AQ
Eaton	PRL1a
 - 2. Branch Circuit Panelboards (277/480 V Operation). Minimum cabinet width shall be 20":

Siemens (basis of design)	P2/P3
ABB (General Electric)	AD
Eaton	PRL3
 - 3. Distribution Panelboards:

Siemens (basis of design)	P4/P5
ABB (General Electric)	ReliaGear neXT
Eaton	PRL4
- K. Where a specific interrupting rating is shown on the drawings, panelboards and associated circuit breakers shall be fully rated for that value as a minimum. Series rating of equipment is not acceptable.

2.3 SURGE PROTECTIVE DEVICES (SPD):

- A. Unless otherwise noted SPD shall be integral and factory installed within panelboards. SPD shall be a standard product of the panelboard manufacturer.
- B. SPD shall be parallel protective devices utilizing Metal Oxide Varistors (MOVs) for the primary suppression components. MOVs shall be furnished with UL recognized surge rated fuses rated 200kAIR for protection and shall incorporate a thermal cutout device.
 - 1. Type 1 SPD connected ahead of the service disconnect shall be furnished as an assembly with a factory disconnect switch to facilitate replacement of SPD components.
- C. SPD shall be provided with:
 - 1. Active indicator lamps which extinguish or change color when protection has failed.
 - 2. Form C dry contact for auxiliary alarm monitoring.
 - 3. Audible alarm with silence switch.

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- D. SPD shall safely reach an end-of-life condition when subjected to fault current levels between 0 and 200kA.
- E. SPD shall be covered by a 10 year unconditional warranty.
- F. SPD shall:
 - 1. Be Type 1 or Type 2 SPD.
 - 2. Provide L-L, L-N, L-G and N-G modes of protection for 1 phase 3 wire and 3 phase 4 wire systems. L-L and L-G modes of protection shall be provided for 1 phase 2 wire and 3 phase delta systems.
 - 3. Nominal discharge current (In) shall be 20kA.
 - 4. Maximum VPR shall be as follows:
 - a. 480/277V: 2000V L-L, 1200V L-N, 1200V L-G, 1200V N-G
 - b. 208/120V: 1200V L-L, 700V L-N, 700V L-G, 700V N-G
 - c. 240/120V: 1200V L-L, 700V L-N, 800V L-G, 700V N-G
 - 5. Single pulse surge current capacity shall be as follows:
 - a. PL1 – 400,000 per phase
 - b. PL2 – 160,000 per phase
 - c. PL3 – 80,000 per phase (branch circuit panelboards)
 - d. PL3 – 40,000 per phase (Fused coordination panelboards)

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS:

- A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.
- D. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.
- E. Provide properly wired electrical connections within enclosures.
- F. Fill out panelboard's circuit directory card upon completion of installation work. Type text, handwriting is not acceptable. Directory shall reflect actual installation configuration and shall incorporate final room numbers. Room numbers shown on architectural plans shall not be used for the directory.
- G. Installation shall comply with the NEC.

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- H. Anchor to walls per manufacturer's recommendation.
- I. Lace all feeder cables with tie wraps in panel housing. All wiring shall be run square inside housing.
- J. Vacuum panel housing to remove all dust and dirt from housing prior to final inspection.
- K. Cover panel housing prior to room painting. Clean all paint from panel.
- L. Provide engraved plastic identification label black face with white lettering, indicating panelboard name, voltage system, and upstream distribution including room name and number. Attach identification labels to panel with rivets or sheet metal screws.
 - 1. Labels for panels fed from the emergency power system shall have red faces with white lettering.
- M. Adjust current setting of solid state trip units to match scheduled overcurrent ratings.

3.2 GROUNDING:

- A. Provide equipment grounding connections for panelboards as indicated. Tighten connections to comply with tightening torques specified in UL Stds. 486A to assure permanent and effective grounds.

3.3 FIELD QUALITY CONTROL:

- A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.
- B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
- C. Prior to energization, check panelboards for electrical continuity of circuits, and for short circuits.
- D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

END OF SECTION

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SECTION 26 25 13 – PLUG-IN BUSWAYS

PART 1 – GENERAL

1.1 SCOPE OF WORK

- A. This section includes the furnishing and installation, at locations shown on the drawings, of approved plug-in busways of types indicated and specified herein.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. Other Division 26000 sections

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain busways, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for busways including clearances between busways and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: UL Listed and labeled as defined in the NEC, by a qualified testing agency, and marked for intended location and application.
- D. Busways and busway installations shall comply and with the following standards:
 - 1. NEMA standards BU 1.1 and KS 1.
 - 2. NFPA 70 (NEC).
 - 3. UL 857.
 - 4. NECA standards #1 and #408.

1.4 SUBMITTALS

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 260501 - Electrical Coordination.
- B. Submit dimensioned plan views and sections, include details for proposed supports.

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1.5 DELIVERY, STORAGE, AND HANDLING

A. Environmental Limitations:

1. Do not deliver or install busways until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.6 COORDINATION

- A. Coordinate layout and installation of busway and components with other construction, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Busways, associated components and accessories, shall be Square D I-Line plug-in busway (Basis of design) or equal products by one of the following manufactures:
1. ABB
 2. Siemens
 3. Eaton

2.2 PLUG-IN BUSWAY

- A. Provide 100% rated, totally enclosed, nonventilated, plug-in busway suitable for voltage system, ampacity and SCCR as indicated on plans.
- B. Busway construction shall utilize silver-plated copper conductor bars. Housing shall be powder coated in manufacturer's standard color.
- C. Plug-in openings shall be on 2' centers and shall utilized permanently attached hinged door covers to protect unused plug-in openings.
- D. Busway shall incorporate an aluminum, 50% busway capacity, equipment grounding conductor that is integral to the construction of the busway housing.
- E. Furnish busways complete with fittings, tap boxes/power feeds, elbows, and end closures to form a complete plug-in busway system.

2.3 CABLE TAP BOXES

- A. Provide busways with cable tap boxes as noted on plans.

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2.4 BUS PLUG-IN UNITS FOR FEEDER AND BRANCH CIRCUITS

- A. Bus plugs-ins shall be 3 phase units with ampacities and overcurrent protection type and rating shown on plans.
- B. Provide bus plug-ins for 4 wire busways with neutral connections.
- C. Plug-in units shall be interlocked to prevent installation or removal of the unit while in the on position.

2.5 SUPPORTS AND BRACING

- A. Hangers and bracing hardware utilized for attachment of supports to busway shall be the standard products of the busway manufacturer.
- B. Provide sway braces for busways that have bus plug-in units installed on only one side of straight runs.

2.6 ACCESSORIES

- A. Provide 8ft hookstick for each run of busway.

PART 3 - EXECUTION

3.1 INSTALLATION OF BUSWAYS

- A. General: Install busways in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA standards, and in compliance with recognized industry practices.
- B. Coordinate installation with cable and raceway installation work.
- C. Support from structure above with spacing between supports not to exceed 5 feet unless otherwise designed and marked by manufacturer to permit longer support spacing intervals. Utilize minimum ½" diameter all-thread rod with busway hangers obtained from busway manufacturer.
- D. Seismic bracing shall be provided in accordance with section 26 0548 - Seismic Support of Electrical Equipment.
- E. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A.
- F. Provide properly wired electrical connections within enclosures.

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- G. Provide engraved plastic identification label black face with white lettering on cable tap box, indicating equipment name, voltage system, and upstream distribution including room name and number. Attach identification labels with rivets or sheet metal screws.
- H. Provide equipment grounding connections, tighten connections to comply with tightening torques specified in UL Stds. 486A to assure permanent and effective grounds.

3.2 FEEDER AND BRANCH CIRCUIT CONNECTIONS

- A. Connections from raceways to plug-in units shall be made utilizing flexible metal conduit in lengths no longer than 6'.
- B. Connection and support of flexible cords to plug-in units shall be in accordance with NEC Article 368.

3.3 FIELD QUALITY CONTROL

- A. Prior to energization of circuitry:
 - 1. Check accessible connections are tightened to manufacturer's torque specifications.
 - 2. Check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.
 - 3. Check for electrical continuity of circuits, and for short circuits.
- B. Subsequent to wire and cable hook-ups, energize and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

END OF SECTION

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SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes the furnishing, installation, and connection of wiring devices as shown on the plans.
- B. Types of electrical wiring devices in this section include the following:
 - 1. Receptacles
 - 2. Switches
 - 3. Faceplates
 - 4. Motor rated toggle switches

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. Other Division 26000 sections
- B. See section on Substitutions.

1.3 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC as applicable to installation and wiring of electrical wiring devices.

1.4 SUBMITTALS

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 26 05 00 - Electrical General Requirements.
- B. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
- C. The specific item proposed, and its area of application shall be marked on the catalog cuts.

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PART 2 - PRODUCTS

2.1 FABRICATED WIRING DEVICES

- A. General: Provide factory-fabricated wiring devices, in types, colors, and electrical ratings for applications indicated. Unless noted otherwise device color shall be ivory. Wiring devices shall comply with NEMA publications WD1 and WD6.
- B. Receptacles shall comply with Federal Spec WC-596.
- C. Toggle switches shall comply with Federal Spec WS-896.
- D. Wiring Devices: 15 and 20A, 120 V devices shall employ modular connections without exposed wiring terminals. Acceptable products are as follows.
 - 1. Legrand/P&S Plugtail
 - 2. Hubbell SnapConnect
 - 3. Leviton Lev-Lok
- E. Wiring devices shall be as listed in the following table, or approved equal:

<u>Description</u>	<u>Legrand</u>	<u>Hubbell</u>	<u>Leviton</u>
Single Pole Toggle Switch	PT20ACI	SNAP1221	M1221-I
Three Way Toggle Switch	PT20AC3I	SNAP1223	M1223-I
20A 125V 2P 3W Grounded Duplex Tamper Resistant Receptacle (NEMA 5-20R)	PTTR5362I	SNAP5362ITR	M5362-I
20A 125V 2P 3W Grounded Duplex Tamper Resistant Ground Fault Interrupter (NEMA 5-20R)	PT2097TRI	GFTWRST20SNAPI	MGFT2-I
20A 125V 2p 3W Grounded USB (2) Type AC USB Ports w/Duplex Tamper Resistant Receptacle (NEMA 5-20R)	TR5362USBI	USB20A5I	T5832-I

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<u>Description</u>	<u>Legrand</u>	<u>Hubbell</u>	<u>Leviton</u>
20A 125V 2P 3W Grounded Duplex Ground Fault Interrupter weather resistant (NEMA 5-20R)	2097TRWR	GFWRST20	G5362-WTT
20A 250V 2P 3W Grounded Single Receptacle (NEMA 6-20R)	5871	HBL5461	5461
30A, 208/120V 3P 4W Dryer Receptacle (NEMA 14-30R)	3864	HBL9430A	278
50A, 208/120V 3P 4W Range Receptacle (NEMA 14-50R)	3894	HBL9450A	279
30A, 600V 2P Motor Rated Toggle Switch	7802MD	HBL7832D	MS302-DS

2.2 WET AND DAMP LOCATION RECEPTACLES

- A. Type "DL" - Damp Locations: Damp location receptacles shall be a weather resistant duplex GFCI receptacles similar to those under 262726 WIRING DEVICES, Part 2.1.C, mounted in cast metal outlet box fitted with a gasketed metal cover with spring door. Damp location receptacles shall be flush mounted unless noted otherwise.
- B. Type "WP" - Wet Locations: Weatherproof receptacles shall be a weather resistant duplex GFCI receptacles as specified under 262726 WIRING DEVICES, Part 2.1.C, mounted in cast metal outlet box fitted with a gasketed "while-in-use" metal cover, Hubbell WP26E or Pass & Seymour WIUC10-CAGV or approved equal. Weatherproof receptacles shall be flush mounted in exterior walls.

2.3 DEVICE PLATES

- A. Outlet boxes shall have a coverplate.
- B. Unused telephone outlets shall be fitted with a blank cover plate.

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- C. Faceplates: Provide faceplates for single and combination wiring devices, of types, sizes, and with ganging cutouts as indicated. Select plates which mate and match wiring devices to which attached. Metal screws shall be used for securing plates to devices; screw heads colored to match finish of plates.
- D. Faceplates shall be uniform in design and finish for switches, receptacles, and other outlets. Plates shall be one-piece of the required number of gangs; sectional plates shall not be used.
- E. Plates shall be jumbo oversize satin finished stainless steel.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

- A. Install wiring devices as indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.
- C. Install wiring devices only in electrical boxes which are clean; free from excess building materials, dirt, and debris.
- D. The devices shall be installed in such a manor as to allow the faceplates to be installed without distortion of the faceplate or gaps between the faceplate and wall.
- E. Install faceplates after painting work is completed.
- F. Unless otherwise specified, install faceplates on all device and outlet boxes including telephone outlet boxes. As a minimum, blank plates shall be included for 25% of telephone/data outlets shown on the drawings.
- G. Tighten connector and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds. 486A. Use properly scaled torque indicating hand tool.

3.2 PROTECTION OF FACEPLATES AND RECEPTACLES

- A. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs.

3.3 GROUNDING

- A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Std. 486A to assure permanent and effective grounds.

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3.4 TESTING

- A. Prior to energizing circuitry, test wiring for electrical continuity, and for short circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION

SECTION 26 28 16 - SAFETY/DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section includes the furnishing, installation, connection, and wiring of safety switches.

1.2 QUALITY ASSURANCE

- A. Safety/Disconnect switches shall conform to Underwriter's Laboratories UL 98, "Enclosed and Dead-Front Switches."

1.3 SUBMITTALS

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 26 05 00 - Electrical General Requirements.

