CONTRACT NO. T-0705-0140

Kirk Bus Division Modernization Project – Phase 1

Volume III of IV

SECTION 10147

VISUAL DISPLAY SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Dry-erase wall coverings.

2. Display rail systems.

1.03 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.

2. For each type of dry-erase wall covering. Include data on physical characteristics, durability, and flame-resistance characteristics.

B. Shop Drawings: Show location and extent. Indicate seams and termination points.

C. Samples for Initial Selection: For each type of dry-erase wall covering.

D. Samples for Verification:

1. Dry-erase wall covering: Full width by 36-inch- long section.

2. Display Rail: 6-inch long section of each type.

1.04 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of dry-erase wall coverings.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For dry-erase wall coverings to include in maintenance

manuals.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install dry-erase wall coverings 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. Lighting: Do not install dry-erase wall covering until a permanent level of lighting is provided on the surfaces to receive dry-erase wall covering.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2.02 DRY-ERASE WALL COVERINGS

A. Dry-Erase Wall Covering: Intended for use with dry-erase markers and as a projection surface and consisting of low-gloss plastic film bonded to fabric backing.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawing by walltalkers; a division of RJF International Corporation or comparable product by one of the following:

a. Egan Visual Inc.

b. Marsh Industries, Inc.; Visual Products Group.

c. Specified Solutions Inc.

2. Color: As indicated on Drawings.

B. Accessories:

1. Display Rail: Manufacturer's standard, extruded-aluminum display rail with natural cork insert, end stops

2. Marker Tray: Manufacturer's standard, extruded-aluminum with aluminum end caps.

3. Size: As indicated on Drawings.

4. Aluminum Color: Clear anodized aluminum.

2.03 ACCESSORIES

A. Adhesives for Field Application: Strippable, mildew-resistant, nonstaining adhesive for use with dry-erase wall coverings; and for substrate application; as recommended in writing by dry-erase wall covering manufacturer.

1. Adhesives shall have a VOC content of 50 g/L or less.

B. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements of dry-erase wall covering manufacturer for intended substrate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, moisture content, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation for dry-erase wall covering.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances, including dirt, mold, and mildew, that could impair the bond of dry-erase wall coverings or affect the smooth, finished surfaces of dry-erase wall coverings.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, and depressions.

D. Prepare substrates indicated to receive dry-erase wall covering as required by manufacturer's written instructions to achieve a smooth, dry, clean, structurally sound surface that is uniform in color.

1. Moisture Content: Maximum of 4 percent when tested with an electronic moisture meter.

2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.

3. Painted Surfaces: Treat areas susceptible to pigment bleeding.

3.03 INSTALLATION

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.

B. Dry-Erase Wall Covering: Comply with dry-erase wall-covering manufacturers' written installation instructions.

1. Install seams horizontal and level, with lowest seam 24 inches above finished floor. Railroad fabric (reverse roll direction) to ensure color matching.

2. Double cut seams, with no gaps or overlaps. Remove air bubbles, wrinkles, blisters, and other defects.

3. After installation, clean dry-erase wall covering according to manufacturer's written instructions. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

C. Display Rails: Install rails at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface with fasteners at not more than 16 inches on center.

3.04 CLEANING AND PROTECTION

A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.

B. Clean dry-erase wall covering according to manufacturer's written instructions. Attach one removable cleaning instructions label to dry-erase wall covering in each room.

C. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

PART 4: MEASUREMENT AND PAYMENT

4.01 VISUAL DISPLAY SYSTEM:

A. Visual Display System will not be measured for payment.

A. Visual Display System will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 10170

TOILET COMPARTMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

B. Related Sections:

1. Section 06105 "Miscellaneous Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments and overhead support of post-to-ceiling screens.

2. Section 10801 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, purse shelves, and similar accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.

2. Show locations of reinforcements for compartment-mounted grab bars.

3. Show locations of centerlines of toilet fixtures.

4. Show ceiling grid and overhead support or bracing locations.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color

selection.

D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on 6-inch- (152-mm-) square Samples of same thickness and material indicated for Work.

2. Each type of hardware and accessory.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Comply with requirements in General Services Adminstration’s (GSA) CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 75 or less.

2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PRODUCTS

2.01 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z (03G).

2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvannealed.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

E. Stainless-Steel Castings: ASTM A 743/A 743M.

2.02 SOLID PLASTIC UNITS (TL-1)

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

1. Accurate Partitions Corporation.

2. American Sanitary Partition Corporation.

3. Ampco, Inc.

4. Bobrick Washroom Equipment, Inc.

5. Bradley Corporation; Mills Partitions.

6. General Partitions Mfg. Corp.

7. Global Steel Products Corp.

8. Knickerbocker Partition Corporation.

9. Metpar Corp.

10. Rockville Partitions Incorporated.

11. Shanahan's Limited.

B. Toilet-Enclosure Style: Floor and ceiling anchored.

C. Urinal-Screen Style: Wall hung with floor support.

D. Door, Panel, Screen, and Pilaster Construction:

1. Material: 1 inch thick High Density Polyethylene (HDPE) resins fabricated into sheet under high pressure.

2. Edge: Rounded to manufacturer’s standard radius.

E. Pilaster Shoes and Sleeves (Caps): Fabricated from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

F. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.

2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

G. Solid Plastic Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.

2. Color and Pattern: As noted on Drawings.

2.03 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Clear-anodized aluminum.

2. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.

3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.

5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.

6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-

aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.04 FABRICATION

A. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide, in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide, out-swinging doors with a minimum 32-inch- (813-mm-) wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).

b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.

b. Align brackets at pilasters with brackets at walls.

B. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.02 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

PART 4: MEASUREMENT AND PAYMENT

4.01 TOILET COMPARTMENTS:

A. Toilet Compartments will not be measured for payment.

B. Toilet Compartments will not be paid directly, but will be included in the lump sum bid prices for maintenance building

END OF SECTION

SECTION 10194

WELDING CURTAINS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Welding curtains.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show layout and types of curtain, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.

C. Samples:

1. Curtain Material: 12-inch- square swatch.

2. Mounting System: Not less than 12 inches long.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For curtain, mounting system, and hardware to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 WELDING CURTAIN

A. Description: Curtain comprised of overlapping transparent PVC strips with colored shade and UV inhibitor.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Flex-Vue, Bondor Manufacturing Company or comparable product by one of the following:

a. pvcstrip.com

b. Singer Safety Company

c. strip-curtain.com

2. Strip Width: 12 inches.

3. Thickness: 0.08 inches.

4. Curtain strip overlap: 67 percent.

5. Color: Bronze.

B. Mounting System: Manufacturer’s standard steel construction with1/4 inch studs and locknuts with reinforcement plates for PVC slate attachment.

1. Attachment: Pre-drilled holes for suspension mounting.

2. Material: 14 gage galvanized steel

3. Fasteners: Hot-dip galvanized.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install mounting system according to manufacturer's written instructions, level and plumb, and at height and location in relation to adjoining openings as indicated on Drawings.

B. Isolate metal parts of tracks and brackets from concrete, masonry, and mortar to prevent galvanic action. Use method recommended by manufacturer.

3.03 ADJUSTING

A. After hanging draperies, test and adjust to ensure the sightline barrier is continuous.

B. Remove and replace strips that are damaged or misaligned.

PART 4 - MEASUREMENT AND PAYMENT

4.01 WELDING CURTAINS:

A. Welding Curtains will not be measured for payment.

B. Welding Curtains will not be paid directly, but will be included in the lump sum bid price for maintenance building

END OF SECTION

SECTION 10210

WALL LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.02 RELATED SECTIONS

A. Section 07620 - Sheet Metal Flashing and Trim.

B. Section 07920 – Architectural Joint Sealants.

1.03 REFERENCES

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.

B. The Air Movement and Control Association International (AMCA) Certified Ratings Program – Product Rating Manual for Air Control Device.

1.04 SUBMITTALS

A. Refer to Section 01300 - Submittal Procedures.

B. Product Data: For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

2. Show mullion profiles and locations.

D. Test Reports: Independent agency reports showing compliance with specified performance criteria.

1.05 QUALITY ASSURANCE

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

documented experience.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

B. Coordinate work of this section with installation of masonry flashings.

C. Coordinate work of this section with installation of mechanical ductwork and electrical services to motorized devices.

1.07 WARRANTY

A. Special Warranty: Prepare and submit in accordance with Section 01780.

1. Warrant installed units to be free from defects in material and workmanship for period of five years.

2. Finish Warranty: Warranty stating organic coating finish will be free from fading more than 10 percent, chalking, yellowing, peeling, cracking, pitting, corroding or non-uniformity of color, or gloss deterioration beyond manufacturer's descriptive standards for 10 years.

PART 2 - PRODUCTS

2.01 DESIGN

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

C. Wind Loads: Determine loads based on pressures as indicated on Drawings.

D. Seismic Performance: Provide louvers, including attachments to other construction, that withstand the effects of earthquake motions as indicated on Drawings.

E. Thermal Movements: Allow for thermal movements from ambient and

surface temperature changes.

F. Sheet Metal and Air Conditioning Manufacturers National Association (SMACNA) Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.02 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Acceptable Manufacturers:

1. The Airolite Company, Marietta, OH.

2. Construction Specialties, Inc., Cranford, NJ.

3. Ruskin, Kansas City, MO.

2.03 LOUVERS

A. General: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified under AMCA 511.

1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.

2. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.

3. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.

B. Stationary Louvers: Horizontal blade, extruded aluminum construction, with intermediate mullions matching frame. Provide mitered corner joints and mechanically fastened, with continuous recessed caulking channel each side.

1. Frame: 4" deep, 6063T5 extruded aluminum. 125" (3.2) nominal wall thickness.

2. Blades: 6063T5 extruded aluminum. 125" nominal wall thickness. Drainable blades positioned at 37 ½ degree angle and spaced 5-3/32" center to center.

3. Screen: 3/4" x .051" expanded, flattened aluminum bird screen in removable frame.

4. Finish:

   a. Color: As selected from manufacturer's standard anodized finished.

5. Basis of Design Product: ELF375DXH, Ruskin, Kansas City, MO.

2.04 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Include supports, anchorages, and accessories required for complete assembly.

D. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

   1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.

   2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.

E. Join frame members to each other and to fixed louver blades with threaded fasteners concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

   1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

2.05 FABRICATION

A. High-Performance Organic Finish: Three-coat fluoropolymer finish

complying with AAMA 2605 and containing not less than **70** percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Match Architect/Engineer's sample.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.

E. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

F. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

H. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Install perimeter sealant and backing rod in accordance with Section 07920.

3.03 ADJUSTING AND CLEANING

A. Strip protective finish coverings. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil

during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

PART 4 – MEASUREMENT AND PAYMENT

4.01 WALL LOUVERS

A. Wall Louvers will not be measured for payment.

B. Wall Louvers will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 10434

PANEL SIGNAGE

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Room-identification signs.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel 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, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

D. Delegated-Design Submittal: For signs indicated in "Performance Requirements" Article.

1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.03 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2: PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S.

Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.02 SIGNS

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. Ace Sign Systems, Inc.

2. Advance Corporation; Braille-Tac Division.

3. APCO Graphics, Inc.

4. ASE, Inc.

5. ASI Sign Systems, Inc.

6. Best Sign Systems Inc.

7. Clarke Systems.

8. Diskey Sign Company.

9. InPro Corporation.

10. Mohawk Sign Systems.

11. Nelson-Harkins Industries.

12. Seton Identification Products.

13. Vista System.

B. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: 8000 ADA Series, Diskey Architectural Signage.

2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated to phenolic backing sheet to produce composite sheet.

a. Composite-Sheet Thickness: Manufacturer's standard for size of sign.

b. Surface-Applied Graphics: Manufacturer’s standard acrylic / polyurethane paint.

c. Color: As selected by Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

a. Edge Condition: Beveled.

b. Corner Condition in Elevation: Square.

4. Mounting: Manufacturer's standard method for substrates indicated.

2.03 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. Exposed Metal-Fastener Components:

a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

B. Adhesives: As recommended by sign manufacturer and with a VOC content of **70** g/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. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

PART 3 - EXECUTION

3.01 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. Mounting Methods:

1. 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.

2. 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.

C. Remove temporary protective coverings and strippable films as signs are installed.

PART 4: MEASUREMENT AND PAYMENT

4.01 PANEL SIGNAGE:

A. Panel Signage will not be measured for payment.

B. Panel Signage will not be paid directly, but will be included in the lump sum bid price for maintenance building.

END OF SECTION

SECTION 10505

METAL LOCKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Heavy-duty metal lockers.

2. Locker benches.

1.03 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 each type of metal locker and bench.

B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.

1. Show locker trim and accessories.

2. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.06 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. Full-size units of the following metal locker hardware items equal to 10 percent of amount installed for each type and finish installed, but no fewer than five units:

   a. Locks.

   b. Identification plates.

   c. Hooks.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain metal locker, locker benches, and accessories from single source from single manufacturer.

C. Regulatory Requirements: Where metal lockers and benches are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.09 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.10 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures.

   b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.

3. Warranty Period for All-Welded Metal Lockers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

B. Expanded Metal: ASTM F 1267, Type II (flattened), Class I, 3/4-inch (19-mm) steel mesh, with at least 70 percent open area.

C. Stainless-Steel Sheet: ASTM A 666, Type 304.

D. Plastic Laminate: NEMA LD 3, Grade HGP.

E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated.

F. Steel Tube: ASTM A 500/A 500 M, cold rolled.

G. Particleboard: ANSI A208.1, Grade M-2.

H. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

I. Anchors: Material, type, and size required for secure anchorage to each substrate.

   1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as required by manufacturer for corrosion resistance.

   2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.02 HEAVY-DUTY METAL LOCKERS

A. Product:

1. Basis-of-Design Product: All-Welded, Quiet Lockers Lyon Workspace Products, LLC

2. Subject to compliance with requirements, provide comparable product by one of the following:

   a. Penco Products, Inc.

   b. Republic Storage Systems Company

B. Locker Arrangement: Single tier and double tier.

C. Material: Cold-rolled steel sheet.

D. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Sides: 0.060-inch (1.52-mm) nominal thickness.

2. Backs: 0.048-inch (1.21-mm) nominal thickness.

3. Shelves: 0.060-inch (1.52-mm) nominal thickness, with double bend at front and single bend at sides and back.

E. Frames: Channel formed; fabricated from 0.060-inch (1.52-mm) nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

F. Doors: One piece; fabricated from 0.075-inch (1.90-mm) nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.

2. Door Style:

   a. Louvered Vents: No fewer than six louver openings at top and bottom for single-tier lockers.

G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

H. Recessed Door Handle and Latch: Stainless-steel cup with integral door

pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with built-in combination locks or padlocks; positive automatic latching and prelocking.

   a. Latch Hooks: Equip doors 48 inches (1219 mm) and higher with three latch hooks; fabricated from 0.120-inch (3.04-mm) nominal-thickness steel sheet; welded to full-height door strikes; with resilient silencer on each latch hook.

   b. Latching Mechanism: Manufacturer's standard, rattle-free latching mechanism and moving components isolated to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

I. Combination Padlocks: Key-controlled, three-number dialing combination locks; capable of five combination changes.

J. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:

1. Single-Tier Units: Shelf, coat rod, and two single-prong wall hooks.

2. Double-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks

K. Accessories:

1. Continuous Sloping Tops: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

   a. Closures: Vertical end type.

2. Recess Trim: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

3. Filler Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

4. Boxed End Panels: Fabricated from 0.048-inch (1.21-mm) nominal-thickness steel sheet.

L. Finish: powder coat.

1. Color(s): As selected by Architect from manufacturer's full range.

2.03 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches (445 mm.

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick (241 mm wide by 32 mm thick) except provide minimum 20-inch- (508-mm-) wide tops where accessible benches are indicated.

2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel: 1-1/2-inch- (38-mm-) diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.

a. Color: Match metal lockers.

2.04 FABRICATION

A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.

2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. All-Welded Construction: Factory preassemble metal lockers by welding

all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

D. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches (381 mm) above the floor.

2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches (1219 mm) above the floor.

E. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

F. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch (9 mm) high.

G. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.

H. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

I. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

J. Recess Trim: Fabricated with minimum 2-1/2-inch (64-mm) face width and in lengths as long as practical; finished to match lockers.

K. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

L. Boxed End Panels: Fabricated with 1-inch- (25-mm-) wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

M. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

N. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.05 STEEL SHEET FINISHES

A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

B. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

2.06 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches (910 mm) o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.

2. Anchor single rows of metal lockers to walls near top of lockers and to floor.

3. Anchor back-to-back metal lockers to floor.

B. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.

2. Attach door locks on doors using security-type fasteners.

3. Identification Plates: Identify metal lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

4. Attach recess trim to recessed metal lockers with concealed clips.

5. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.

6. Attach sloping-top units to metal lockers, with closures at exposed ends.

7. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

D. Fixed Locker Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

PART 4: MEASUREMENT AND PAYMENT

4.01 METAL LOCKERS:

A. Metal Lockers will not be measured for payment.

B. Metal Lockers will not be paid directly, but will be included in the lump sum bid price for maintenance building.

END OF SECTION

SECTION 10523

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes portable, hand-carried fire extinguishers for fire extinguishers.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.

B. Product Schedule: For fire extinguishers. Coordinate final fire extinguisher schedule with fire protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.04 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by Factory Mutual Insurance Company (FM Global).

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.

b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. J. L. Industries, Inc.; a division of Activar Construction Products Group.

b. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.

c. Larsen's Manufacturing Company.

2. Valves: Manufacturer's standard.

3. Handles and Levers: Manufacturer's standard.

4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

5. Multipurpose Dry-Chemical Type in Steel Container with monoammonium phosphate-based dry chemical in enameled-steel container.

a. Type 1: UL-rated 2-A:10-B:C, 5-lb (2.3-kg)

b. Type 2: UL-rated 4-A:80-B:C, 10-lb (4.5-kg)

B. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

a. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install fire extinguishers and mounting bracket in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher. Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

PART 4: MEASUREMENT AND PAYMENT

4.01 FIRE EXTINGUISHERS:

A. Fire Extinguishers will not be measured for payment.

B. Fire Extinguishers will not be paid directly, but will be included in the lump sum bid price for maintenance building.

END OF SECTION

SECTION 10605

WIRE MESH PARTITIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Heavy-duty wire mesh partitions.

1.03 DEFINITIONS

A. As defined in ASTM E 2016:

1. Intermediate Crimp: Wires pass over one and under the next adjacent wire in both directions, with wires crimped before weaving and with extra crimps between the intersections.

2. Lock Crimp: Deep crimps at points of the intersection that lock wires securely in place.

1.04 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 wire mesh items.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Include clearances required for operation of doors and gates.

C. Setting Drawings: For anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: 12-by-12-inch (300-by-300-mm) panel constructed of specified frame members and wire mesh. Show method of

finishing members at intersections.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wire mesh unit hardware to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include fabricating and installing wire mesh items and providing professional engineering services needed to assume engineering responsibility.

2. Engineering Responsibility: Preparation of data for wire mesh items, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Source Limitations: Obtain wire mesh items from single source from single manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. AWS D1.3/ D1.3M, "Structural Welding Code - Sheet Steel."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver wire mesh items in manufacturer’s standard secure packaging to provide protection during transit and Project-site storage.

B. Inventory wire mesh partition door hardware on receipt and provide secure lockup for wire mesh partition door hardware delivered to Project site.

1. Tag each item or package separately with identification and include basic installation instructions with each item or package.

1.08 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of construction contiguous with wire mesh units by field measurements before fabrication.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Style 840 Wire Partition, Wire Crafters, LLC.

B. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include the following:

1. Acorn Wire & Iron Works, Inc.
2. American Woven Wire Corporation.
3. Central Wire and Iron.
4. Donaldson, R. J., Inc.
5. Folding Guard Corporation.
6. G-S Company (The).
7. Indiana Wire Products, Inc.
8. Jesco Industries, Inc.
9. Kenco Wire and Iron Products Inc.
10. Kentucky Metal Products Co.
11. King Wire Partitions, Inc.
12. Lakeside Wire and Iron Company.
13. Miller Wire Works, Inc.
14. Newark Wire Works Inc.
15. Standard Wire & Steel Works.

2.02 MATERIALS

A. Steel Wire: ASTM A 510 (ASTM A 510M).

B. Steel Plates, Channels, Angles, and Bars: ASTM A 36/A 36M.

C. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

D. Steel Pipe: ASTM A 53/A 53M, Schedule 40 unless another weight is indicated or required by structural loads.

E. Square Steel Tubing: ASTM A 500, cold-formed structural-steel tubing.

F. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron-alloy (galvannealed) coating designation.