PART 2 - PRODUCTS

2.1 GENERAL SAFETY/DISCONNECT SWITCH FEATURES

- A. Switches shall be NEMA type HD (Heavy Duty) and UL listed.
- B. All switches shall have switch blades which are fully visible in the "OFF" position when the switch door is open. All current carrying parts shall be plated to resist corrosion and promote cool operation. Switches shall have removable arc suppressors where necessary to permit easy access to line side lugs. Lugs shall be front removable, and UL listed for 60 degrees C and 75 degrees C, aluminum or copper wires.
- C. Switches shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started. The operating handle shall be an integral part of the box, not the cover. Provisions for padlocking the switch in the "OFF" position with at least three locks shall be provided. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. The handle position shall indicate whether the switch is "ON" or "OFF".
- D. Switches shall be horsepower rated for AC and/or DC as indicated by the plans. All fusible switches rated 100 thru 600 amperes at 240 volts and 30 thru 600 amperes at 600 volts shall have a UL approved method of field conversion from standard Class H fuse spacing to Class J fuse spacing. The switch also must accept Class R fuses and have provisions for field installation of a UL listed rejection feature to reject all fuses except Class R. The UL listed short circuit rating of the switches shall be 200,000 rms symmetrical amperes when Class R or Class J fuses are used with the appropriate rejection scheme. The UL listed short circuit rating of the

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switch, when equipped with Class H fuses, shall be 10,000 rms symmetrical amperes. 800 and 1200 ampere switches shall have provisions for Class L fuses and shall have a UL listed short circuit rating of 200,000 rms symmetrical amperes.

- E. Disconnect switches shall be equipped with ground lug.

2.2 NEMA 1 AND 3R HEAVY DUTY SAFETY/DISCONNECT SWITCHES

- A. Switches shall be furnished in NEMA 1 general purpose enclosures unless exposed to weather which shall be NEMA 3R. Covers on NEMA 1 enclosures shall be attached with pin type hinges. NEMA 3R covers shall be securable in the open position. NEMA 3R enclosures for switches thru 200 amperes shall have provisions for interchangeable bolt-on hubs. Hubs shall be as indicated on the plans. NEMA 3R enclosures shall be manufactured from galvanized steel. Enclosures shall have a gray baked enamel finish, electrodeposited on cleaned, phosphatized steel.

2.3 NEMA 4X HEAVY DUTY SAFETY/DISCONNECT SWITCHES

- A. Provide NEMA 4X disconnect switches where indicated on the drawings.

2.4 SPECIFIED MANUFACTURERS

- A. Specified manufacturers shall be as follows, or approved equal:
 1. General Electric
 2. Square D
 3. Eaton
 4. Siemens

PART 3 - EXECUTION

3.1 INSTALLATION LOCATION

- A. As a general rule, install switches on the equipment it serves, if shown that way on the drawings.
- B. Do not install switch on equipment removable panel.
- C. All switches shall be accessible.

3.2 GROUNDING

- A. Connect ground wires to ground lug.
- B. See section - GROUNDING.

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3.3 CONDUIT BUSHINGS

- A. Use plastic bushings where conduit enters switch.

END OF SECTION

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SECTION 26 51 00 - LIGHTING

PART 1 - GENERAL

1.1 SCOPE

- A. This section included the furnishing, installation, and connection of light fixtures, conduit, lamps, fittings, and boxes to form complete, coordinated, grounded interior lighting systems.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the Contractor shall refer to other specification sections and drawings to ascertain the extent of work included. This shall include, but not be limited to, the following:
 - 1. Division 1
 - 2. All other Division 26000 sections

1.3 QUALITY ASSURANCE

- A. NEC Compliance: Comply with NEC as applicable to installation and construction of lighting fixtures.
- B. UL Compliance: Provide lighting fixtures which have been UL listed and labeled.
- C. CBM Labels: Provide fluorescent lamp ballasts which comply with certified Ballast Manufacturers Association standards and carry the CBM label.

1.4 SUBMITTALS

- A. Submit catalog cuts and descriptive literature for approval in accordance with Section 26 05 00 - Electrical General Requirements.

1.5 COORDINATION OF CEILING TYPE

- A. Determine the exact ceiling to be furnished in each area and obtain fixtures to suit. Deviate from specifications only where necessary and to the extent necessary to ensure fixture-ceiling compatibility.

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES - GENERAL

- A. Shall conform to the drawings and fixture schedule.

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PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC, and as shown on the drawings.
- B. Align, mount, and level the lighting fixtures uniformly.
- C. For suspended lighting fixtures, the mounting heights shall provide the clearances between the bottoms of the fixtures and the finished floors as shown on the drawings.
- D. Support fixtures securely from building structure. Grid ceiling framing members shall not be used to support fixtures.

3.2 CLEAN-UP AND RE-LAMPING

- A. Before final acceptance of the electrical work in all or any part of the building, the Contractor shall clean the bottoms, the trim, the reflecting surfaces, lenses, baffles, reflector cones and lamps of all lighting fixtures.
- B. Mask the trim and bottoms of all lighting fixtures if necessary to protect the fixture during construction.
- C. Review and ensure that all lamps installed are exactly as specified for each fixture type.
- D. Replace all burned out or inoperative lamps and inoperative ballasts in all fixtures so that all lighting fixtures will be in first class operating condition upon acceptance.

END OF SECTION

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SECTION 28 31 11 - FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performance of all operations required to extend the existing Simplex 4010 Fire Alarm System serving the building to the renovation areas as shown on the drawings and as specified herein.
- B. The Fire Alarm System shall provide fire protection and warning to the building as presently configured.
- C. All equipment, devices and wiring required to form a complete code-compliant fire alarm system and comply with the requirements of this specification shall be included.
- D. For each new 24VDC power supply provided, provide a new dedicated 20A, 120V **circuit (not shown on drawings)** sized 2#12, #12Gnd., ¾"C. from the nearest existing 120/208V branch circuit panelboard.

1.2 RELATED WORK/SECTIONS

- A. In addition to this section, the requirements of the conditions of the Contract, Supplementary Conditions and General Requirements, apply to the work specified in this section.
- B. The work covered by this section of the specifications is to be coordinated with the related work as specified elsewhere under the project specifications.

1.3 QUALITY ASSURANCE

- A. The complete installation is to conform to the applicable sections of the International Building Code (IBC), NFPA-72, Local Code Requirements, and the National Electric Code, with particular attention to Article 760.
- B. UL Compliance and Labeling: Provide components which are UL listed and labeled in accordance with the following UL Standards:
 - 1. UL 268 – Standard for Smoke Detectors for Fire Alarm Signaling Systems
 - 2. UL 864 (9th edition) - Standard for Control Units and Accessories for Fire Alarm.
 - 3. UL 1481 - Standard for Power Supplies for Fire-Protective Signaling
 - 4. UL 1971 – Standard for Signaling Devices for the Hearing Impaired
 - 5. UL 2572 - Standard for Control and Communication Units for Mass Notification Systems.
 - 6. Other UL listings: Each device, component and sub-component of the fire alarm system shall be listed for its intended function.
- C. NEMA Compliance: Comply with applicable portions of NEMA Std. Pub. SB 4 pertaining to installation of fire alarm systems.

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- D. The system is not required to be U.L. certificated. However, the following items shall be included in the bid:
1. System installation, checkout/testing, and system demonstration for the Owner, Engineer, and Authority Having Jurisdiction per NFPA-72 requirements and per the Construction Drawings and Specifications.
 2. Central Station monitoring service is existing and is provided by the Owner's existing Central Station monitoring company (obtain monitoring company phone number and account numbers from the Owner).
 3. **Installation and testing of all fire alarm system devices, equipment, and wiring shall be performed by a qualified electronics contractor licensed specifically for signal systems installation and that is an authorized Simplex distributor.**
 - a. All installers shall be factory trained representatives of the equipment manufacturer and shall be licensed and authorized to install the fire alarm system wiring and equipment approved for the installation.
 - b. All installers shall have a minimum of two years of wire, equipment, and device installation experience *with the make/model of equipment being furnished*.
 - c. The installation of the system wiring, equipment, and devices shall be supervised throughout the entire duration of the project by a factory trained Technician or Engineer employed by the manufacturer's representative with a minimum of five years of experience *in the installation of the make/model of equipment being furnished*. This person shall hold a current minimum NICET III Certification.
 - d. All system programming shall be performed by a factory trained Technician employed by the manufacturer's representative with a minimum of two years of experience *in programming of the specified system*.

1.4 SUBMITTALS

- A. Shop Drawings: As a minimum, the fire alarm and fire detection shop drawing submittal shall include all items relating to fire alarm system modifications:
1. Complete data sheets bearing the printed logo or trademark of the fire alarm control panel manufacturer for all equipment including but not limited to the following:
 - a. System power supplies with battery backup and charger
 - b. Standby batteries and battery charger
 - c. Each separate type of automatic smoke and heat detector to be connected to the system
 - d. Manual alarm initiating stations
 - e. Visual alarm notification appliances
 - f. Combination audible/visual notification appliances
 - g. Control and monitoring modules
 - h. Any other items of fire alarm equipment required by the drawings and/or specifications
 2. Battery manufacturer date-codes keys.
 3. Evidence of listing of all proposed equipment by Underwriter's Laboratories for application as fire alarm equipment.
 4. Complete calculations showing the following:
 - a. Battery calculations for all system power supplies and amplifiers.
 - b. Voltage drop (visual notification appliance circuits)

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5. Written certification by the contractor that no battery, power supply or circuit on the system has an electrical load greater than 80% of its actual capacity, when all items are taken into account.
6. Provide scaled floor plans, riser diagrams, factory wiring diagrams, field wiring diagrams indicating the wiring of all devices to include raceway size and routing, junction boxes, and conductor size, type and quantity in each raceway. Information to be included on layout plans shall include but shall not be limited to the following:
 - a. Circuit tags on all circuit legs.
 - b. Labeling of all initiation devices (to include signaling circuit designation and device address).
 - c. Labeling of all notification appliances with specific device identifier label and notification circuit number.
 - d. Connections to HVAC systems.
 - e. Connections to fire protection systems.
7. Submit labeling scheme for typical alarm and supervisory points as they are to appear at the specified display points. Include all abbreviations for device types and operational areas.
8. Provide specifications of all cable types labeled with their intended application. This cable shall have been tested and approved by the fire alarm control panel manufacturer for use with the manufacturer's equipment.
9. The Contractor shall not purchase any materials or equipment prior to receipt of approved shop drawings.

1.5 AS BUILT DRAWINGS

- A. See Specification 26 0501 - ELECTRICAL COORDINATION.

1.6 SYSTEM SOFTWARE

- A. Provide all fire alarm system operational software to owner that will allow the owner to operate, maintain the systems and make changes, additions and deletions to system initiation devices. Format shall be on flash drive.

1.7 SYSTEM DESCRIPTION

- A. The major system elements include but are not limited to the following items:
 1. Existing control panel modifications (FACP)
 2. Manual pull stations
 3. Visual alarm notification appliances
 4. Audible/visual notification appliances
 5. Smoke detectors
 6. Duct smoke detectors
 7. Smoke detectors
 8. Batteries and chargers at fire alarm control panels, and power extender panels.
- B. Audible & visual occupant notification configuration :

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1. The system shall be configured to automatically activate all notification appliances throughout all areas of the facility upon activation of any manual or automatic fire alarm initiation device.
- C. The building's fire alarm system shall signal all system alarm, trouble and supervisory conditions to the remote monitoring station.
- D. Power Extenders with battery backup and charger, locations as shown on plans. Provide additional units as required for power to all notification appliances.
- E. Conduit routing and system wiring is not shown on the plans. It shall be the responsibility of the fire alarm installer to coordinate with the fire alarm manufacturer to determine the conduit requirements (size and routing) and wiring required for system operation.
- F. Surge Protective Devices (SPD) shall be provided as recommended by the manufacturer for all copper cables (at each end - install at cable termination points.) that enter and leave the buildings and for all 120V circuits serving fire alarm panels.
- G. The system shall be electrically supervised non-presignal type.
- H. Operation of any manual or automatic device shall:
 1. Activate the audible and visual indicators and event message display at the local fire alarm control panel (FACP) and the remote annunciator panel(s) indicating the status of the event, initiating device or zone.
 2. Activate remote station alarm, supervisory and trouble reporting procedure through the digital communicator and telephone system.
 3. Initiate the local emergency evacuation signal throughout the building.
 4. The system may be "reset" to normal standby condition upon restoring the initiating device to "normal" and activating the "reset" switch on the FACP panel or the "reset" switch at the remote annunciator panel(s).
- I. All trouble and supervisory events shall cause the audible trouble signal to sound at the system control panels and Remote annunciator panel(s). Trouble and supervisory events shall be silenced locally by a switch at the control panels or Remote Annunciator panel. Visual indication of all trouble and supervisory events shall be displayed as follows:
 1. The common trouble lamp shall illuminate and the trouble/supervisory event shall be displayed alpha-numerically on the LCD display on the control panels and Remote annunciator panel(s). Visual indication of trouble events shall remain until the condition is corrected and the system is reset. Visual indication of supervisory events shall remain until the condition is corrected and the system is reset (latching applications) or until the supervisory condition is self-restored (non-latching application). Trouble/supervisory events include but are not limited to the following:
 - a. Ground, fault, or open on a signaling, 24VDC power circuit, or notification circuit.
 - b. Failure of a system component or device.
 - c. Loss of 120 volt operating power to control panel (see specifications on delay of remote reporting of this signal).
 - d. Activation of any fire protection system supervisory point.
- J. The main control panel (FACP) and Remote Annunciator panel (FAA) shall display system events via color touch screen liquid crystal display (LCD) screens. A consistent system of definitive and distinctive abbreviations shall be utilized to maintain a concise format of all

displays. Upon activation of a fire alarm initiation and/or supervisory device, the FACP panel and FAA shall display information as follows.

1. Device type (i.e. smoke detector, duct smoke detector, fire suppression system, manual pull station, etc.).
 2. Air handler designation (if device is a duct smoke detector located at an air handler).
 3. For fire protection system flow switches (where applicable), the display shall indicate the zone or area(s) served by that branch of the fire protection system.
 4. For fire protection system tamper switches (where applicable), the display shall indicate the room name and room number where device is located.
- K. All initiating devices shall be equipped with a local LED indicator to indicate alarm status of the device.
- L. Each independently supervised circuit shall include a discrete panel readout to indicate disarrangement conditions per circuit.
- M. Provide isolator modules as required by NFPA-72 to protect/isolate signaling circuit segments.
- N. The system shall be configured for control of auxiliary equipment as follows:
1. Provide individual, remote addressable output modules with form "C" contacts for control of auxiliary equipment as noted on the plans.
 2. Addressable output modules shall not reset until the system is manually reset.
 3. All addressable output modules shall be configured for programmable activation by any initiation point or grouping of initiation points.
 4. Provide heavy duty slave relays as required to accommodate the current and voltage requirements of the peripheral systems connected to the fire alarm system.

1.8 POWER REQUIREMENTS

- A. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of twenty-four (24) hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to the standby batteries upon power failure.
- B. Provide battery chargers at all system panels as recommended by the system manufacturer. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be audibly and visually indicated at the control panel. All battery charging and recharging operations shall be automatic. The charging equipment shall be capable of recharging the batteries within 24 hours.
1. With exception of batteries for amplifiers, all batteries shall be sized with 20% minimum spare capacity. "Derating" factors do not qualify as spare capacity.
- C. All circuits requiring system operating power shall be 24VDC and shall be individually fused at the control panel.
- D. Date marking of batteries:
1. All system batteries shall be permanently marked by the manufacturer with the month/year of manufacture using the month/year format.

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- a. Date-codes are not acceptable.
 2. All system batteries shall be marked with machine generated stick-on labels by the contractor with the month/day/year of installation
- 1.9 COMMUNICATION WITH ADDRESSABLE DEVICES:
- A. All addressable devices are to have the capability of being disabled or enabled individually.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide fire alarm system components and as manufactured by one of the following manufacturers (no equal):
 1. Simplex

2.2 GENERAL:

- A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. This shall include, but not be limited to, control panel modifications (hardware, firmware & software), manual pull stations, automatic fire detectors, horn/strobe units, strobe units, monitoring devices, control devices, all wiring, raceways, connections to devices, outlet boxes, junction boxes, and all other necessary material for a complete operating system.
- B. All panels and peripheral devices shall be the standard product of a single manufacturer and shall display the manufacturer's name on each component.

2.3 FIRE ALARM CONTROL PANELS (FACP): Existing to remain in service

- A. Remote reporting (digital communicator): Existing to remain in service.
- B. Existing Fire Alarm Control Panel (FACP) model is as follows
 1. Simplex: 4010

2.4 FIRE ALARM POWER EXTENDER (FPE)

- A. Fire alarm power extenders shall be by Simplex – no equal.

2.5 ALARM NOTIFICATION DEVICES

- A. Alarm notification devices shall include:
 1. Horn/strobes (combination audiovisual)

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2. Strobes (visual only)

B. Audible/visual notification appliances shall meet the following requirements:

1. Wall appliance color: Red
2. Strobes:
 - a. Synchronized flashing for all units within any viewing area. Strobe flash frequency shall be 1 fps.
 - b. UL 1638 listed as a Visual Signaling Appliance for wall or ceiling mounted configuration as shown on the drawings.
 - c. Multi-candela type with field selectable candela ratings as follows:
 - 1) 15 cd
 - 2) 30 cd
 - 3) 75 cd
 - 4) 95 cd
 - 5) 110 cd
 - 6) 135 cd
 - 7) 185 cd
 - d. Minimum strobe candela settings shall be as noted on the drawings. Final settings shall be adjusted as required to ensure compliance with NFPA-72.
 - e. Synchronized flashing for all strobe units within any viewing area (including strobes powered from different remote power supplies for which network synchronization modules shall be used). Strobe flash frequency shall be 1 fps.
 - f. UL 1638 listed as a Visual Signaling Appliance for wall or ceiling mounted configuration as shown on the drawings.
 - g. Device color shall match existing.

C. Notification appliances shall operate from the 24V DC polarized indicating circuits.

D. All visual notification appliances shall have meet the equivalent requirements of the Americans with Disabilities Act (ADA).

E. Flush devices shall mount on 4 x 4-inch or 2-gang electrical boxes. Box depth shall be coordinated with device supplier.

F. Outdoor devices exposed directly to weather shall be U.L. listed as weatherproof.

2.6 ADDRESSABLE DEVICE TYPES

A. General: The system control panels, over the two wire signaling channels, must be capable of communicating with the types of addressable devices specified below. All smoke detectors and heat detectors and the associated control panel hardware and software shall utilize the latest and most advanced intelligent detection technology available from the manufacture at the time of bidding.

B. Photo-electric Smoke Detectors:

1. Photo-optic sensing chamber, UL listed to Standard 268.
2. Low voltage, 2-wire solid state design incorporating tamper proof, plug-in head assembly.
3. Tamper-resistant design.

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4. Intelligent addressable design with integral addressable transponder. Detector shall utilize fuzzy logic intelligence to continually analyze the ambient conditions present and shall signal the host control panel accordingly when ALARM or TROUBLE conditions are detected.
5. Separate detector mounting base: Molded construction equipped with terminal screws for all wiring connections, designed for mounting on any standard 4 inch square outlet box for concealed wiring, or special box for surface raceway.
6. Design to produce TROUBLE signal if detector head is removed from its mounting base and ALARM signal if detection chamber is removed.
7. LED that blinks when sensor is being polled and glows steady when in alarm.
8. Factory set device type code.

C. Addressable Pull Stations:

1. Pull stations shall be addressable. The stations shall be manufactured from high impact red Lexan or cast metal. Lettering shall be raised and painted white. Stations shall be single-action pull type requiring a firm downward pull to activate.
2. The station shall mechanically latch upon operation and remain so until manually reset by opening with a key common to all system locks.
3. The front of the station is to be hinged to a backplate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. The station shall consist of high impact Lexan, red in color.
4. The addressable manual station shall be capable of field programming of its "address" location on an addressable signaling line circuit.
5. There shall be no limit to the number of stations which may be activated or "in alarm" simultaneously.

2.7 CONTROL MODULES:

- A. Addressable (field programmable).
- B. Supervised.
- C. Lexan coverplate.
- D. Contacts shall be form "C", rated at 2A, 24 VDC and 0.5A, 120 VAC.
- E. Where higher contact current ratings are required for the controlled device, provide heavy duty relays with proper Form "C" contact ratings slaved directly off of a control module through a supervised control circuit.
- F. Provide supervised 24VDC circuits as required, powered from the local fire alarm control panel, for activating control modules and relays.
- G. Coordinate contact voltage and current ratings with voltage and current ratings of controlled devices.

2.8 AUXILIARY RELAYS:

- A. Specifications:

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1. Electrically held.
2. 7A contact rating (@24Vdc & 120Vac).
3. 24Vdc coil, 15mA coil current (@24Vdc).
4. Form "C" contacts.
5. LED status indicator.

B. Model: PAM-SD (or approved equal)

2.9 MONITORING MODULES:

- A. Addressable (field programmable).
- B. Supervised.
- C. Lexan coverplate.
- D. Field assignable personality codes as follows:
 1. Normally open alarm - Latching
 2. Normally open alarm - Delayed latching
 3. Normally open active - Non-latching
 4. Normally open active - Latching

2.10 FIRE ALARM REMOTE ANNUNCIATOR PANELS (FAA): Existing to remain.

2.11 SYSTEM WIRING

- A. General:
 1. Survivability and pathway configurations:
 - a. Unless otherwise specified herein, all circuits covered under this specification shall have a pathway survivability level of 0 (pathway defined by NFPA-72 as *"any circuit, conductor, optic fiber, radio carrier, or other means for transmitting system information to remain operational during fire conditions"*).
 2. All cables installed underground or below building foundations shall be U.L. listed for exposure to wet locations (West Penn Aquaseal or approved equal).
 3. All signaling circuit cables shall be provided as follows.
 - a. NEC Type FPLP for all non-riser type cables (U.L. listed for fire alarm use).
 - b. NEC FPLR (not applicable to this project).
 - c. Minimum size shall be #18AWG.
 4. All floor-to-floor cables serving notification appliances, and 24VDC powered devices shall be provided as follows (manufacturer's requirements shall take priority):
 - a. NEC Type FPLR riser type cables, manufactured specifically for fire alarm system applications.
 - b. Minimum size shall be #14AWG.

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5. All horizontal circuits serving notification appliances, and 24VDC powered devices shall be provided as follows (manufacturer's requirements shall take priority):
 - a. NEC Type FPLP, manufactured specifically for fire alarm system applications (non-riser type cables).
 - b. 600V, THWN insulated wiring.
 - c. Minimum size shall be #14AWG.
 6. Separation shall be maintained for circuits utilizing copper conductors as required per NFPA 70, Article 760.
- B. Initiation device signaling circuit pathways shall be Class B.
1. Floor-to-floor initiation device signaling circuit cable shall be FPLP type as classified by NEC Article 760.
- C. Remote annunciator signaling circuit pathway shall be Class B.
1. Remote annunciator signaling circuit cable shall be FPLP type as classified by NEC Article 760.
- D. Notification appliance circuit pathways shall be Class B.
- E. All circuits shall be protected (power limited) as required per NFPA 70 to allow notification circuits to be installed in the same conduit as initiation and signaling circuits.
- F. Fire Alarm circuits may be solid or stranded as recommended by the equipment manufacturer for each specific application.

2.12 GROUNDING OF LOW VOLTAGE SURGE SUPPRESSION DEVICES

- A. Install a #12AWG THHN green insulated equipment grounding conductor in all fire alarm conduits serving low voltage surge suppressors. Connect the grounding conductor to each surge suppressor's grounding terminal and to the ground lug in the power supply or control panel enclosure serving the fire alarm devices connected to the associated fire alarm circuit(s).

2.13 BATTERIES

- A. System batteries shall be sealed lead acid type listed for use with Fire Alarm systems.
- B. All batteries furnished shall be new (unused) and shall be installed within one (1) year from the date of manufacturer.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. The Contractor is responsible for assuring that conduit size and wire quantity, size, and type is suitable for the equipment supplied. The Contractor shall review the proper installation of each type of device with the equipment supplier.

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- B. All wiring shall be installed in new conduit in unfinished spaces and above ceilings, and unless noted otherwise shall be installed in new wiremold where located below finished ceilings in finished spaces.
- C. Furnish and install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations.
- D. All wiring shall be installed in strict compliance with all the provisions of NEC - Article 760, Part III - Power-Limited Fire Alarm (PLFA) Circuits, or if required may be reclassified as non-power limited and wired in accordance with NEC-Article 760, Part II Non-Power-Limited Fire Alarm (NPLFA) Circuits.
- E. For ceiling device installations in suspended tile ceilings, adjustable T-bars & extra deep boxes shall be provided to accommodate specific ceiling types and to provide ample capacity and space for wiring pulling and circuit terminations.
- F. The Contractor shall clean all dirt and debris from the inside and the outside of the fire alarm equipment after completion of the installation.
- G. Make all fire alarm wiring continuous from control panel (or power extender panel) to device terminals.
- H. T-taps are not allowed without approval (submit formal request for specific T-tap applications early in submittal phase and prior to submittal of layout drawings)
- I. Protect detectors during construction period as required by NFPA-72.
- J. Smoke detectors shall be mounted only in an orientation for which they have been listed.
 - 1. Smoke detectors shall not be located any closer than 3'-0" from any ceiling type HVAC supply or return air grille and shall not be located anywhere within the direct path of any side-wall type HVAC supply air grilles. Separation shall be greater where higher air velocities dictate and smoke detection performance is likely to be impaired. All devices requiring relocation after installation that were not brought to the attention of the Engineer shall be relocated at the Contractor's expense.
- K. Final locations of all visual notification appliances and combination visual/audible notification appliances shall be adjusted as required up to 3' maximum from the nearest obstruction (casework, smart board projectors, etc.) to provide unobstructed direct visibility of all visual appliances in the field of view. Review Architectural drawings (where applicable) prior to rough-in phase and report all discrepancies to the Engineer in writing. All devices requiring relocation after installation that were not brought to the attention of the Engineer shall be relocated at the Contractor's expense
- L. Installation and testing of all fire alarm system devices and equipment shall be performed by a qualified electronics contractor licensed specifically for signal systems installation. This Contractor shall be a factory trained representative of the equipment manufacturer and shall be licensed and authorized to install and maintain the fire alarm system approved for the installation.

3.2 CONTROL MODULES

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- A. Control modules shall be installed within 18 inches of their associated devices to be controlled and in a readily accessible location.
- B. Verify locations of interface points with all systems in the field prior to conduit rough-in.
- C. Provide control module interfaces for systems including but not limited to the following:
 - 1. As noted on the drawings.

3.3 MONITORING MODULES

- A. Monitoring modules shall be installed within 24 inches of their associated devices to be controlled and in a readily accessible location.
- B. Verify locations of interface points with all systems in the field prior to conduit rough-in.
- C. Provide monitoring module interfaces for systems as shown or as noted on the drawings.
- D. The contractor shall be responsible for assigning the proper "personality code" for each monitoring module depending on the application.