G. Panel-to-Panel Fasteners: Manufacturer's standard steel bolts, nuts, and washers.

H. Postinstalled Expansion Anchors: With capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Carbon Steel: Zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition (mild).

2. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.

I. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated and fabricated from corrosion-resistant materials; with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by wire mesh construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.

2.03 HEAVY-DUTY WIRE MESH PARTITIONS

A. Mesh: 10 gauge wire, woven into a 2 inch by 1 inch rectangular mesh

B. Vertical and Horizontal Panel Framing: 1 1/4" x 1 1/4" x 1/8" hot rolled steel angle. Provide vertical panel stiffeners in shapes and sizes as recommended by manufacturers.

C. Top Capping Bars: Manufactuer’s standard steel channel.

D. Posts: 2-by-2-inch by 14 gage- steel tube with ½ inch diameter bolt holes aligning with bolt holes in vertical framing; with floor anchor clips. Base plate 2 by 7 by ¼ inch steel plate the minimum 7/16 inch diameter bolt holes.

E. Floor Shoes: Steel, cast iron, or cast aluminum, not less than 2 inches high; sized to suit vertical framing, drilled for attachment to floor, and

with set screws for leveling adjustment.

F. Sliding Doors: Fabricated from same mesh as partitions, with framing fabricated from manufacturer's standard steel channels or C-channels, banded with 1-1/2-by-1/8-inch (38-by-3-mm) flat steel bar cover plates on 4 sides.

1. Hardware: Two, four-wheel roller-bearing carriers, box track, and bottom guide channel for each door.

2. Padlock Lug: Mortised into door framing and enclosed with steel cover.

3. Cylinder Lock: Mortise type with cylinder specified in Section 08710 "Door Hardware; operated by key outside and lever inside.

G. Accessories:

1. Sheet Metal Base: Not less than 0.060-inch- (1.5-mm-) thick, cold-rolled steel sheet.

2. Adjustable Filler Panels: Not less than 0.0598-inch- (1.5-mm-) thick, cold-rolled steel sheet; capable of filling openings from 2 to 12 inches (50 to 300 mm).

3. Wall Clips: Manufacturer's standard, cold-rolled steel sheet.

H. Finish for Uncoated Ferrous Steel: Shop primed for field painting unless otherwise indicated.

1. Color: As selected by Architect/Engineer from manufacturer's full range.

2.04 FABRICATION

A. General: Fabricate wire mesh items from components of sizes not less than those indicated. Use larger-sized components as recommended by wire mesh item manufacturer. As required for complete installation, provide bolts, hardware, and accessories with manufacturer's standard finishes.

1. Fabricate wire mesh items to be readily disassembled.

2. Welding: Weld corner joints of framing and grind smooth, leaving no evidence of joint.

B. Heavy-Duty Wire Mesh Partitions: Fabricate wire mesh partitions with

cutouts for pipes, ducts, beams, and other items indicated. Finish edges of cutouts to provide a neat, protective edge.

1. Mesh: Securely clinch mesh to framing.

2. Framing: Fabricate framing with mortise and tenon corner construction.

   a. Provide horizontal stiffeners as indicated or, if not indicated, as required by panel height and as recommended by wire mesh partition manufacturer. Weld horizontal stiffeners to vertical framing.

   b. Fabricate partition and door framing with slotted holes for connecting adjacent panels.

3. Fabricate wire mesh partitions with 3 inches of clear space between finished floor and bottom horizontal framing.

4. Doors: Align bottom of door with bottom of adjacent panels.

   a. For doors that do not extend full height of partition, provide transom over door, fabricated from same mesh and framing as partition panels.

5. Hardware Preparation: Mortise, reinforce, drill, and tap doors and framing as required to install hardware.

2.05 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 "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.

2.06 FINISHES

A. Steel Finish: Manufacturer’s standard shop applied powder coating.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where wire mesh items will be installed.

C. Examine walls to which wire mesh items will be attached for properly located blocking, grounds, and other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WIRE MESH PARTITIONS ERECTION

A. Anchor wire mesh partitions to floor with 3/8-inch- diameter, postinstalled expansion anchors at 12 inches o.c. through anchor clips or floor shoes located at each post and corner. Shim anchor clips as required to achieve level and plumb installation.

1. Anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if indicated on Shop Drawings.

B. Anchor wire mesh partitions to walls at 12 inches o.c. through back corner panel framing and as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

2. For hollow masonry anchorage, use toggle bolts.

3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with carpentry work to locate backing members.

4. For steel-framed gypsum board assemblies, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

5. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to support structural loads.

C. Secure top capping bars to top framing channels with 1/4-inch- (6-mm-) diameter "U" bolts spaced not more than 28 inches (700 mm) o.c.

D. Provide line posts at locations indicated or, if not indicated, as follows:

1. On each side of sliding door openings.

2. For partitions that are 7 to 9 feet (2.1 to 2.7 m) high, spaced at 15

to 20 feet (4.6 to 6.1 m) o.c.

3. For partitions that are 10 to 12 feet (3.0 to 3.7 m) high, located between every other panel.

4. For partitions that are more than 12 feet (3.7 m) high, located between each panel.

E. Provide seismic supports and bracing as indicated or, if not indicated, as recommended by manufacturer and as required for stability, extending and fastening members to supporting structure.

F. Where standard-width wire mesh partition panels do not fill entire length of run, provide adjustable filler panels to fill openings.

G. Install doors complete with door hardware.

H. Weld or bolt sheet metal bases to wire mesh partitions and doors.

I. Bolt accessories to wire mesh partition framing.

3.03 ADJUSTING AND CLEANING

A. Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Remove and replace defective work including doors and framing that are warped, bowed, or otherwise unacceptable.

PART 4: MEASUREMENT AND PAYMENT

4.01 WIRE MESH PARTITIONS:

A. Wire Mesh Partitions will not be measured for payment.

B. Wire Mesh Partitions will not be paid directly, but will be included in the lump sum bid price for maintenance building.

END OF SECTION

SECTION 10670

STORAGE EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. The work specified in this Section consists of furnishing and installing storage equipment at the locations as shown on the Contract Drawings.

B. Related Sections

1. Drawings, General Provisions, Special Provisions and Division 1 apply to the work of this section.

2. Section 01300 – Submittals

3. Section 05120 – Structural Steel

4. Section 05500 – Metal Fabrication

5. Section 09915 – Interior Painting

6. Section 11005 – Basic Equipment Materials and Methods

1.02 QUALITY ASSURANCE:

A. Comply with the provisions of Section 01450 Quality Assurance and Quality Control.

B. References

1. ASTM International (ASTM)

a. ASTM A 36/A 36 M Specification for Carbon Structural Steel

2. National Fire Protection Association (NFPA)

a. NFPA 30 Flammable and Combustible Liquids Code

3. Occupational Safety and Health Administration (OSHA)

a. 29 CFR 1910 Occupational Safety and Health Standards

C. Use adequate numbers of skilled workers who are completely familiar with the specified requirements and the materials and methods necessary

for proper performance of the Work of this Section.

D. Model numbers indicated are to establish a minimum standard of quality only.

1.03 SUBMITTALS:

A. Pursuant to the provision of the General Provisions, Section 01300, Submittals and Section 11005 Basic Equipment Material and Methods, the Contractor shall submit:

1. Material and Equipment List including details indicating quantities of storage equipment and unit dimensions

2. Product Data including manufacturer's product descriptive literature and color chips for storage equipment types and color selection.

3. Shop Drawings

4. Installation instructions including bracing and anchoring details.

1.04 JOB CONDITIONS:

A. Paint storage equipment in manufacturer's standard finish of color selected by the Engineer.

B. Units with damaged or missing parts or components will be rejected.

PART 2 PRODUCTS

2.01 PALLET RACK:

A. Equipment Item Nos. MS-5; two required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quantity for the pallet rack:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

   a. Steel King Industries Inc.

      2700 Chamber St.

      Stevens Point, WI 54481

      Telephone: (800) 826-0203, (715) 341-3120

   b. Stanley Vidmar, Inc.

      P.O. Box 1151

      11 Grimmes Road

      Allentown, PA 18105

      Telephone: (800) 523-9462

C. Design Requirements:

1. Design each staging rack to stand independently of any adjacent unit, consisting of 2 upright frames, 4 pairs of beams, wire decking, and additional hardware to meet installation requirements.

2. Provide 20 percent spares on both beams and wire deck covers.

D. Construction Features:

1. Tubular steel construction with horizontal and diagonal bracing.

2. Provide foot floor plates for each upright to meet seismic requirements.

3. Gravity - lock or safety catch beam connection.

4. “Z” beam design.

5. Beams adjustable on 1-1/2 inches centers.

6. Wire Decking.

E. Dimensions and Capacities:

1. Frame size (approximate): 72 inches height by 36 inches deep.

2. Frame capacity (minimum): 20,000 pounds per pair

3. Beam size (approximate): 96 inches (clear span) by 4 inches thick

4. Beam capacity (minimum): 3,300 pounds

5. Overall rack size (approximate): 96 inches wide by 36 inches deep by 72 inches height.

6. Wire Decking capacity: 1,000 pounds

7. Approximate shipping weight: 600 pounds shipped knocked down.

F. Provide Pallet Rack consisting of Model No. 64363 uprights with Model No. 62296 beams, Wire Decking Model 65480 with back to wall supports and anchoring feet as manufactured by Lyon Metal Products.

2.02 PARTS STORAGE RACK WITH DECK:

A. Equipment Item Nos. FM-5; three required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quantity for the parts storage rack with deck:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. Steel King Industries Inc.

2700 Chamber St.

Stevens Point, WI 54481

Telephone: (800) 826-0203, (715) 341-3120

b. Stanley Vidmar, Inc.

P.O. Box 1151

11 Grimmes Road

Allentown, PA 18105

Telephone: (800) 523-9462

C. Design Requirements:

1. Design each staging rack to stand independently of any adjacent unit, consisting of 2 upright frames, 4 pairs of beams, wire decking, and additional hardware to meet installation requirements.

2. Provide 20 percent spares on both beams and wire deck covers.

D. Construction Features:

1. Tubular steel construction with horizontal and diagonal bracing.

2. Provide foot floor plates for each upright to meet seismic requirements.

3. Gravity - lock or safety catch beam connection.

4. “Z” beam design.