3.4 PROGRAMMING

- A. The system installer shall provide complete programming for all systems whether programming is factory installed or installed in the field by the system installer.
- B. The system installer shall derive all user specified programming information (building designations, room descriptions, etc.) from the actual room names and numbers *not the construction drawings*.
- C. All programming changes required by the Owner to render the system usable and functional by the Owner's standards shall be made at the contractor's expense.

3.5 LABELING

- A. New power extender panels (FPE) shall be permanently labeled with their respective panel designations in accordance with general Division 26 labeling requirements.
- B. Initiation devices and addressable monitoring and control modules shall be labeled with the SLC loop and address using machine generated stick-on labels.

3.6 120V BRANCH CIRCUIT BREAKER LOCK-OUT, MARKING, AND LABELING

- A. All 120V branch circuit breaker handles serving fire alarm panels shall be provided with a "lock-out" type accessory per NFPA-72 requirements with a pad lock (keyed alike - furnish ten keys to the Owner) that allows the circuit breaker to be locked in the "ON" position and allow the circuit breaker to trip in an overload condition.

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- B. All 120V branch circuit breaker handles serving fire alarm panels shall be permanently marked with red color per NFPA-72 requirements.
- C. The 120V panelboard index circuit designations for all 120V branch circuit panelboards serving fire alarm panels shall be identified typically FIRE ALARM CIRCUIT-FPE", etc. per NFPA-72 requirements.

3.7 TESTING, GUARANTEE, SERVICE

- A. Provide initial certification testing of the system in accordance with the procedures outlined in NFPA 72. The minimum required tests for new equipment, devices, and circuits shall be as follows:
 - 1. Verify the absence of unwanted voltages between circuit conductors and ground.
 - 2. Test all conductors for short circuits utilizing an insulation testing device.
 - 3. Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.
 - 4. Perform the following tests for all system batteries in strict accordance with NFPA-72:
 - a. Charger test.
 - b. Discharge test.
 - c. Load voltage test.
 - 5. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner specified.
 - 6. Test each initiating and notification circuit. One connection each should be opened at not less than 10 percent of the initiating and notification devices.
 - 7. Test each initiating and notification device for alarm operation and proper response at the control unit.
 - 8. Test smoke detectors and carbon monoxide detectors with listed aerosols acceptable to the manufacturer or other such testing methods which are approved by the manufacturer.
 - 9. Test heat detectors with U.L. listed heat generating test equipment.
 - 10. Test the system for all specified functions in accordance with the manufacturer's operating and maintenance manual.
 - 11. Verify that each alarm notification device functions as specified. Determine that the system is operable under trouble conditions as specified.
 - 12. Field verification of auxiliary function interfaces:
 - a. Field-verify and pretest each and every interface with auxiliary systems (air handler shut-down, elevator recall, kitchen hood suppression systems, etc.) at least three (3) weeks prior to acceptance testing.
 - b. Submit a report to the Engineer at least seven (7) calendar days prior to scheduled acceptance testing with final confirmation of proper functioning of each auxiliary system. Each and every auxiliary system shall be listed in line item format with "PASS"/" FAIL" condition documented.
 - 13. Provide all labor required for making one post-acceptance testing field adjustment to all audible notification appliance dB settings as directed by the Owner, Engineer, or Authority Having Jurisdiction (final scope of adjustments to be established by the Engineer following acceptance testing).
 - 14. Provide all other testing required by NFPA 72 but not specified herein.

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- B. Test a minimum of 10% of existing devices and circuits that were directly or indirectly affected by renovations.
- C. Document all testing in accordance with the National Fire Alarm Code. Submitted documentation shall include but shall not be limited to the following items:
 - 1. Fully completed Partial NFPA-72 Record of Completion form (2019 Edition).
 - 2. Fully completed Partial NFPA-72 Inspection and Testing form (2019 Edition).
- D. Upon completion, the Contractor shall conduct a functional test of the entire system for the Authority Having Jurisdiction, Owner and Engineer.
 - 1. Additional testing and demonstration for the Authority Having Jurisdiction, Owner and Engineer shall be provided as required until the system is demonstrated to be free of unexplained alarms, troubles, faults, or any abnormalities.
- E. In the event that additional software programming is necessary to complete the tests, the system shall be completely retested as outlined in this section at the contractor's expense.
- F. All components, parts and assemblies supplied by the manufacturer shall be guaranteed by the manufacturer against defects in materials and workmanship for a period of three (3) years. The equipment manufacturer shall provide normal labor service as required during this period at no cost to the Owner and shall respond to any call within two (2) hours 24 hours a day, seven days per week.
- G. The equipment manufacturer shall have a local branch office or authorized factory distributor staffed with trained, full-time employees who are capable of performing testing, inspection, repair and maintenance services for the life of the fire alarm system.

3.8 COMPLETION

- A. Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and the like and leave the premises clean, neat and orderly.
- B. Certification:
 - 1. The contractor shall certify in a letter to the Engineer that the complete system has been checked in accordance with the required NFPA-72 testing standards and has been installed in accordance with the contract documents and that all items have been labeled.
- C. Training: Not applicable.
- D. Two (2) weeks prior to the final completion, provide to the Owner (through the engineer) a complete printout of the system programming along with flash drive copy of the program. The flash drive shall include all manufacturer's software necessary to perform maintenance and adds. Software shall be installed on the Owner's computer as directed by Owner. Moves and changes to the system shall be provided to the Owner two (2) weeks prior to the final completion.

3.9 SPARE PARTS Not applicable

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3.10 KEYS

- A. Keys and locks for all equipment shall be identical where possible. Provide not less than six keys of each type required. Identify keys by an appropriate number stamped on each key or on a metal tag attached thereto. Provide a key numbering chart in the operation and maintenance manual furnished.

END OF SECTION

REPORT OF GEOTECHNICAL EXPLORATION

AMSC CENTER EXPANSION
MIDLANDS TECHNICAL COLLEGE, AIRPORT CAMPUS
1260 LEXINGTON DRIVE
WEST COLUMBIA, SOUTH CAROLINA

Prepared For:
Midlands Technical College
1260 Lexington Drive
West Columbia, South Carolina 29170

BLE Project Number 25-25810
April 28, 2025



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April 28, 2025

Midlands Technical College
1260 Lexington Drive
West Columbia, South Carolina 29170

Attention: Mr. Tommy Wise

Subject: **Report of Geotechnical Exploration
AMSC Center Expansion
Midlands Technical College, Airport Campus
West Columbia, South Carolina
BLE Project No. 25-25810**

Mr. Wise:


Bunnell-Lammons Engineering, Incorporated (BLE) is pleased to present this report of geotechnical exploration for the proposed AMSC Center Expansion at the Midlands Technical College, Airport Campus located at 1260 Lexington Drive in West Columbia, South Carolina.

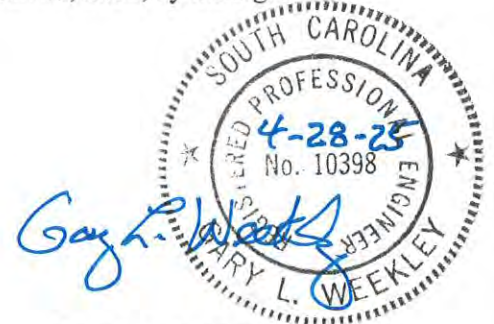
This exploration was performed generally as described in Bunnell-Lammons Engineering (BLE) Proposal No. 25-25810P dated March 25, 2025. The exploration was authorized on March 31, 2025, by the signature of Mr. Tommy Wise on our Proposal Acceptance Sheet.

Sincerely,

BUNNELL-LAMMONS ENGINEERING, INC.


Alex Skoler, E.I.T.
Engineering Associate


Kevin Morgan, P.E.
Geotechnical Engineer
Registered, SC #39160



Gary L. Weekley, P.E.
Senior Engineer
Registered, SC #10398

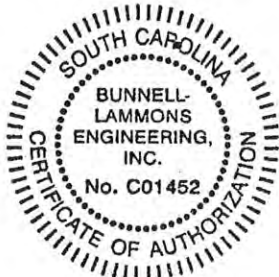




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Appendix C	Field Exploration Procedures
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Appendix F	Important Information About This Geotechnical Report

1.0 EXECUTIVE SUMMARY

This Executive Summary is intended as an overview of the geotechnical conditions that are expected to affect design and construction. The following summarizes the main findings of the exploration, particularly those that have a cost impact on the planned development. Further, our principal foundation recommendations are summarized. The information provided in the executive summary should not be used in lieu of reading the entire geotechnical report.

The geotechnical conditions at the site of the proposed ASMC expansion located at the Midlands Technical College Airport Campus in West Columbia, South Carolina, were explored by drilling two soil test borings to depths of approximately 20 and 50 feet below the existing ground surface. A summary of the findings and recommendations are as follows:

- The soil test borings encountered approximately 7 to 8 inches of asphalt pavement underlain by approximately 2 to 3 feet of fill material classified as medium dense poorly graded sand with silt (SP-SM). The fill material is underlain primarily by Coastal Plain native very loose to loose poorly graded sand with silt (SP-SM) and silty clayey sand (SC-SM) to a depth of 33 feet below the existing ground surface. Below a depth of 33 feet, boring B-2 encountered stiff sandy silt (ML), medium dense clayey sand (SC) and very stiff plastic clay (CH).
- Groundwater was not encountered during the subsurface exploration.
- Building loads can be supported on shallow foundations designed using an allowable bearing pressure of 3,000 psf.
- The shallow spread foundations shall have minimum dimensions of 24 inches for column footings and continuous/strip footings. The minimum embedment depth for foundations is 18 inches below the final exterior grade.
- Floor slab subject to forklift traffic should be designed by structural engineer.
- The proposed structure may have a slab-on-grade bearing on approved coastal plain soils or engineered fill, provided the subgrade is evaluated and prepared as outlined in this report.
- Grade slab should have a minimum 6-inch thick compacted gravel base course to support forklift traffic.
- Engineered fill can be placed in maximum 8-inch loose lifts to 95% of the standard Proctor maximum dry density and 98% of the standard Proctor maximum dry density in the top 24-inch thickness of fill placement.
- Pavements can be supported directly on approved Coastal Plain soil or engineered fill, provided the subgrades are evaluated and prepared as outlined in this report.
- Rigid (concrete) pavements are recommended for all locations planned for forklift traffic due to the high wheel and shear loads which can degrade asphalt pavement.
- It is recommended that BLE conduct a geotechnical review of the project plans (prior to issuance for construction) to confirm that BLE's geotechnical recommendations have been properly interpreted and implemented.

2.0 AUTHORIZATION

A geotechnical exploration for the proposed AMSC Center Expansion located at the Midlands Technical College Airport Campus in West Columbia, South Carolina was performed generally as described in Bunnell-Lammons Engineering (BLE) Proposal No. 25-25810P dated March 25, 2025. The exploration was authorized on March 31, 2025, by the signature of Mr. Tommy Wise on our Proposal Acceptance Sheet.

3.0 SCOPE OF EXPLORATION

This report presents the findings of the geotechnical exploration performed for the proposed AMSC Center Expansion located at 1260 Lexington Drive in West Columbia, South Carolina (reference Figure 1, Appendix A). The intent of this exploration was to evaluate the subsurface soil and groundwater conditions at the site to provide geotechnical recommendations for design of the foundations, pavements, and associated project elements. We have also included a discussion of secondary design considerations and provided geotechnical related construction recommendations.

4.0 PROJECT INFORMATION

The following project information was provided in a request for proposal (RFP) from Mr. Tommy Wise to our Mr. Kevin Morgan. Included with the RFP were civil drawings in which included an existing site and demolition plan, site plan, and additional civil drawings. The plans were dated with an original date of August 2013 and a revision date of September 2014.

It is proposed to construct an expansion of the existing AMSC Center Building. The new expansion will be one story and fabricated as an I-beam structure adjoining to the existing building. The proposed expansion will be used for construction classes including use of a forklift. Based on our review of available online aerial imagery and our recent site visit, the site is occupied by the AMSC Center building with an associated metal canopy attached on the west side of the building. Ground cover for the expansion predominately consists of asphalt pavement.

Structural information provided to us by Mr. Tommy Wise consists of wheel loads of 7.5 kips and maximum column loads of 20 kips. Grading information was not available at this time. However, we anticipate the expansion structure will be at a similar elevation as the existing structure, therefore we expect minimal (less than 5 feet) of earthwork cut and/or fill will be required for construction.

5.0 FIELD EXPLORATION

5.1 Soil Test Borings

The site was explored by drilling two soil test borings (ASTM D1586) at the approximate locations shown on the attached Boring Location Plan (reference Figure 2, Appendix A). Borings, B-1 and B-2, located within the proposed expansion limits, were advanced to depths of 20 and 50 feet, respectively. A description of our field procedures is also included in Appendix C. The borings were located and logged by our Mr. Alex Skoler by referencing the provided site plan and identifiable site landmarks. Boring elevations were

estimated using publicly available sources. Boring logs are presented in the Appendix D of this report. The boring locations and elevations shown in the Appendix should be considered approximate.

6.0 SITE GEOLOGY

The site is located within the Atlantic Coastal Plain Physiographic Province of South Carolina. The soils in this province are generally interbedded silts, sands, and clays that have been deposited during successive advances and retreats of the ocean over the past several million years. Along rivers the marine deposits have, in more recent times, been successively eroded and overlain by alluvial (water-deposited) soils.

Most formations within the Coastal Plain were laid down in a shallow sloping sea bottom, tilting gradually toward the sea at the rate of a few feet per mile. During periods of relatively low sea level, the old bottom deposits emerged, forming plains tilting toward the sea. These plains were subsequently eroded by coastal streams which formed shallow troughs in an otherwise uniform stratum. During periods of relatively high sea level, the former troughs were inundated and filled with more recent sediments. Consequently, many of the formations in the Coastal Plain exist as fractional erosional remnants sandwiched within more continuous strata.

7.0 SUBSURFACE CONDITIONS

Beneath an approximate 7 to 8-inch layer of asphalt pavement across the site, the borings encountered fill and native coastal plain soils. The fill material encountered consisted of a medium dense to dense poorly graded sand with silt (SP-SM). The native Coastal Plain soils underlying the fill material consists primarily of very loose to loose poorly graded sand with silt (SP-SM) and silty clayey sand (SC-SM) to a depth of 33 feet below the ground surface. Underlying the SC-SM soils, interchanging layers of stiff sandy silt (ML), medium dense clayey sand (SC) and very stiff fat clay (CH) were encountered to a termination depth of 50 feet. The letters in parentheses represent a visual classification of the soils in accordance with the Unified Soil Classification System. A key to symbols and classification is included as Appendix E.

The above descriptions provide a summary of the subsurface conditions encountered. The boring logs included as Appendix D contain detailed information recorded at each boring location. The boring logs represent our interpretation of the field logs based on engineering examination of the field samples and soil laboratory testing. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. It should be noted that the soil conditions will vary between boring locations.

7.1 Groundwater

Groundwater was not encountered by the borings. It should be noted that groundwater levels may fluctuate several feet with seasonal changes, rainfall variations and with changes in the water level in adjacent drainage features. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall.

8.0 LABORATORY TESTING

A summary of the laboratory testing is presented in the following Table 1:

Table 1: Laboratory Index Test Results

Boring ID	Sample Depth (feet)	Soil Description	Natural Moisture Content (%)	Atterberg Limits			Percent Gravel (%)	Percent Fines (%)	USCS
				LL	PL	PI			
B-01	3.5 – 5.0	Poorly Graded Sand with Silt	5.1	NV	NP	NP	0.0	11.1	SP-SM
B-02	8.5 – 10.0	Silty Clayey Sand	7.6	21	17	4	0.0	12.2	SC-SM

Note: NP: Non-Plastic, NV: Non-Viscous

These laboratory tests were used to assist in soil classifications as well as foundation and pavement recommendations. The laboratory test results are presented in Appendix B along with a discussion of the laboratory test procedures.

9.0 ANALYSIS AND DESIGN RECOMMENDATIONS

9.1 Foundations

Structural information provided to us consists of maximum building column loads of 20 kips and wheel point loads of 7.5 kips. Based on our review of the boring and laboratory data and our experience with similar project conditions, the encountered native Coastal Plain soils are suitable for use for shallow foundation support, however these soils should be densified as specified in the following sections. The recommendations below assume that the site has been prepared in accordance with the Construction Recommendations section of this report.

Given the provided load of 20 kips, foundations bearing in approved coastal plain soils may be sized for an allowable bearing pressure of 3,000 pounds per square foot (psf). We recommend that the native bearing soils in the foundation excavations be densified with multiple passes of a vibratory compactor prior to placement of steel reinforcement. Foundations bearing on new engineered fill that is placed on densified native soil and compacted to at least 98 percent of the standard Proctor maximum dry density (ASTM D698), as recommended later in this report, may also be sized for an allowable bearing pressure of 3,000 psf.

We recommend that the minimum width for individual column and continuous wall footings be 24 inches. The minimum width will provide a margin of safety against a local or punching shear failure of the foundation soils. There is a minimal frost depth at the project site, however footings should bear at least 18 inches below final exterior grade to provide sufficient bearing capacity embedment considerations. We recommend that walls be provided with movement joints to accommodate some possible differential settlement.

Exposure to the environment may weaken the soils at the foundation bearing level if the foundation excavations remain open for long periods of time. Therefore, we recommend that once each foundation excavation is extended to final grade, the foundation be constructed as soon as possible to minimize the potential damage to loose soil, ponded water, and debris. Foundation concrete should not be placed on soils that have been disturbed by seepage. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the excavation must remain open overnight or if rainfall becomes imminent while the bearing soils are exposed, we recommend that a 2 to 4-inch thick "mud-mat" of "lean" (2,000 psi) concrete be placed on the bearing soils for protection before the placement of reinforcing steel.

To verify that the soils encountered in footing excavations are similar to those encountered by the soil test borings, we recommend that foundation excavations be examined. Part of this examination should include checking the bearing soils to a depth of 3 feet with a dynamic cone penetrometer (DCP) performed by an experienced engineering technician working under the direction of the geotechnical engineer.

9.2 Settlement

We conducted settlement estimates assuming conventional shallow spread foundations were used to support the structure. The settlement estimates are based on the maximum loading information provided to us as indicated in Section 9.1. Assuming foundations are designed and constructed in accordance with the recommendations presented in this report, we estimate the total foundation settlement to be less than 1-inch. Maximum differential settlement between adjacent similarly loaded foundations is estimated to be approximately ½-inch or less.

9.3 Lateral Earth Pressure

Retaining walls must be capable of resisting the lateral earth pressures that will be imposed on them. Walls which will be permitted to rotate at the top, such as cantilever retaining walls, may be designed to resist the active earth pressure. The active earth pressure coefficient is designated as K_a . Typically, a top rotation of about 1 inch per 10 feet height of wall is sufficient to develop active pressure conditions in soils similar to those encountered at the site. We recommend a K_a value of 0.33 for the soils encountered at this site when placed in accordance with the requirements for engineered fill.

Walls which will be prevented from rotating such as underground storage tank pits should be designed to resist the at-rest lateral earth pressure. The at-rest earth pressure coefficient is designated as K_o . We recommend a K_o value of 0.5 for the soils encountered at this site in their natural state or when placed in accordance with the requirements for engineered fill.

The passive earth pressure may be considered as the pressure exerted on the side of a foundation which aids in resisting sliding of the foundation. The passive earth pressure coefficient is designated as K_p . Friction resistance along the base of the foundation may also be used to resist sliding. The coefficient of frictional resistance is designated as f_s . We recommend a f_s value of 0.4 and a K_p value of 3.0 for the soils encountered

at this site. Consideration should be given to dividing the passive earth pressure coefficient by a safety factor of 2 to limit the amount of lateral deformation required to mobilize the passive resistance. Published documentation¹ indicates that very little horizontal compression (approximately 0.5% relative to wall height) is required to develop one-half of the available passive resistance, hence the suggested safety factor of 2. However, depending on soil type and relative density it may take 2 to 15% horizontal compression to develop the full passive resistance.

The values presented above assume that the ground surface is level. Sloping backfill (or sloping soil surfaces in front of a footing when considering passive resistance) will dramatically influence the earth pressure coefficients. Bunnell-Lammons Engineering should be consulted concerning applicable earth pressure coefficients where sloping soil surfaces may be present.

The compacted mass unit weight of the backfill soil, which we estimate to be approximately 125 pcf, should be used with the earth pressure coefficients to calculate lateral earth pressures. Lateral pressure arising from surcharge loading, earthquake loading, and groundwater should be added to the above soil earth pressures to determine the total lateral pressures which the walls must resist. Where practical, we recommend that retaining walls and other below grade walls incorporate filtered gravity drainage systems to prevent the buildup of excess hydrostatic pressures behind the walls. In addition, transient loads imposed on the walls by construction equipment during backfilling should be taken into consideration during design and construction. Excessively heavy grading equipment should not be allowed within about 5 feet horizontally of the walls.

9.4 Seismic Site Classification

Geotechnical seismic design requirements are detailed in the International Building Code. The seismic site class is determined based on the soil/rock properties within the upper 100 feet.

It was beyond the scope of this exploration to drill borings extending to a depth of 100 feet and there was no rock encountered within the depths explored. In accordance with the International Building Code (IBC) Section 1613 (2021) and ASCE 7-16, a Site Class D shall be used when soil properties are not known in sufficient detail to determine the Site Class unless the building official determines that Site Class E or F soil is likely to be present at the site. Based on our knowledge of the area and the conditions encountered in the soil test borings, we recommend that the structure be designed using a seismic Site Class D.

Table 2: Seismic Acceleration Parameters (IBC 2021 / ASCE 7-16)

Site Class	S _s (g)	S ₁ (g)	PGA (g)	F _a	F _{PGA}	S _{DS} (g)	S _{D1} (g)	PGA _M (g)	Seismic Design Category
									RC I-IV
D	0.346	0.114	0.196	1.523	1.409	0.352	0.18	0.276	II

¹ *Soil Mechanics* by T. William Lambe and Robert V. Whitman; Massachusetts Institute of Technology; 1969; p.165.

9.5 Grade Slabs

Building grade slabs may be soil supported assuming that the native soils are densified in accordance with the recommendations in this report. Grade slabs that will have forklift traffic should have a minimum 6-inch-thick compacted gravel base course underlying a minimum 6-inch-thick concrete slab. Grade slabs should be designed by the structural engineer. The grade slab should be jointed around columns and along footing supported walls so that the slab and foundations can settle differentially without damage. This jointing is not required when slabs and foundations are cast as a monolithic unit (i.e. thickened edge foundations). If slab thickness permits, joints containing dowels or keys may be used in the slab to permit movement between parts of the slab without cracking or sharp vertical displacements.

Based on the soils encountered at the site, we recommend a modulus of subgrade reaction, k , of 225 pci for use in design of slabs and dumpster pads. This modulus value is for a one-foot square plate.

Floor slabs supported on grade which will be carpeted, tiled, painted or receive some other covering or sealant should incorporate a vapor barrier. The vapor barrier should be installed in accordance with the requirements of ACI 302 and per the manufacturer’s recommendations.

9.6 Pavement

A site-specific pavement design requires detailed information about projected traffic frequency and intensity, acceptable service limits, life expectancy and other factors. For the purpose of this report, light duty pavement is considered to be subject to automobile traffic, such as a car parking lot. Heavy duty pavement is considered to be subject to an occasional loaded delivery truck and garbage trucks. Pavement planned to have forklift traffic should be designed as rigid concrete pavement because of the high wheel and shear loads.

Presented in the table below are recommended pavement sections based on the assumed traffic type/frequency, our evaluation of the laboratory test results and our experience with similar projects in this region. Assuming the site is prepared in accordance with the recommendations of this report, the pavement sections presented below could be expected to provide adequate performance considering a 15- to 20-year service life.

Table 3: Pavement Recommendations

Pavement Type	Layers	Material	Thickness (Inches)	
			Light Duty	Heavy Duty
Flexible	a.	Asphaltic concrete surface course	2.0	3.0
	b.	Aggregate base course	6.0	8.0
Rigid	a.	Concrete	6.0	6.0
	b.	Aggregate base course	6.0	6.0

The asphaltic concrete should conform to the South Carolina Department of Transportation Supplemental Technical Specification for Hot-Mix Asphalt Material Properties (SCDOT Designation: SC-M-402) Type C HMA Surface Course and Type C HMA Intermediate Course. The stone base course should meet the requirements of Section 305 of SCDOT Standard Specifications for Macadam base. The base course should be compacted to 100 percent of the standard Proctor (ASTM D698) maximum dry density.

The concrete for rigid pavement should be air-entrained and have a minimum flexural strength (third point loading) of 550 psi which could likely be achieved by a concrete mix having a compressive strength of at least 4,000 psi at 28 days. Recommended air contents from the Portland Cement Association (PCA) are as follows:

<u>Maximum Aggregate Size</u>	<u>Percent Air</u>
1½ inches	5 percent plus or minus 1½ percent
¾ to 1-inch	6 percent plus or minus 1½ percent

In addition, we recommend a maximum slump of 4 inches for plastic concrete.

Joint spacing for the recommended concrete thickness should be on the order of 12 to 15 feet. Control joints should be sawed as soon as the cut can be made, without raveling (aggregate pulling out of the concrete matrix) or cracks forming ahead of the saw blade. Joints should be sawed consecutively so that the joints commence working together. The American Association of State Highway and Transportation Officials (AASHTO) suggests that transverse contraction joints should be one quarter of the slab thickness and longitudinal joints should be one third of the slab thickness. All joints should be filled with flexible joint filler.

Curing of the concrete slab should begin as soon as the slab has been finished and the joints sawed. Moist curing by fog spray nozzles or wet burlap is the most dependable curing procedure. Other methods of curing could consist of spray applied curing compounds or covering the slab with waterproof paper or heavy plastic. If paper or plastic is used for curing, the edges of the cover should be anchored and joints between sheets should be taped or sealed.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations, and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

It is advisable to use rigid (concrete) pavement in areas where forklift traffic is expected, as these vehicles exert significant point loads that can cause ruts in asphalt surfaces. The recommended rigid pavement sections consist of unreinforced plain Portland Cement Concrete (PCC). For dumpster pads and the approaches to dumpsters, we suggest utilizing reinforced PCC pavement. Additionally, these pads should also be designed using a modulus of subgrade reaction value, k, of 225 pci.

9.7 Secondary Design Considerations

The following items are presented for your consideration. These items are known to enhance performance of structural and pavement systems.

- Roof drainage should be collected by a system of gutters and downspouts and directed away from all structures.
- Sidewalks should be sloped so that water drains away from the structures.
- Site grading and paving should result in positive drainage away from the structures. Water should not be allowed to pond around the structures or in such locations that would lead to saturation of pavement subgrade materials. A minimum slope of approximately ¼ to ½-inch per foot should provide adequate drainage.
- Backfill for utility lines should be placed in accordance with the requirements for engineered fill to minimize the potential for differential settlement.