5. Beams adjustable on 1-1/2 inches centers.

6. Wire Decking.

E. Dimensions and Capacities:

1. Frame size (approximate): 120 inches height by 24 inches deep.

2. Frame capacity (minimum): 20,000 pounds per pair

3. Beam size (approximate): 96 inches (clear span) by 4 inches thick

4. Beam capacity (minimum): 3,300 pounds

5. Overall rack size (approximate): 96 inches wide by 24 inches deep by 120 inches height.

6. Wire Decking capacity: 1,000 pounds

7. Approximate shipping weight: 600 pounds.

F. Provide Parts Storage Rack with Deck consisting of Model No. 64247 uprights with Model No. 62296 beams, Wire Decking Model 65462 with back to wall supports and anchoring feet as manufactured by Lyon Metal Products.

2.03 PALLET RACK WITH DECK:

A. Equipment Item Nos. PS-8; total of twenty-three required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quantity for the pallet rack with deck:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. Steel King Industries Inc.

2700 Chamber St.

Stevens Point, WI 54481

Telephone: (800) 826-0203, (715) 341-3120

b. Stanley Vidmar, Inc.

P.O. Box 1151

11 Grimmes Road

Allentown, PA 18105

Telephone: (800) 523-9462

C. Design Requirements:

1. Design each staging rack to stand independently of any adjacent unit, consisting of 2 upright frames, 4 pairs of beams, wire decking, 16 front to back supports per rack, and additional hardware to meet installation requirements.

2. Provide 20 percent spares on beams.

D. Construction Features:

1. Roll formed steel construction with horizontal and diagonal bracing.

2. Provide foot floor plates for each upright to meet seismic requirements.

3. Gravity - lock or safety catch beam connection.

4. Step beam design.

5. Wire decking.

E. Dimensions and Capacities:

1. Frame size (approximate): 144 inches height by 42 inches deep.

2. Frame capacity (minimum): 25,000 pounds. Use heavy duty upright.

3. Beam size (approximate): 96 inches (clear span) by 4.8 inches thick.

4. Beam capacity (minimum): 7,000 pounds per pair.

5. Overall rack size (approximate): 96 inches wide by 42 inches deep by 144 inches height.

6. Wire Decking capacity: 3000 pounds per section.

F. Provide Pallet Rack consisting of Model No. U2614442 uprights with Model No. B6550096 beams, wire decking with front and back supports, row and back spacers and anchor feet as manufactured by Lyon Metal Products.

2.04 STORAGE SHELVING:

A. Equipment Item Nos. PS-5, and ES-2; total of seventy required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the storage shelving:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. Equipto

225 Main Street

Tatamy, PA 18085

Telephone: (800) 323-0801, (610) 253-2775

b. Republic Storage Systems Company, Inc.

1038 Belden Ave NE

Canton, OH 44705

Telephone: (800) 477-1255

C. Construction Features:

1. 20 gauge Box W high capacity shelves, 900 pound shelf.

2. Adjustable on 1-1/2 inch centers.

3. 16 gauge uprights.

4. Closed shelving.

5. 12 gauge shelf clips (four per shelf).

D. Dimensions:

1. Overall Size:

a. Equipment No. PS-5: 36 inches wide x 18 inches deep x 84 inches high; five shelves

b. Equipment No. ES-2: 36 inches wide x 24 inches deep x 84 inches high; five shelves

E. Provide Storage Shelving Model Number 8038SH and 8038H for Equipment No. PS-5 and 8039SH for Equipment No. ES-2 as manufactured by Lyon Metal Products.

2.05 FLAMMABLE MATERIAL CABINET:

A. Equipment Item Nos. MS-6, FM-4 and PS-6; Total of six required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the flammable material cabinet:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. Equipto

225 Main Street

Tatamy, PA 18085

Telephone: (800) 323-0801, (610) 253-2775

b. Justrite Manufacturing Company

2454 Dempster Street

Des Plaines, IL 60016

Telephone: (312) 298-9250

C. Design Requirements:

1. Design Flammable Material Cabinet to meet requirements of OSHA and NFPA 30.

D. Construction Features:

1. Yellow caution enamel painted cabinet with "FLAMMABLE - KEEP FIRE AWAY" in red on both doors.

2. Two adjustable galvanized steel shelves on ½ inch centers.

3. 18 gauge steel double wall construction with 1-1/2 inch insulation air space between walls.

4. Screened flame arrestor vents on each side, threaded and fitted with 2 inch steel plugs.

5. Positive grounding attachment on each side.

6. Adjustable zinc-plated leveling feet.

7. Two full length swinging hinged doors with 3-point latch and built-in flat key lock.

8. 2 inch deep pan-type bottom.

E. Dimensions and Capacities:

1. Size: 43 inches wide x 18 inches deep x 65 inches high.

2. Capacity: 45 gallons.

3. Load capacity of 350 lbs. per shelf

4. Approximate shipping weight: 370 pounds fully assembled.

F. Provide Flammable Material Cabinet, Model No. 5444N, as manufactured by Lyon Metal Products, Inc.

2.05 MODULAR DRAWER CABINET WITH 2 SHELVES:

A. Equipment Item Nos. PS-2, and PS-3; total of twenty required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the modular drawer cabinets with 2 shelves:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. Stanley Vidmar

P.O. Box 1151

11 Grammes Road

Allentown, PA 18105

b. Equipto

225 Main Street

Tatamy, PA 18085

Telephone: (800) 323-0801, (610) 253-2775

C. Construction Features:

1. All steel housing.

2. Cabinet capacity: minimum 2,400 pounds.

3. Drawer operating capacity: minimum of 400 pounds.

4. Items consist of ten (10) full width drawers, consisting of the following drawer depths:

a. Equipment Items PS-2

i. Three – 3 inch

ii. One – 3 7/8 inch

iii. Two – 5 3/8 inch

iv. One – 10 1/8 inch

v. One – 12 ½ inch

b. Equipment Item PS-3

i. One – 2-1/4 inch

ii. One – 3 7/8 inch

iii. Two – 5 3/8 inch

iv. Two – 6 ¼ inch

v. One – 7 inch

vi. One – 10 1/8 inch

c. Drawer layout kits shall be provided as follows:

d. Each 2-1/4 inch drawer shall have 24 compartments

e. Each 3 inch drawer shall have 9 compartments

f. Each 3 7/8 inch drawer shall have 8 compartments

g. Each 5 3/8 drawer shall have 4 compartments

h. Each 6 ¼ inch drawer shall have 6 compartments

i. Each 7 inch drawer shall have 2 compartments.

5. Housing locks allows all drawers in a cabinet to be locked with one key.

D. Capacity and Dimensions:

1. Size (approximate): 30 inches wide x 28-1/4 inches deep x 86 inches high.

E. Provide Modular Drawer Cabinet with Two Shelves Model No. 240-950C-1 for PS-2 and FM-8, and 240-950E-1 for PS-3 supplied by Lyon Metal Products.

2.06 STORAGE CABINET (HEAVY DUTY):

A. Equipment Item Nos. MS-4, FM-7, PS-4, and TS-9; total of eight required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the storage cabinet:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. Equipto

225 Main Street

Tatamy, PA 18085

Telephone: (800) 323-0801, (610) 253-2775

b. Hodge Manufacturing Co.

55 Fisk Avenue

Springfield, MA 01107

Telephone: (800) 262-4634

C. Design Requirements:

1. Each cabinet shall have double door access with padlock hasp.

2. Shelves shall be adjustable on 3 inch centers with 1450 pound shelf capacity.

3. Construction with 14 gauge steel.

4. Base shelf and 4 adjustable shelves - all reinforced.

5. Polished chrome handle.

D. Capacity and Dimensions

1. Dimensions (approximate): 36 inches wide by 24 inches deep by 82 inches high.

E. Provide Storage Cabinet Model No. 1115, as manufactured by Lyon Metal Products.

2.07 TIRE STORAGE RACKS, TWO TIER:

A. Equipment Item No. TS-1 and TS-1A; total of eleven required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the tire storage racks two tier:

a. BCW Engineering and Manufacturing

230 Umbarger Road, Unit #5

San Jose, CA 95111

Telephone: (408) 867-7810

2. Products of equal quality and utility of other approved manufacturers will be accepted:

C. Construction Features:

1. Store mounted and unmounted single and dual wheel bus tires.

2. Heavy wall steel and tubular pipe construction with 2 tiers

D. Dimensions:

1. TS-1: 16 feet wide x 30 inches deep x 8 feet high.

2. TS-1A: 10 feet wide x 30 inches deep x 8 feet high

E. Provide Tire Storage Racks Two Tier, as manufactured by BCW Engineering and Manufacturing.

2.08 CYLINDER STORAGE CABINET:

A. Equipment Item Nos. PS-7; one required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the cylinder storage cabinet:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (630) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. EGA Products, Inc.

4275 North 127th Street

Brookfield, WI 53008

Telephone: (800) 937-3427

b. Hodge Manufacturing Co.

55 Fisk Avenue

Springfield, MA 01107

Telephone: (800) 262-4634

C. Construction Features:

1. Construct from 13 gauge expanded metal in 1-1/2 inch diamonds.

2. Padlock hasp.

3. Provide solid roof for weather protection.

4. Provide Identification Sign Holders on each door.

5. Comply with the requirements for storage equipment specified in NFPA 30 and 29 CFR 1910.

D. Dimensions and Capacities:

1. Overall dimensions: 32 inches x 38 inches x 70 inches.

E. Provide Cylinder Storage Cabinet Model No. 43104 as manufactured by Lyon Metal Products.

2.09 BIN UNITS:

A. Equipment Item No. PS-11; three required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the bin units:

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (630) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. C&H Distributing, Inc.

770 South 70th Street

P.O. Box 14770

Milwaukee, WI 53214-0770

Telephone: (800) 558-9966

b. Equipto

225 Main Street

Tatamy, PA 18085

Telephone: (800) 323-0801, (610) 253-2775

C. Design Requirements:

1. Free-standing revolving bin.

2. Steel construction.

3. Shelves adjustable on 1-1/2 inch centers.

4. Permanent dividers on each shelf.

D. Capacity and Dimensions:

1. 56 Openings:

a. 2 – 36 inches wide x 12 inches high

b. 3 – 12 inches wide x 9 inches high

c. 4 – 9 inches wide x 9 inches high

d. 8 – 9 inches wide x 6 inches high

e. 9 – 4 inches wide x 6 inches high

f. 12 – 6 inches wide x 6 inches high

g. 18 – 4 inches wide x 4.5 inches high

2. Overall Dimensions (approximate): 36 inches wide by 12 inches deep by 84 inches high.

E. Bin Units shall be Model 6610 as manufactured by Lyon Metal Products.

2.10 RECYCLING BINS:

A. Equipment Item No. MB-16; six required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer/suppliers are specified as the standard of quality for the recycling bins:

a. McMaster Carr

6100 Fulton Industrial Blvd.

Atlanta, GA 30336-2852

Telephone: (404) 346-7000

2. Products of equal quality and utility of other approved manufacturers will be accepted:

C. Design Requirements:

1. Welded steel container to hold recycle material.

D. Capacity and Dimensions:

1. Capacity: 4000 pounds.

2. Overall Dimensions (approximate): 35 inches long by 30 inches deep by minimum 24 inches high.

E. Recycling Bins shall be Model 4546T as manufactured by Material Flow and Conveyor Systems Inc. as distributed by McMaster Carr.