10.0 CONSTRUCTION RECOMMENDATIONS

10.1 Clearing and Grubbing

All existing asphalt pavement, topsoil, vegetation, trees, stumps, disturbed soils, unsuitable soils and surface soils containing organic matter or other deleterious materials should be stripped from within the proposed building and pavement areas. Topsoil and organic soils may be stockpiled for later use in areas to be landscaped. Other deleterious material should be disposed of offsite or in areas of the site that will not be developed.

10.2 Drainage

Groundwater was not encountered by the borings at the time of drilling of our exploration. However, it should be noted that groundwater levels may fluctuate several feet with seasonal and rainfall variations and with changes in the water level in adjacent drainage features. Normally, the highest groundwater levels occur in late winter and spring and the lowest levels occur in late summer and fall. The contractor should be prepared to promptly remove any surface water or groundwater from the construction area. This has been done effectively on past jobs by means of gravity ditches and pumping from filtered sumps. At this time, we do not expect groundwater to affect the proposed construction.

10.3 Proofrolling

After stripping and rough excavation grading, we recommend that areas to provide support for the foundations, floor slab, engineered fill, and pavement be carefully inspected for soft surficial soils and proofrolled with a 25 to 35-ton, four-wheeled, rubber-tired roller, or similar approved equipment. The proofroller should make at least four passes over each location, with the last two passes perpendicular to the first two where practical.

Any areas which wave, rut, or deflect excessively and continue to do so after several passes of the proofroller should be excavated to firmer soils. The excavated areas should be backfilled in thin lifts with engineered fill.

The proofrolling and excavating operations should be carefully monitored by an experienced engineering technician working under the direction of the geotechnical engineer. Proofrolling should not be performed when the ground is frozen or wet from recent precipitation.

10.4 Engineered Fill

All fill used for raising site grade or for replacement of material that is undercut should be uniformly compacted in thin lifts, no greater than 8-inch-thick loose lift, to at least 95 percent of the standard Proctor maximum dry density (ASTM D698). In addition, at least the upper 24 inches of subgrade fill beneath pavements and floor slabs exposed to forklift traffic should be compacted to at least 98 percent of the standard Proctor maximum dry density. We recommend that the fill be placed and compacted at a moisture content within three percent of the standard Proctor optimum moisture content.

Based on our visual examination, laboratory testing, and experience with similar soil types, most of the on-site soil appears to be suitable for use as engineered fill with proper moisture adjustment. Soils having a Plasticity Index (PI) greater than 30 (less than 15 is preferable) should not be used for fill. Soils used for engineered fill should be reasonably free from organics (less than 3% organics by weight), should contain particles no larger than 3-inches, and should exhibit a standard Proctor maximum dry density greater than 90 pcf. The near surface soils encountered across the site primarily classify as poorly graded sand with silt (SP-SM) and silty clayey sand (SC-SM) and may be used as engineered fill.

Before filling operations begin, representative samples of each proposed fill material should be collected and tested to determine the compaction and classification characteristics. The maximum dry density and optimum moisture content should be determined for each type of fill soil. Once compaction begins, a sufficient number of density tests should be performed by an experienced engineering technician working under the direction of the geotechnical engineer to measure the degree of compaction being obtained. Existing slopes steeper than 6:1 (horizontal:vertical) should be benched prior to placement of engineered fill such that the fill is placed in horizontal layers and keyed into the existing slopes.

The edge of engineered fill extending above surrounding grade should extend horizontally beyond the outside edge of the building foundations at least 10 feet or a distance equivalent to the height of fill to be placed, whichever is greater, before sloping. The edge of fill should extend at least 5 feet beyond paved areas. Fill slope surfaces should be protected from erosion by grassing or some other means.

The surface of compacted subgrade soils can deteriorate and lose its support capabilities when exposed to environmental changes and construction activity. Deterioration can occur in the form of freezing, formation of erosion gullies, extreme drying, exposure for a long period of time or rutting by construction traffic. We recommend that the surfaces of floor slab and pavement subgrades that have deteriorated or softened be recompacted prior to construction of the floor slab or pavement. Additionally, any excavations through the subgrade soils (such as utility trenches) should be properly backfilled in compacted lifts. Recompanction of subgrade surfaces and compaction of backfill should be checked with a sufficient number of density tests to determine if adequate compaction is being achieved.

10.5 Slopes

Confined temporary excavations such as for utility installation or below-grade wall construction should conform to OSHA regulations. For permanent slopes which are not confined, our experience suggests that excavation side slopes through the existing soil overburden at the site should be laid back at a 2H:1V (horizontal to vertical) slope or flatter. Permanent fill slopes placed on a suitable foundation should be constructed at 2.5:1, or flatter. Fill slopes should be adequately compacted. Cut and fill slope surfaces should be protected from erosion by grassing or other means. Permanent slopes of 3:1 or flatter may be desirable for mowing.

11.0 SPECIFICATIONS REVIEW

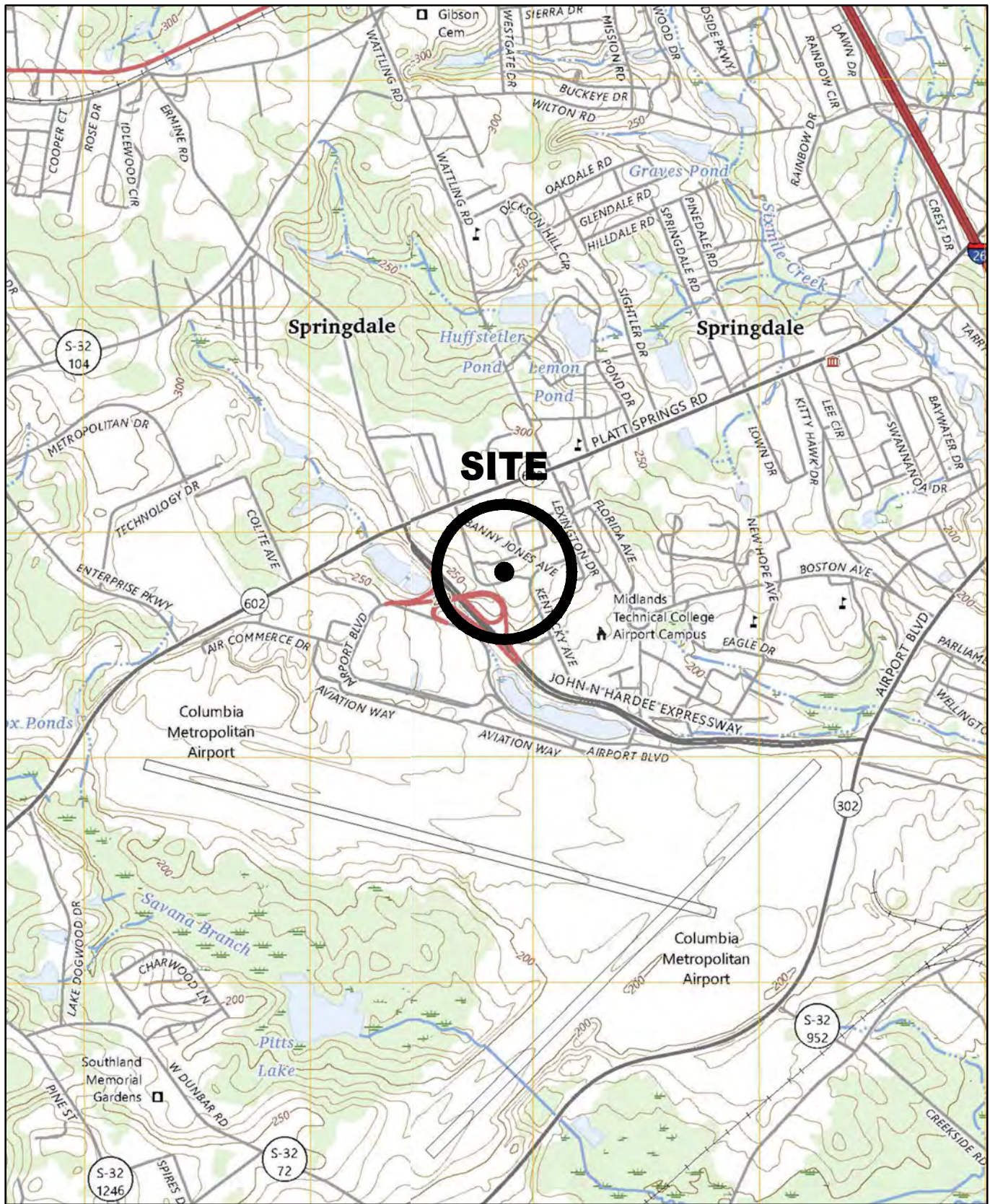
It is recommended that Bunnell-Lammons Engineering be retained to make a review of the foundation and earthwork plans and specifications prepared from the recommendations presented in this report. We would then suggest any modifications so that our recommendations are properly interpreted and implemented.

12.0 BASIS OF RECOMMENDATIONS

Our evaluation of foundation support conditions has been based on our understanding of the project information and data obtained in our exploration as well as our experience on similar projects. The generalized subsurface conditions utilized in our foundation evaluation have been based on interpolation of the subsurface data between the widely spaced borings. Subsurface conditions between the borings may differ. If the project information is incorrect or the structure location (horizontal or vertical) and/or dimensions are changed, please contact us so that our recommendations can be reviewed. The discovery of any site or subsurface conditions during construction which deviate from the data obtained in this exploration should be reported to us for our evaluation. The assessment of site environmental conditions for presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this exploration. Soil cuttings used as backfill in boreholes will settle over time resulting in a depression at the surface. It is beyond the scope of our services to return to the site to repair boreholes that have exhibited settlement of the backfill soils.

APPENDIX A

Figures



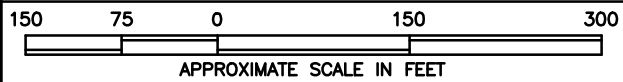
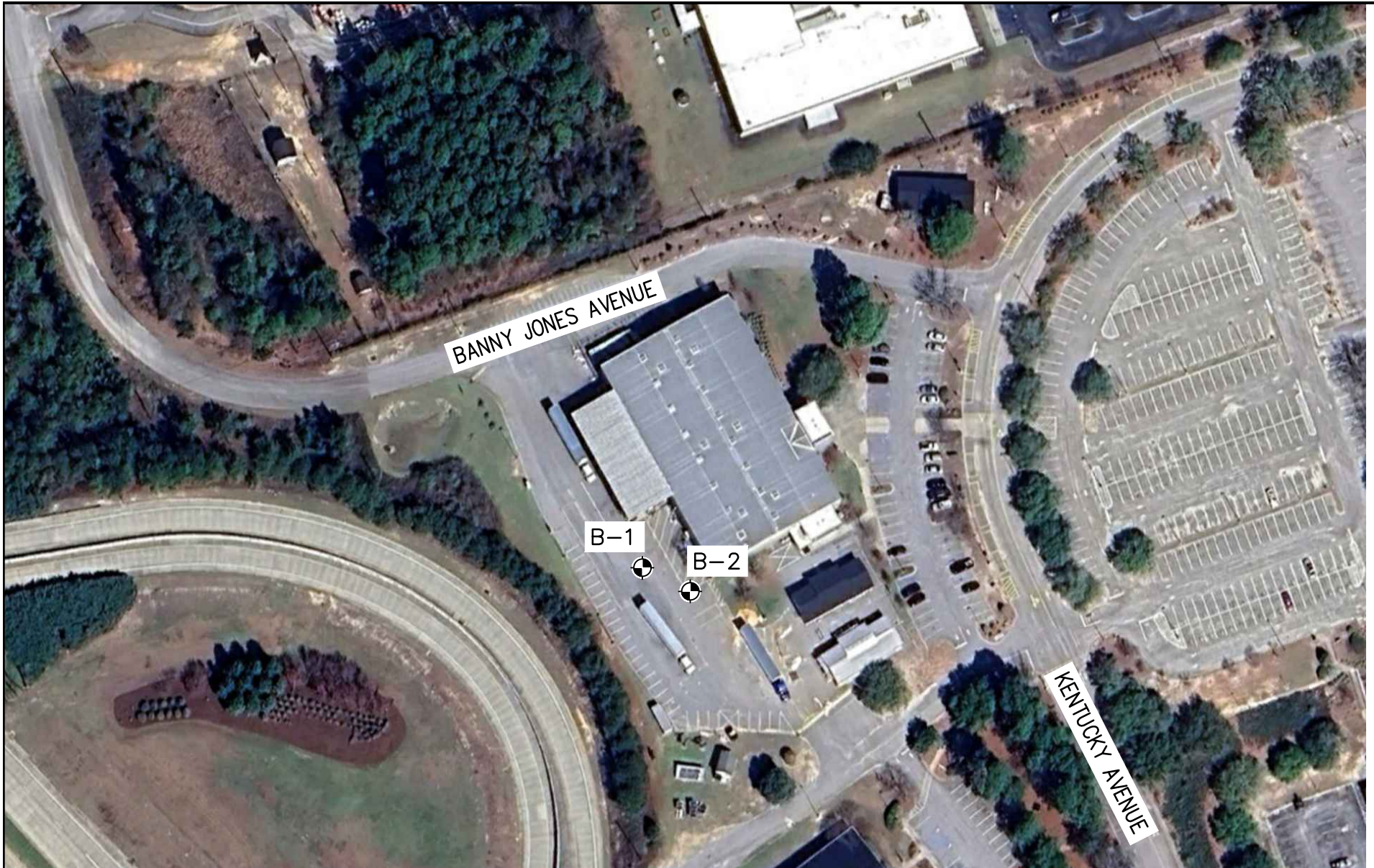
REFERENCE:
 USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES,
 SOUTHWEST COLUMBIA AND LEXINGTON, S.C. QUADRANGLE, 2024.