2.11 SUPPLYBAY CABINET:

A. Equipment Item No. PS-13; four required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the Supplybay Cabinet:

a. Supply Pro

50 E-Business Way, Suite 150

Cincinnati, OH 45241

Telephone: 513-671-4933

2. Products of equal quality and utility of other approved manufacturers will be accepted:

C. Construction Features

1. Provide and dispense only, absolute control machine.

2. Operators shall be able to be authorized part numbers.

D. Design Requirements:

1. Operator interfaces (SupplyLink) and card reader at two locations

2. Wrap around LED lighting

3. Large dispensing door

4. Large Lexan clear door

5. Smart motor technology

6. Easy to load and refill

7. Easy to reconfigure – no tools required

8. Large variety of risers and dispense aids

9. Patented multiple motor rotation

10. Swing Arm Controller to accommodate fill and administration at point of use.

E. Capacity and Dimensions:

1. Overall Dimensions (approximate): 72 inches high x 41 inches wide x 33 inches deep.

2. Each SupplyBay shall be configured to accommodate Safety Supplies, Shop Supplies and Small Maintenance Equipment to assist the mechanics with bus maintenance.

F. Power Requirements

1. 110Volt/1Phase/20Amps

G. SupplyBay Cabinet shall be as manufactured by Supply Pro.

2.12 SUPPLYLOCKER:

A. Equipment Item No. PS-15; two required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the SupplyLocker:

a. Supply Pro

50 E-Business Way, Suite 150

Cincinnati, OH 45241

Telephone: 513-671-4933

2. Products of equal quality and utility of other approved manufacturers will be accepted:

C. Design Requirements:

1. Patented take/return technology

2. Standard LED-lighting

3. Advanced control capabilities

4. Clear doors

5. Operator interfaces (SupplyLink) and card reader at two locations

D. Drawer Configuration:

1. 1-Door:

a. Quantity: Three Modules; 3 Doors

b. Inner Compartment Dimensions: 18 inches wide by 22 inches deep by 18 inches high.

c. Overall Module Dimension: 54 inches wide by 18 inches high

2. Two-Door Modules

a. Quantity: Three Modules; Six Doors

b. Inner Compartment Dimensions: 18 inches wide by 22 inches deep by 9 inches high.

c. Overall Module Dimension: 54 inches wide by 18 inches high

3. Four-Door Modules:

a. Quantity: Three Modules; Eight Doors

b. Inner Compartment Dimensions: 9 inches wide by 22 inches deep by 9 inches high.

c. Overall Module Dimension: 36 inches wide by 18 inches high

4. SupplyLink Universal Touch Screen Control Module

a. Overall Module Dimension: 18 inches wide by 18 inches high

5. Six-Door Modules:

a. Quantity: Three Modules; Twelve Doors

b. Inner Compartment Dimensions: 6 inches wide by 22 inches deep by 9 inches high.

c. Overall Module Dimension: 54 inches wide by 18 inches high

6. Overall Dimensions (approximate): 7 feet high x 54 inches wide x 22 inches deep.

E. Power Requirements

1. 110Volt/1Phase/20Amps

F. Accessories:

1. SupplyLink Universal Touch Screen Control Module to drive the SupplyPro Point of use devices (PS-15 SupplyLocker and PS-14 SupplyBay Cabinets.

a. Flat screen design

b. Display: 12.1 SVGS (800x600) Color TFT LCD

i. 12 Inch touch screen panel with integrated keyboard

c. CPU and Core Logic: AMD GX# Processor

d. Touch Sensor: Analog Resistive (8-wire)

e. Operating System: Windows XP Pro

f. BIOS: Award 256 KB

g. Cooling: Fanless Cooling System

h. Meet IP-22 standards for industrial environments

i. Attach to SupplyLocker by embedding into a module position

G. SupplyLocker with Accessories shall be as manufactured by Supply Pro.

2.13 ROLLER BATTERY STORAGE BENCH

A. Equipment Item No. BC-2; four required.

B. Acceptable Manufacturers:

1. Products of the following manufacturers are specified herein as the standard of quality for the Roller Battery Storage Bench.

a. Service Scaffold Co.

Box 888

South Fallsburg, NY 12779

Telephone: (914) 434-8888

2. Products of equal quality and utility of other approved manufacturers will be accepted:

C. Construction Features:

1. All welded construction.

2. Acid resistant black finish.

3. 2 inch hardwood rollers, five per bank.

4. Slide out acid resistant trays.

D. Capacities and Dimensions:

1. Overall Dimensions: 96 inches long by 24 inches deep by 18 inches high.

2. Capacity: 200 pounds per lineal foot.

E. Roller Battery Storage Bench shall be Model BB100 as manufactured by Service Scaffold or approved equal with the above minimum requirements.

2.14 REEL RACK:

A. Equipment Item Nos. MS-14; two required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the reel rack:

a. Parker Hannifin Corporation, Hydraulic Products Division

30242 Lakeland Boulevard

Wickliffe, OH 44092-1247

Telephone: (440) 833-2120

2. Products of equal quality and utility of other approved manufacturers will be accepted:

C. Construction Features:

1. Steel construction

D. Dimensions and Capacities:

1. 4 Reel capacity

2. Dimension: 27-3/4 inches wide by 27-1/2 inches long by 82-1/2 inches high.

E. Reel Rack shall be Model No. TH7-8-F as manufactured by Parker Hannifin Corporation, Hydraulic Products Division.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install units in a rigid assembly with each member plumb and in true alignment. Execute component assembling in accordance with the directions and recommendations of the product manufacturers.

B. Install units at locations as shown on the drawings.

C. Repair all surfaces where the finish has been marred or scratched during installation with paint approved by the manufacturer to the satisfaction of the Engineer.

3.02 FIELD QUALITY CONTROL:

A. Provide the services of a qualified manufacturer's representative to perform the following:

1. Supervise installation.

PART 4 : MEASUREMENT AND PAYMENT

4.01 PALLET RACK:

A. Pallet Rack (MS-5) will be measured for at the contract unit price bid per each.

B. Pallet Rack (MS-5) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.02 PARTS STORAGE RACK WITH DECK:

A. Parts Storage Rack with Deck (FM-5) will be measured for at the contract unit price bid per each.

B. Parts Storage Rack with Deck (FM-5) will be paid per each, complete in place, accepted, which price will be full compensation for all material,

equipment, tools, labor, and all work incidental to complete the item as specified.

4.03 PALLET RACK WITH DECK:

A. Pallet Rack with Deck (PS-8) will be measured for at the contract unit price bid per each.

B. Pallet Rack with Deck (PS-8) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.04 STORAGE SHELVING:

A. Storage Shelving (FM-6, PS-5 and ES-2) will be measured for at the contract unit price bid per each.

B. Storage Shelving (FM-6, PS-5and ES-2) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.05 FLAMMABLE MATERIAL CABINET:

A. Flammable Material Cabinet (MS-6, FM-4 and PS-6) will be measured for at the contract unit price bid per each.

B. Flammable Material Cabinet (MS-6, FM-4 and PS-6) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.06 MODULAR DRAWER CABINET WITH 2 SHELVES:

A. Modular Drawer Cabinet with 2 Shelves (PS-2, and PS-3) will be measured for at the contract unit price bid per each.

B. Modular Drawer Cabinet with 2 Shelves (PS-2, and PS-3) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.07 STORAGE CABINET (HEAVY DUTY):

A. Storage Cabinet (Heavy Duty) (MS-4, FM-7, PS-4, and TS-9) will be measured for at the contract unit price bid per each.

B. Storage Cabinet (Heavy Duty) (MS-4, FM-7, PS-4, and TS-9) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.08 TIRE STORAGE RACK, TWO TIER:

A. Tire Storage Racks, Two Tier (TS-1 and TS-1A) will be measured for at the contract unit price bid per each.

B. Tire Storage Racks, Two Tier (TS-1 and TS-1A) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.09 CYLINDER STORAGE CABINET:

A. Cylinder Storage Cabinet (PS-7) will be measured for at the contract unit price bid per each.

B. Cylinder Storage Cabinet (PS-7) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.10 BIN UNITS:

A. Bin Units (PS-11) will be measured for at the contract unit price bid per each.

B. Bin Units (PS-11) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.11 RECYCLING BINS:

A. Recycling Bins (MB-16) will be measured for at the contract unit price bid per each.

B. Recycling Bins (MB-16) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.12 SUPPLYBAY CABINET:

A. SupplyBay Cabinet (PS-13) will not be measured for payment..

B. SupplyBay Cabinet (PS-13) will be paid for at the lump sum bid price, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.13 SUPPLY LOCKER:

A. SupplyLocker (PS-15) will not be measured for payment..

B. SupplyLocker (PS-15) will be paid for at the lump sum bid price, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.14 ROLLER BATTERY STORAGE BENCH:

A. Roller Battery Storage Bench (BC-2) will be measured for at the contract unit price bid per each.

B. Roller Battery Storage Bench (BC-2) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.15 REEL RACK:

A. Reel Rack (MS-14) will be measured for at the contract unit price bid per each.

B. Reel Rack (MS-14) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

END OF SECTION

SECTION 10801

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.

2. Custodial accessories.

B. Related Sections:

1. Section 09310 "Ceramic Tile" for ceramic toilet and bath accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.

2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.

3. Material and finish descriptions.

4. Features that will be included for Project.

5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.

2. Identify products using designations indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.06 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.07 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.08 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

F. Fasteners: Screws, bolts, and other devices of same material as accessory

unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.02 WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A & J Washroom Accessories, Inc.

2. American Specialties, Inc.

3. Bobrick Washroom Equipment, Inc.

4. Bradley Corporation.

5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

6. Tubular Specialties Manufacturing, Inc.

B. Toilet Tissue (Roll) Dispenser:

1. Basis-of-Design Product: Bobrick B-4288 Contura Series.

2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.