DRAWN: ENC	DATE: 4-8-25
CHECKED: KRM	CAD: AMSC EXPANSION
APPROVED: KRM	JOB NO: 25-25810

BLE | BUNNELL
 LAMMONS
 ENGINEERING

720 Gracern Rd, Ste 132 Columbia, SC 29210
 Phone: (803) 832-1380 Fax: (803) 832-1379

SITE LOCATION MAP
 AMSC CENTER EXPANSION
 MIDLANDS TECHNICAL COLLEGE, AIRPORT CAMPUS
 WEST COLUMBIA, SOUTH CAROLINA



LEGEND:
SOIL TEST BORING  B-1

REFERENCE:
1. GOOGLE EARTH IMAGE DATED
3-7-2025.

DRAWN:	ENC	DATE:	4-8-25
CHECKED:	KRM	CAD:	AMSC EXPANSION
APPROVED:	KRM	JOB NO:	25-25810

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ENGINEERING**
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BORING LOCATION PLAN
AMSC CENTER EXPANSION
MIDLANDS TECHNICAL COLLEGE, AIRPORT CAMPUS
WEST COLUMBIA, SOUTH CAROLINA

FIGURE

2

APPENDIX B
Laboratory Test Procedures and Results



**BUNNELL
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Laboratory Test Procedures

NATURAL MOISTURE CONTENT

The natural moisture content of selected samples was determined in accordance with ASTM D2216. The moisture content of the soil is the ratio, expressed as a percentage, of the weight of water in a given mass of soil to the weight of the soil particles.

GRAIN SIZE DISTRIBUTION

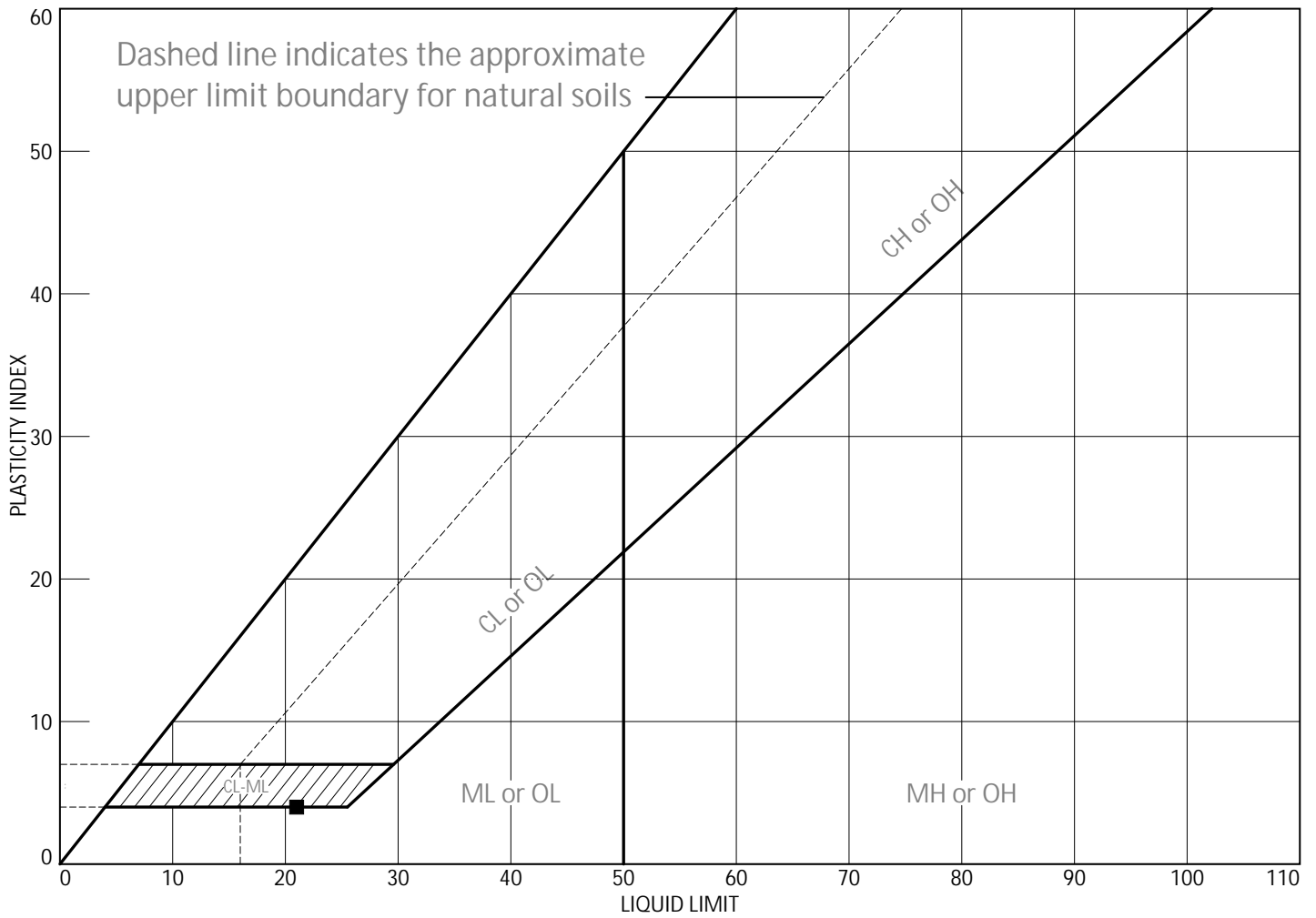
Grain size tests were performed on selected soil samples to determine the particle size distribution of these materials. After initial drying, the samples were washed over a U.S. Standard No. 200 Sieve to remove the fines (particles finer than a No. 200 mesh sieve). The samples were then dried and sieved through a standard set of nested sieves. This test was performed in accordance with ASTM D6913. The results are presented as percent finer by weight versus particle size curves.

SOIL PLASTICITY

Representative samples were selected for Atterberg Limits testing to determine their soil plasticity characteristics. The soil's Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). These characteristics are determined in accordance with ASTM D4318. The LL is the moisture content at which the soil will flow as a heavy viscous fluid. The PL is the moisture content at which the soil begins to lose its plasticity.

Certain soils swell and shrink with increases and decreases in soil moisture. The PI is related to this potential volume change ability. When such volume changes occur in soils confined beneath foundations, floor slabs, and pavements, structural deformations can be produced. Past experience has shown that soils having a PI of less than 30 are only slightly susceptible to volume changes. Soils having a PI greater than 50 are generally very susceptible to these volume changes. Soils with a PI between these limits have moderate volume change potential.

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	Borings	B-1	3.5-5.0 Ft.	5.1	NP	NV	NP	SP-SM
■	Borings	B-2	8.5-10.0 Ft.	7.6	17	21	4	SC-SM

Bunnell Lammons Engineering, Inc.

Greenville, SC

Client: Midlands Technical College

Project: AMSC Center Expansion

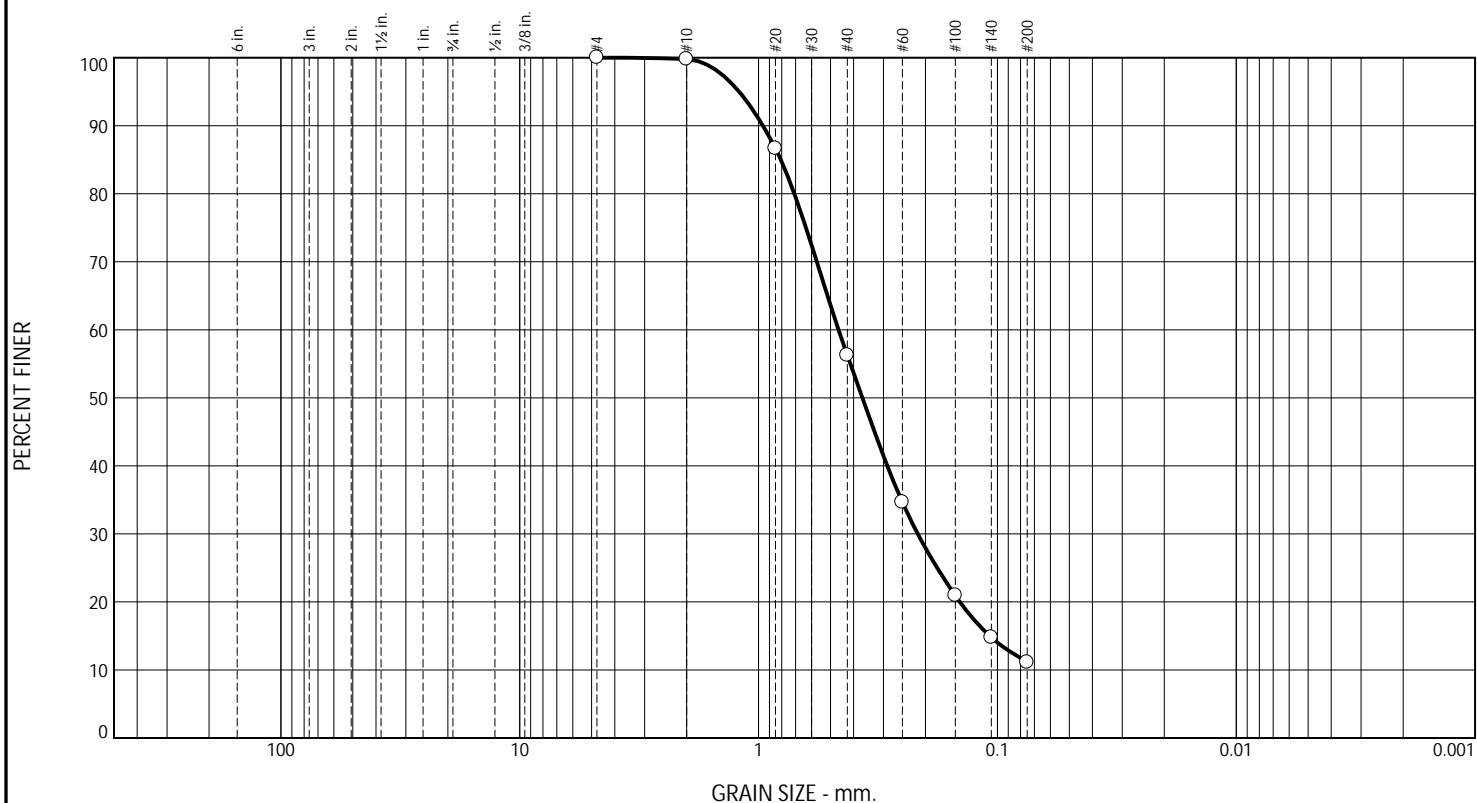
Project No.: 25-25810

Figure 1

Tested By: JT Checked By: KM

Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	43.5	45.2	11.1	

Test Results (ASTM D6913)				
Sieve Size or Diam. (mm.)	Finer (%)	Spec. * (%)	Out of Spec. (%)	Pct. of Fines
#4	100.0			
#10	99.8			
#20	86.7			
#40	56.3			
#60	34.7			
#100	20.9			
#140	14.8			
#200	11.1			

Material Description

Poorly Graded Sand with Silt (SP-SM), light brown

PL= NP	<u>Atterberg Limits</u>	PI= NP
	LL= NV	
	<u>Coefficients</u>	
D ₉₀ = 0.9591	D ₈₅ = 0.8067	D ₆₀ = 0.4626
D ₅₀ = 0.3674	D ₃₀ = 0.2155	D ₁₅ = 0.1077
D ₁₀ =	C _u =	C _c =
USCS= SP-SM	<u>Classification</u>	AASHTO= A-2-4(0)
	<u>Test Remarks</u>	

* (no specification provided)

Source of Sample: Borings Depth: 3.5-5.0 Ft.
 Sample Number: B-1

Sample Date: 4/7/2025

Bunnell Lammons Engineering, Inc.