3. Mounting: Surface mounted.

4. Operation: Noncontrol delivery with theft-resistant spindle.

5. Capacity: Designed for 5 ¼” diameter tissue rolls.

6. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Waste Receptacle:

1. Basis-of-Design Product: Bobrick B-2300.

2. Description: Floor standing open top waste receptacle.

3. Minimum Waste-Receptacle Capacity: 18 gal.

4. Material and Finish: Stainless steel, No. 4 finish (satin).

5. Liner: Reusable, vinyl waste-receptacle liner.

D. Grab Bar:

1. Basis-of-Design Product: Bobrick.

2. Mounting: Flanges with concealed fasteners.

3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches (38 mm).

5. Configuration and Length: As indicated on Drawings.

E. Vendor:

1. Basis-of-Design Product: Bobrick B-4706.

2. Type: Sanitary napkin and tampon.

3. Mounting: Surface mounted.

4. Operation: Two coin (50 cents).

5. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).

6. Lockset: Tumbler type with separate lock and key for coin box.

F. Sanitary-Napkin Disposal Unit:

1. Basis-of-Design Product: Bobrick B-254.

2. Mounting: Surface mounted.

3. Door or Cover: Self-closing, disposal-opening cover.

4. Receptacle: Removable.

5. Material and Finish: Stainless steel, No. 4 finish (satin).

G. Seat-Cover Dispenser:

1. Basis-of-Design Product: Bobrick B-221

2. Mounting: Surface mounted.

3. Minimum Capacity: 250 seat covers.

4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).

5. Lockset: Tumbler type.

H. Mirror Unit:

1. Basis-of-Design Product: Bobrick B-290 series welded-frame.

2. Frame: Stainless-steel angle, 0.05 inch (1.3 mm) thick.

a. Corners: Welded and ground smooth.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated on Drawings.

2.03 CUSTODIAL ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. A & J Washroom Accessories, Inc.

2. American Specialties, Inc.

3. Bobrick Washroom Equipment, Inc.

4. Bradley Corporation.

5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

6. Tubular Specialties Manufacturing, Inc.

B. Utility Shelf:

1. Basis-of-Design Product: Bobrick B-298.

2. Description: With exposed edges turned down not less than 1/2

inch (13 mm) and supported by two triangular brackets welded to shelf underside.

3. Size: 24 inches long by 8 inches deep.

4. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, No. 4 finish (satin).

C. Mop and Broom Holder:

1. Basis-of-Design Product: Bobrick B-239.

2. Description: Unit with shelf, hooks and holders suspended beneath shelf.

3. Length: 36 inches (914 mm).

4. Hooks: Four.

5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.

6. Material and Finish: Stainless steel, No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel.

2.04 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.02 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

PART 4: MEASUREMENT AND PAYMENT

4.01 TOILET AND BATH ACCESSORIES:

A. Toilet and Bath Accessories will not be measured for payment.

B. Toilet and Bath Accessories will not be paid directly, but will be included in the lump sum bid price for Maintenance building.

END OF SECTION

SECTION 11005

BASIC EQUIPMENT MATERIAL AND METHODS

PART 1 GENERAL

1.01 DESCRIPTION:

A. The requirements of this Section shall apply to Divisions 11and 14 Equipment Specifications, as well as to Section 10670.

B. Furnish and install as directed by the Engineer all equipment, as specified, complete and ready for operation. Each item shall be specifically designed for the intended function. Provide necessary accessories, items of equipment, mechanical, electrical and structural items, whether specified or not in order to provide properly installed and functional equipment.

C. Equipment shall be suitable for installation in the new MTA Kirk Operations and Maintenance Facility as shown and required by the Contract Documents. Any modification or redesign to the building structure or utilities because of an alternate equipment selection by the Contractor shall be provided by the Contractor at no additional cost to the Owner and shall be as approved by the Engineer. All alternate equipment selections or proposed substitutions must be submitted and approved in accordance with the provisions of Section 01600 - Products.

D. In all cases where a device or part of the equipment is referred to in the singular number, it is intended that such reference shall apply to as many such devices as are required to complete the installation.

E. There will be no separate payment for the work of this Section.

F. Related Documents:

1. Drawings, MTA General Provisions for Construction Contracts, Supplementary General Provisions and Division 1 specification sections apply to the work of this section.

G. Related Sections:

1. Section 01300 - Submittals.

2. Section 01450 – Quality Assurance and Quality Control.

3. Section 01600 – Products.

4. Section 01780 –Close Out.

5. Section 03050 – Portland Cement Concrete.

6. Section 03210 – Reinforcing Steel

7. Section 03300 – Cast-in-Place Concrete

8. Section 03350 – Concrete Finishes

9. Section 10670 – Storage Equipment

10. Section 11510 – Shop Work Stations

11. Section 11520 – Shop Equipment

12. Section 11535 – Cleaning Equipment

13. Section 14450 – Vehicle Lifts

14. Section 14513 – Forklifts

15. Section 14630 – Bridge Crane

16. Section 14635 – Fall Arrest System

17. Section 14920 – Monorail Cranes

18. Division 15 – Mechanical

19. Division 16 – Electrical

1.02 QUALITY ASSURANCE:

A. Work shall conform to Federal, State and local governing rules and regulations and ordinances, including but not limited to the following requirements, and shall pass inspection by the authorities having jurisdiction.

1. National Fire Protection Association (NFPA) including but not limited to NFPA 70 – National Electrical Code; NFPA 72 – National Fire Alarm Code; NFPA 101 – Life Safety Code

2. Occupational Safety and Health Administration (OSHA)

3. American National Standards Institute (ANSI)

4. American Institute of Steel Construction (AISC)

   a. Manual of Steel Construction

5. ASTM International (ASTM)

a. ASTM A123/A 123M Specification for Zinc (Hot-Dip Galvanized Coatings on Iron and Steel Products

b. ASTM A385/A385 M Practice for Providing High Quality Zinc Coatings (Hot Dip)

6. American Welding Society (AWS): Structural Welding Code Steel (AWS D 1.1/AWS D 1.1M)

7. National Electrical Manufacturers Association (NEMA)

a. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

8. Underwriters' Laboratories, Inc (UL)

9. Institute of Electrical and Electronic Engineers (IEEE)

10. Anti-Friction Bearing Manufacturers Association (AFBMA)

11. Building Code of the State of Maryland and the Building Code as adopted therein

B. General:

1. All articles, materials, fittings, equipment and appurtenances incorporated in the work shall be new and unused, free from defects and imperfections, of first grade commercial quality, and shall, as far as practicable, be manufacturer's standard make. Manufacturers shall have proven experience in the design and manufacture of specified items, suitable for the purpose intended and subject to approval by the Engineer.

2. When two or more items of equipment are required, they shall be products of a single manufacturer.

3. All work shall be performed in a neat and workmanlike manner by workers skilled in their respective trades, and all materials and equipment shall be installed as recommended by the manufacturers and in accordance with specified codes and standards.

4. Touch-up or repaint to match original finish, all factory finishes or painted equipment and materials which are scratched or marred during shipment or installation.

5. Designations used to describe the type and quality of equipment and work for the Divisions 11, Division 14 and Section 10670 are based

on the products specified in each section's Part 2 - Products.

C. Substitutions: Requests for approval of equipment items other than those specified herein shall be made in accordance with the Special Provisions, General Requirements and Section 01600 Products.

D. Permits and Tests: Obtain all necessary permits from the State and other authorities having jurisdiction, make application and file all drawings required for such permits, and pay all fees. Arrange for inspections and tests required by governing authorities and by the Owner, and pay all costs connected therewith. Obtain and file with the Owner written evidence that all the above requirements have been met.

E. Furnish proof that the Installing Contractor is licensed by the State of Maryland.

F. Certifications: Obtain all necessary certifications from suppliers and testing agencies as required by the Contract and pay all fees related to obtaining them.

1.03 SUBMITTALS

A. Pursuant to the provisions of the General Provisions and Section 01300, Submittals, the Contractor shall submit:

1. List of material and equipment proposed for the work of Division 11, Division 14, and Section 10670 under this contract.

2. Product data (e.g., catalog cuts, manufacturer's data, manufacturer's certificate of conformance or compliance, certified test report, samples).

3. Shop Drawings and Installation Instructions for material and equipment proposed for the work of Division 11, Division 14, and Section 10670 under this contract, including the following:

a. Layout drawings showing equipment, elevations, conduit runs, utilities and hook-ups, and all required dimensions. Drawings shall show plan and elevation views of all required conduit and piping runs. Equipment drawings shall clearly indicate all maintenance access points.

b. Foundation and structural support drawings including anchor bolt plan and elevation. Verify that the pit configuration meets the requirements of the new equipment.

c. Utility connection plan

d. Electrical equipment layout, with all motors, limit switches, solenoid valves, disconnects, control panels, emergency shut off switches, interlocks, accessories, all located and labeled.

e. Piping systems including pipe routing, pipe and fittings, sizing, valving, lubricators, regulators, pumps, nozzles and accessories, fully noted and scheduled.

f. HVAC and exhaust air systems including duct routing, duct sizes, fittings, dampers, grilles, supports, etc., fully noted and scheduled including elevations, in addition to details of penetrations and equipment connections.

4. Schedule of Work.

5. Operations Maintenance Manuals as required by this section and Section 01780.

a. General Requirements for Manuals:

i. Manufacturer's operating manuals giving complete instructions relative to assembly, installation operation, adjustment, lubrication, maintenance, and carrying complete parts list every item of machinery and equipment.

ii. Manuals furnished may be manufacturer's standard publications in regard to size and binding provided they comply with specified requirements relative to quantity and quality of information and data.

iii. Manuals shall be bound in hard or flexible covers. Illustrations shall be clear, and printed matter, including dimensions and lettering on drawings, shall be easily legible. If reduced drawings are incorporated into manuals, original lines and letters shall be heavier-up as necessary to retain their legibility after reduction. Larger drawings may be folded into manuals to page size.

b. Format Manuals as follows:

i. Title page: Include the name and function of the equipment, manufacturer's identification number, and the project Specifications number and title.

ii. Table of contents, in numerical order listing each

section and subsection title of the Operation and Maintenance (O&M) Manual with reference to the page on which each starts and a list of included diagrams and drawings.

iii. Index, in alphabetical order

iv. Frontispiece: Recognition illustration of the equipment described in the Operation and Maintenance (O&M) Manual.

v. Manufacturer's literature describing each piece of equipment, including major assemblies and subassemblies, and giving manufacturer's model number and drawing number.

vi. Operation instructions including step-by-step preparation for starting, safe operation, shutdown and draining, and emergency requirements.

vii. Control diagrams, as-installed by the manufacturer.

viii. Sequence of operation by the control manufacturer.

ix. Wiring diagrams, as-installed and color codes, of electrical motor controllers, connections and interlock connections.

x. Diagrammatic location, function and tag numbers of each valve.

xi. Maintenance instructions: Include step-by-step procedures for inspection, operation checks, cleaning, lubrication, adjustments, repair, overhaul, disassembly, and reassembly of the equipment for proper safe operation of the equipment. Include list of special tools which are required for maintenance with the maintenance information.

xii. Possible breakdowns and repairs.

xiii. Manufacturer's parts list of functional components, control diagrams and wiring diagrams, giving manufacturer's model number and manufacturer's part number.

xiv. "Long-Lead-Time" spare parts list for spare parts not readily available on the local open market or for

which it is anticipated ordering and delivery time will exceed 10 days.

xv. List of nearest local suppliers of all equipment parts.

xvi. Lubrication schedule indicating type and frequency of lubrication.

xvii. Manufacturer's warranty and guarantee data.

xviii. Spare parts data as follows:

1) Complete list of parts and supplies, with current unit prices and sources of supply.

2) List of parts and supplies that are either normally furnished at no extra cost with purchase of equipment, or specified herein to be furnished as part of Contract.

3) List of additional items recommended by manufacturer to assure efficient operation for period of 120 days.

xix. Complete sufficient copies of manufacturer's preventive maintenance forms to properly address each equipment item and all major equipment components installed under this section.

xx. Appendix: Include safety precautions, a glossary, and, if available at time of submittal, copies of test reports, and other relevant material not specified to be submitted.

xxi. Delete information on material or equipment not used in the work from the Operations and Maintenance (O&M) Manual.

6. Training Program as required by this section and Section 01780.

a. General Requirements: Provide training as outlined in this section.

i. Maintenance management classes are to take place prior to substantial completion of the facility. Mechanics training will commence only after installation of machine is complete at the garage.

ii. Training shall be conducted at the new facility.

iii. Hours for training are to be between 7:00 am and 3:00 pm unless specifically permitted otherwise.

iv. Owner Personnel to be Trained:

1) Mechanics: Minimum 8 hours.

2) Maintenance Personnel: Minimum 8 hours.

3) Supervisors: Minimum 2 hours.

b. Ensure that the instructors teaching these training courses are not only familiar with technical information, but able to utilize proper methods of instruction, training aids, audiovisuals, etc. to ensure effective presentations.

c. Provide all training aids, audiovisual equipment and visual aids for the conduct of these courses.

d. All training materials are to become the property of the Owner at the conclusion of training.

e. Submission and Approval of Training Plans:

i. Meet with the Engineer and the Owner no later than three weeks prior to the start of formal training. At that time, submit lesson plans and an outline of training program, and demonstrate any training aids involved. Present handouts for approval and later provide handouts in a ratio of one per student. Each location shall receive a complete set of prints and schematics.

ii. Describe plans for meeting the specification training requirements. The Owner will approve and then coordinate and schedule all training involved with necessary personnel.

f. Outline specific objectives for each of the required training courses. Provide a detailed schedule outlining the length and content of each of these sessions in accordance with the guidelines established.

i. The course includes sessions in safety, machine operation, a comprehensive seminar on learning basic

skills/knowledge of each operation. The course shall include both classroom and practical exercise sessions and is to provide the maintenance staff with the basic knowledge necessary to utilize all training materials.

ii. The training program shall include familiarization with safe equipment operation and performance and detailed instruction in operation, maintenance and test procedures.

g. Sequence of Approval:

i. Tentative Approval of Equipment: Before submittal of shop drawings, submit to the Engineer for approval, drawings, specifications and lists of equipment to be incorporated in the work. This list shall include catalog numbers, cuts, and such other descriptive data as may be required to assure compliance with these specifications. No consideration will be given to partial lists submitted from time to time. Approval of equipment will be tentative subject to submission of complete shop drawings indicating compliance with the Contract Documents.

ii. Final Approval of Equipment: After receiving tentative approval of the equipment lists, submit shop drawings, product data and installation instructions for final approval.

iii. Equipment substitutions must conform to the requirements of Section 01600 – Products.

h. Certificates:

i. Furnish an affidavit certifying that all materials and workmanship comply with the applicable code requirements.

ii. Before final acceptance, furnish certificates of the authorities having jurisdiction.

iii. Furnish factory certificates stating that all specification requirements relating to load capacities, pump capacities and fan capacities are provided.

iv. Certify that the design of equipment items and

systems complies with Seismic Use Group 1, Seismic Design Category B criteria as per the International Building Code.

1) Certification must be by a Professional Engineer registered in the State of Maryland.

2) Supporting calculations must be submitted for review by the Engineer.

1.04 JOB CONDITIONS

A. Within 60 days of the effective date of the Notice to Proceed, submit to the Engineer for approval a detailed narrative explaining the quality control procedures to be utilized for the fabrication and installation of equipment. The narrative shall include details of the methods and procedures to be used to regulate the production of the equipment to assure compliance with the specified standards of quality. The narrative shall also include full information on the Contractor's methods of testing and inspection and shall identify the Contractor's representatives and their duties.

B. During the course of the work, the Engineer will monitor the Contractor's approved quality control program to verify compliance. Any work undertaken, including the ordering and purchase of materials and supplies for the work, by the Contractor prior to approval of the Quality Control Program shall be at the Contractor's risk.

C. Certificates of Compliance: Upon delivery of the equipment, submit certificates of compliance. Each certificate shall be signed by an authorized representative of the manufacturer stating that the equipment complies in all respects with the Contract requirements.

D. General Design And Fabrication Requirements:

1. Equipment shall be designed, fabricated, installed and adjusted to secure the best commercially available results with respect to smooth, quiet, convenient and efficient operation, durability, economy of maintenance and operation, and the highest standards of safety.

2. It is not the intent of these Specifications to detail the design and fabrication of the several parts of the equipment, but it is expected that the type, material, design, workmanship and fabrication of each and every part shall be fully adequate for the service required, durable, properly coordinated with all other parts, in accordance with the best commercial standards and of the highest commercial efficiency. The components of electric circuits shall be of ample and proper size, design and material to avoid injurious heating and arcing,

and all other objectionable effects which may reduce the efficiency of operation and economy of maintenance and upkeep below the best commercially available results. Minimum requirements are given herein for the certain parts of equipment. Equivalent requirements approved by the Engineer shall apply to such parts as are of special design, construction or material and to which the specified requirements are not directly applicable. These minimum requirements as a whole shall also be considered as establishing proportionate general minimum standards for all parts of the equipment.

3. The Engineer may permit variations from the requirements of these Specifications to permit the use of the manufacturer's standard equipment, provided in his opinion such standard equipment is in every way adequate for the intended use and meets the full intent of these Specifications. All such variations proposed by the Contractor shall be called to the attention of the Engineer in writing and shall be made only if approved in writing. All proposed substitutions must conform to the requirements of Section 01600.

4. Certain design limitation, tests, etc., are herein specified as a partial check on the adequacy of design, fabrication, and materials. These requirements do not cover all features necessary to insure satisfactory and approved operation of the equipment. Conformity with these requirements shall, in no way, supersede the general requirements as to satisfactory and efficient operation of the equipment.

E. Remove, relocate and repair any items that are necessary for the installation of the equipment, at no additional cost to the Owner.

1.05 GUARANTEE

A. Warranty: All equipment shall be warranted as a minimum in accordance with Section 01780 of the General Provisions and the following provisions:

1. The Contractor shall furnish a warranty covering all parts of the work performed, and all materials and equipment furnished hereunder by Contractor or his subcontractors or suppliers will be free from defects in design, material, workmanship and operation for a period of two years from the date of acceptance of the work.

2. Warranty shall provide for 24 hour parts availability and 24 hour response time. Supplier shall maintain an adequate parts stock such that equipment down times attributable to unavailable typical repair parts shall be 48 hours or less during the first five year period.

3. The Contractor shall repair or pay for the repair of any such defect at his own expense.

4. Work which has been abused or neglected is excluded from this warranty.

5. Furnish written warranties required by the respective sections of the Specifications for time stipulated therein. These warranties shall be in writing, on the Contractor's or supplier's letterhead and shall be included in the operations and maintenance manual(s) as specified in 1.04 of this section.

6. Major equipment components, (as required by the respective sections of the specifications) specifically those manufactured by other than the primary equipment supplier, shall be covered by their own respective warranties, which shall not be less than the suppliers mandated two year warranty. These warranties shall also be included in the operations and maintenance manual(s).

7. Nothing in these requirements, conditions or specifications including the Owner's right to a complete inspection shall constitute a disclaimer to or limit, negate, exclude or modify in any way any warranty created hereunder.

1.06 NOISE AND VIBRATION ISOLATION

A. Operation of the equipment shall not exceed noise and vibration limits established by OSHA, local code or other regulatory requirements. Where required, provide approved type noise and vibration isolation pads equipped with necessary bearing plates and bolts. Pads shall be specifically designed for the weights, speeds and vibration characteristics of the equipment supported. The pads shall provide proper distribution of weight to avoid distortion of the bedplates.

B. Bolts and other fastenings in connection with these pads shall also be isolated.

1.07 SHOP PAINTING

A. Equipment shall be given one shop prime coat of approved rust-inhibitive paint containing at least 50 percent rust-inhibitive pigments and manufacturer's standard finish coat system. Shop drawings shall indicate brand and type of paint for both the prime coat and finish coat systems, as well as the color of all finish coats. All color selections must be approved by the Engineer.

B. Special equipment painting requirements are outlined in the respective sections of Divisions 11 and 14, as well as Section 10670.

C. Refer to Section 09915 for specific requirements for painting interior and exterior galvanized surfaces and ferrous metal surfaces.

1.08 ELECTRICAL REQUIREMENTS

A. Electrical materials and devices shall conform to the standard of Underwriters' Laboratories, Inc. (UL). Where material standards have not been established by UL, standards of quality and performance shall be those of the specified manufacturers, subject to approval of the agencies having jurisdiction. Products that are not UL listed shall be tested in place to demonstrate that the item complies with FEP (Field Evaluated Product) UL requirements. The Contractor is responsible to include the costs for all such testing in his bid price and no additional compensation related to this testing will be provided.

B. Power supply for equipment shall be 480 volts, 3-phase, 60 hertz unless otherwise specified.

C. Provide transformers for equipment as required to step down the specified supply voltage to provide lower voltage for controls and accessories and to provide voltage compatible with equipment as required.