 Greenville, SC

Client: Midlands Technical College
 Project: AMSC Center Expansion

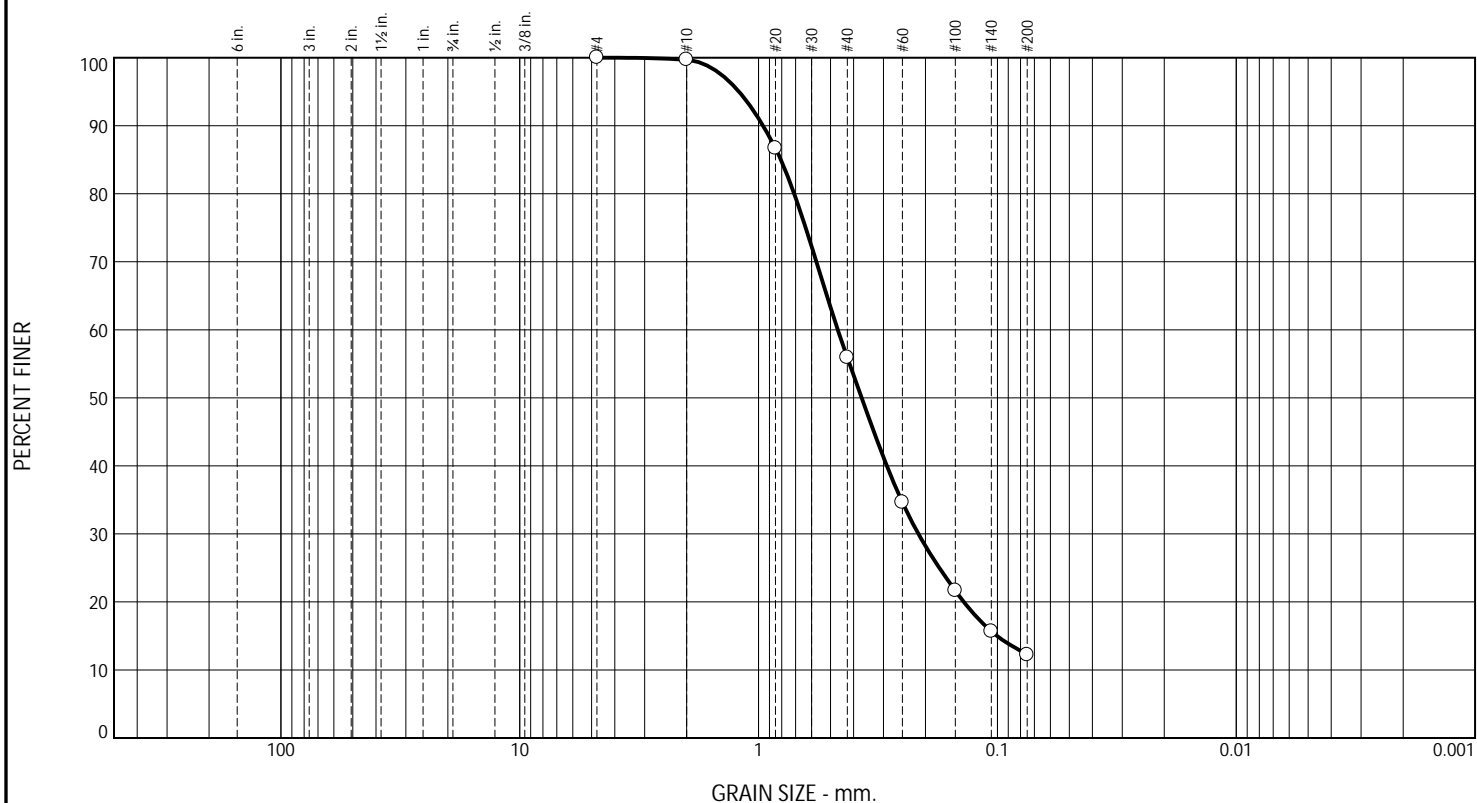
 Project No: 25-25810

Figure 2

Tested By: JT Checked By: KM

Particle Size Distribution Report

ASTM D6913



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	43.8	43.7	12.2	

Test Results (ASTM D6913)				
Sieve Size or Diam. (mm.)	Finer (%)	Spec. * (%)	Out of Spec. (%)	Pct. of Fines
#4	100.0			
#10	99.7			
#20	86.7			
#40	55.9			
#60	34.6			
#100	21.6			
#140	15.7			
#200	12.2			

* (no specification provided)

Material Description

Silty Clayey Sand (SC-SM), reddish brown

PL= 17	<u>Atterberg Limits</u>	LL= 21	PI= 4
<u>Coefficients</u>			
D ₉₀ = 0.9580	D ₈₅ = 0.8064	D ₆₀ = 0.4659	
D ₅₀ = 0.3700	D ₃₀ = 0.2141	D ₁₅ = 0.1005	
D ₁₀ =	C _u =	C _c =	
<u>Classification</u>		AASHTO= A-2-4(0)	
USCS= SC-SM	<u>Test Remarks</u>		

Source of Sample: Borings Depth: 8.5-10.0 Ft.
 Sample Number: B-2

Sample Date: 4/7/2025

Bunnell Lammons Engineering, Inc.

 Greenville, SC

Client: Midlands Technical College
 Project: AMSC Center Expansion

Project No: 25-25810

Figure 3

Tested By: JT _____ Checked By: KM _____

APPENDIX C
Field Exploration Procedures



**BUNNELL
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Field Exploration Procedures

SOIL TEST BORINGS – HOLLOW STEM AUGERS WITH SPT

The soil borings were made by mechanically twisting a continuous flight steel auger into the soil. Soil standard penetration testing (SPT) were performed in general accordance with ASTM D1586. At assigned intervals, soil samples were obtained with a standard 1.4-inch I. D., 2-inch O. D., split-tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches to 18 inches with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the second and third 6-inches was recorded and is designated the "standard penetration resistance," or "N-Value." The penetration resistance, when properly evaluated, is an index to the strength of the soil and foundation supporting capability.


Representative portions of the soil samples, thus obtained, are collected in glass jars or sealed bags and transported to our laboratory. In the laboratory, the samples were examined by a geotechnical engineer to verify the field classifications and to conduct selected laboratory tests. Boring Logs are attached, showing the soil descriptions and penetration resistance.

LOCATIONS AND ELEVATIONS






Test boring elevations and coordinates were obtained using publicly available software and are shown on Figure 2 in Appendix A. Elevations and coordinates should be considered approximate, and are only as accurate as the means used to obtain them.

APPENDIX D
Boring Logs

SOIL TEST NO. B-01


PROJECT: AMSC Center Expansion		PROJECT NO.: 25-25810	
CLIENT: Midlands Technical College		START: 04/04/2025	END: 04/04/2025
LOCATION: 1260 Lexington Dr, West Columbia, SC 29170, USA		GS ELEVATION: 277	
NORTHING/EASTING: 770445.68 N, 1963551.63 E			
DRILLER: W Walker Environmental, R. Hook		LOGGED BY: A. Skoler	
DRILLING METHOD: Geoprobe 7822DT; direct push 2 1/4 inch HSA			
DEPTH TO - WATER> INITIAL: ∇ N/A		AFTER 24 HOURS: ∇ N/A	
		CAVING:  15.5	

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 GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

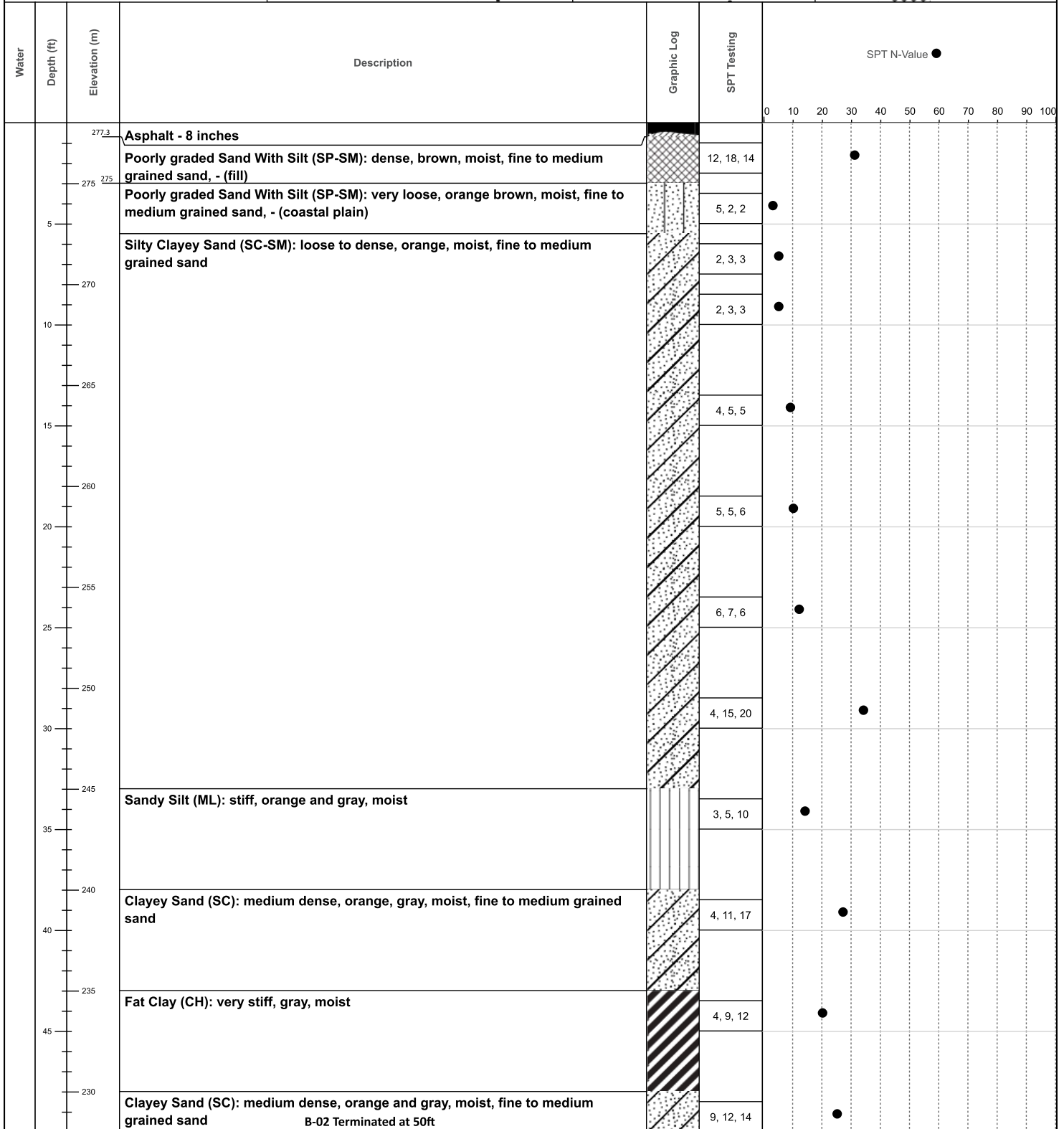
Water	Depth (ft)	Elevation (m)	Description	Graphic Log	SPT Testing	SPT N-Value ●
		276.4	Asphalt - 7 inches			
	275		Poorly graded Sand With Silt (SP-SM): medium dense, brown, moist, fine to medium grained sand, - (fill)		17, 12, 13	●
	273.5		Poorly graded Sand With Silt (SP-SM): loose, light brown, moist, fine to medium grained sand, - (coastal plain)		3, 3, 3	●
	5					
	270		Silty Clayey Sand (SC-SM): loose, light brown, moist, fine to medium grained sand		2, 2, 3	●
	10					
	265		orange brown		3, 4, 4	●
	15					
	260				3, 4, 4	●

B-01 Terminated at 20ft

SOIL TEST NO. B-02

PROJECT: AMSC Center Expansion		PROJECT NO.: 25-25810	
CLIENT: Midlands Technical College		START: 04/04/2025	END: 04/04/2025
LOCATION: 1260 Lexington Dr, West Columbia, SC 29170, USA		GS ELEVATION: 278	
NORTHING/EASTING: 770422.72 N, 1963576.47 E			
DRILLER: W Walker Environmental, R. Hook		LOGGED BY: A. Skoler	
DRILLING METHOD: Geoprobe 7822DT; direct push 2 1/4 inch HSA & 2 1/4 inch HSA			
DEPTH TO - WATER> INITIAL: ∇ N/A		AFTER 24 HOURS: ∇ N/A	
CAVING:  21			

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B-02 Terminated at 50ft

APPENDIX E
A Key to Soil Classification

KEY TO SOIL CLASSIFICATIONS AND CONSISTENCY DESCRIPTIONS

BUNNELL-LAMMONS ENGINEERING, INC.

Penetration Resistance* Blows per Foot

0 to 4
5 to 10
11 to 30
31 to 50
over 50

SANDS

Relative Density

Very Loose
Loose
Medium-Dense
Dense
Very Dense

Particle Size Identification

Boulder: Greater than 300 mm
Cobble: 75 to 300 mm
Gravel: Coarse - 19 to 75 mm
 Fine - 4.75 to 19 mm
Sand: Coarse - 2 to 4.75 mm
 Medium - 0.425 to 2 mm
 Fine - 0.075 to 0.425 mm
Silt & Clay: Less than 0.075 mm

Penetration Resistance* Blows per Foot

0 to 2
3 to 4
5 to 8
9 to 15
16 to 30
31 to 50
over 50

SILTS AND CLAYS

Consistency

Very Soft
Soft
Firm
Stiff
Very Stiff
Hard
Very Hard

*ASTM D 1586

KEY TO DRILLING SYMBOLS



Bulk Sample



Groundwater Table at Time of Drilling



Split Spoon Sample



Groundwater Table 24 Hours After
Completion of Drilling



Undisturbed Sample



Cave-in Depth

KEY TO SOIL CLASSIFICATION



Well-graded Gravel
GW



Fat Clay
CH



Elastic Silt
MH



Well Graded Sand
SW



Poorly-graded Gravel
GP



Lean Clay
CL



Silt
ML



Poorly Graded Sand
SP



Partially Weathered Rock
PWR



Sandy Clay
CL



Sandy Silt
ML



Clayey Sand
SC



Fill
FILL



Silty Clay
CL-ML



Topsoil
TOPSOIL



Silty Sand
SM

APPENDIX F
**Important Information About This Geotechnical
Engineering Report**

IMPORTANT INFORMATION ABOUT THIS

GEOTECHNICAL-ENGINEERING REPORT

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Bunnell-Lammons Engineering, Inc. (BLE) has prepared this advisory to help you interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and their development, which for decades have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, reach to your BLE contact.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, And At Specific Times

Geotechnical engineers structure their services to meet the needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a

project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

-
-
- for a site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like droughts, earthquakes, or

Note, too, the reliability of a geotechnical-engineering report can be by the passage of time, because of factors like changed subsurface conditions; new or codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, factors when developing the scope of study behind this report and developing the recommendations the report conveys. Typical changes that could erode the reliability of this report include those that

- the site's size or shape;
- the elevation, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may – maybe – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are In other words, they are not because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- review pertinent elements of other design professionals’ plans and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you’ve included the material for information purposes*

only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about project requirements, including options selected from the report, *only* from the design drawings and Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. *Geotechnical engineers are not building-envelope or mold specialists.*