D. Wiring shall be provided for complete installation of all equipment and accessories and shall be adequate for proper operation of equipment. Disconnect switch shall be provided for each equipment item requiring electric power. Disconnect switch shall meet the requirements of the respective equipment item manufacturer and these Specifications. Permanently label each disconnect switch to identify corresponding equipment item; labeling method shall be subject to approval of the Engineer. Contractor shall provide power wiring to line side of disconnect switch. Make connection to secondary side of disconnect switch and provide all wiring and conduit from this point, including wiring to controllers and starters. Provide 480 volt, and 230 volt equipment, as required, with electric fusible disconnecting means, sized and fused as required for each equipment item. All disconnect switches shall be fused with 100,000 amp limiter fuses. Provide 120 volt equipment with electric thermal overload disconnecting means sized as required for each equipment item. Wire and cable for light, power and signal circuits shall conform to those specified in the National Electrical Code. In no case shall maximum current carried exceed that specified by National Electrical Code for type of conductor used. Provide conduit where required; all wiring and conduit shall be in accordance with the requirements of Division 16.

E. Motors:

1. Motors shall be high efficiency makes, each bearing the UL label and constructed to standard of NEMA, IEEE, ANSI, and AFBMA.

2. Motors shall be suitable for operation on the electrical service indicated.

3. Horsepower ratings and sizes shall be selected at 104°F ambient temperature for open motors, with a service factor of 1.15 for open motors and unity service factor for totally enclosed or drip-proof motors. Provide motors with epoxy encapsulated insulation for severe usage in a corrosive atmosphere.

4. Motors rated one horsepower or greater shall have a full-load power factor of 85 percent or higher. Motors rated 25 horsepower and over shall be designed for reduced voltage starting.

F. Drives:

1. Guards shall be provided for each coupling and belt drive in conformance with applicable codes.

2. Belt drives shall have adjustable motor drive pulleys, and pulleys shall be replaced by the Contractor if required to properly operate the equipment.

3. Provide sliding motor bases where adjustable motor drive pulleys are provided.

1.09 GASKETS AND FASTENERS

A. Provide new gaskets wherever gasketed mating equipment items or pipe connections have been dismantled. Gaskets shall be in accordance with manufacturer's recommendations.

B. Replace all assembly bolts, studs, nuts and fasteners of any kind which are bent, flattened, corroded, or have their threads, heads or slots damaged.

C. Furnish all bolts, studs, nuts and other fasteners for make-up of all connections to equipment and replace any of these items damaged in storage, shipment or moving. Bolts shall comply with applicable SAE requirements including manufacturer's identification and certification of testing.

1.10 EQUIPMENT

A. Equipment, machinery and materials shall be as specified in Divisions 11and

14, as well as Section 10670.

B. Starters, controllers, disconnect switches and start-stop stations shall be provided for all equipment. Correct sizing of starters and disconnect switches shall be the joint responsibility of the Contractor and the equipment or apparatus manufacturer.

1. Electrical enclosures shall be NEMA 12 for indoor units and NEMA 4 for outdoor units unless otherwise noted by the Engineer.

2. Starters shall be complete with two sets of auxiliary contacts; one set normally open; one set normally closed.

3. For motors 25 HP or greater provide auto transformer type reduced voltage starters.

4. Provide labels for all disconnects for the equipment furnished under respective section of work.

C. Control devices necessary for proper operation shall be provided and shall be located to permit efficient operation of the equipment, and where possible shall be grouped in a factory fabricated NEMA approved control panel complying with the Specifications.

D. Switches, lights and control functions shall be identified with commercially available touch pads. The touch pads shall be industrial type oil resistant, etc. that are used on Computer Numerical Control (CNC) control panels. No decals will be accepted.

E. Piped services for equipment shall be terminated near the piece of equipment in a shut-off means. As part of the work of this Section, extend these piped services to the equipment and make the connections.

F. Provide piping, fittings, valves, connections, etc., of a type and size as recommended by the equipment manufacturer that will properly interface with the existing piped services.

G. All piping, valves, fittings, conduits and wiring required for the equipment installation shall be in accordance with the applicable portions of these Specifications.

1.11 INSTALLATION REQUIREMENTS

A. Furnish common and skilled labor, tools, rigging equipment, scaffolding, shims, dowels, and other materials necessary to make complete installation of equipment specified and indicated in the Contract Documents. Equipment Manufacturer shall provide on site representative during equipment

installation.

B. Receive, unload, check and store equipment in suitable facilities. All equipment should be kept clean, dry, and free from damage and be marked and tagged with equipment item numbers.

C. Examine equipment for concealed damage and report any damage.

D. Be responsible for safety and protection from loss or damage of equipment received until work is complete.

E. Pay demurrage charges and claims for damage resulting from unloading operations.

F. Reassemble equipment items which were dismantled for shipment or moving. Assemble items which are delivered knocked down, or disassembled.

G. Coordinate the installation of equipment with the Engineer.

H. Protect equipment during storage and prior to start-up, which shall include covering of openings, protection against rust and other damage, etc. Equipment may be stored outdoors only with approval of the Engineer.

I. Furnish and install grout, shim material and miscellaneous steel necessary for brackets, anchors, or supports required in installation of equipment.

J. Accomplish field machining that might be required to fit equipment together or to install equipment.

K. Lubricate apparatus before start-up.

L. Field check for clearance and interferences before fabrication or installation and relocate material and equipment furnished as required to eliminate interferences as approved by the Engineer.

M. Details listed in these specifications are given for a better understanding of the work required by the Contractor, and do not place a limitation on the amount of work to be done nor do they relieve the Contractor of additional work that may be required for a complete installation.

N. Perform mechanical and electrical work required to install the equipment in accordance with the requirements of the jurisdictional authorities and the current applicable codes and standards of practice employed by these trades.

1.12 HOLES, OPENINGS AND INSERTS

A. Provide holes and openings in floors, walls, ceilings and roofs as required. Coordinate all holes and openings with reinforcement and sleeves as required

by Structural Contract Drawings.

B. Core drill holes in existing work using dustless method. Grout holes in concrete walls, floor and roof slabs after installation of equipment, and leave them in a completely neat and sealed condition.

C. Install concrete inserts and flashings as required.

1.13 SETTING AND ALIGNING EQUIPMENT

A. Equipment shall be set and aligned in accordance with manufacturer's recommendations, approved shop drawings and applicable standards of trade practice.

B. Equipment shall be set true and level. Demonstrate adequate leveling of installed equipment.

C. Retighten bolted connections after installation.

1.14 CLEANING AND PROTECTION

A. Clean fabricated assemblies and equipment items thoroughly before and after operating and testing.

B. Protect equipment from damage, deterioration, paint or coating spills or spots, corrosion, or harm from any source.

1.15 CONCRETE FOUNDATIONS

A. Provide concrete foundations for equipment as required for proper installation and operation. Contractor shall be responsible for all foundation modifications required because of submitting substitute or as equal equipment.

B. Concrete and reinforcement shall conform to Section 03050 and Section 03300.

C. Provide anchor bolts as required for equipment to be mounted. Size anchors for embedding in concrete and expansions anchors as recommended by the equipment manufacturer, in accordance with specified seismic criteria.

D. Provide grouting as necessary to stabilize equipment bases to concrete foundations.

E. Provide hard rubber shims and dampening pads as recommended by the equipment manufacturer for leveling of equipment and dampening of equipment vibration transmission.

1.16 EQUIPMENT TEST AND CHECK-OUT

A. Before Final Acceptance, the Contractor-furnished building equipment and systems shall be tested in accordance with Section 01450 (by a testing agency when required) in the presence of the Engineer to his satisfaction and demonstrated to be correctly connected and installed. Submit a testing schedule to the Engineer for approval prior to the start of the equipment test and check-out.

B. Testing and check-out procedures of the manufacturer shall be carried out completely.

C. Equipment tests shall not only be performed to demonstrate that the equipment has been properly installed and connected and operates properly but also to demonstrate that the equipment performs the work as described in Divisions 11and 14 Equipment Specifications.

D. Tested equipment found to be defective or inoperable to any extent shall be reported to the Engineer immediately.

E. Any operating difficulty or defective item shall be repaired or replaced and put into proper operation by the Contractor immediately, at no additional expense to the Owner.

F. Protect equipment and surrounding areas from damage resulting from testing operations. Clean-up spills or leakage from testing.

G. The Contractor shall bear all expenses of all tests, including the furnishing of all necessary instruments, lubricant, hydraulic fluids, supplies, data recorders, certificates and operating personnel. Provide and bear all expenses for fuel/power required to operate the equipment during the tests.

H. At the sole discretion of the Engineer, the Contractor will be required to repeat any test at no additional cost to the Owner.

1.17 MOTORS AND DRIVES

A. Motors and drives shall be checked carefully for correct rotation and alignment before placing equipment into operation.

B. Couplings shall be disconnected and realigned before placing into service or testing.

C. Belt drives shall be adjusted and worn belts replaced in sets. Speed adjustment shall be subject to approval of the Engineer.

1.18 INSPECTION

A. Work will be inspected by the Engineer periodically during the course of construction.

B. Provide for inspections by all those having jurisdiction over the work performed under Divisions 11 and 14 during the progress of the work.

C. At time of final inspection, furnish certificate or certificates of final approval by all those having jurisdiction as applicable.

1.19 FIELD PAINTING

A. Field painting equipment, including touch-up painting, if any, is included under this Section of Specifications. Normally, equipment shall be factory-finished as previously specified.

B. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

1.20 EQUIPMENT START-UP

A. Unless otherwise specified in other Sections of these Specifications, all lubricants, cleaning compounds, and similar operating materials will be furnished by the Contractor during start-up and testing.

B. After all equipment and systems have been installed, connected and tested, proceed with start-up.

1.21 TRAINING

A. General: The Contractor is responsible for providing training on equipment and documentation in accordance with requirements of Specification Section 01780 –Close Out.

B. The Contractor will outline specific objectives for each of the courses that he is required to present.

1. The course should include sessions in safety, machine operation, a comprehensive seminar on learning basic skills/knowledge of each operation for each type of equipment. The course should include both classroom and practical exercise sessions and is to provide the mechanic with the basic knowledge necessary to utilize all training materials. The Contractor will provide a detailed schedule outlining

the length and content of each of these sessions in accordance with the guidelines established.

2. The training program shall include familiarization with safe equipment operation and performance and detailed instruction in operation maintenance and test procedures. The minimum level of training shall be provided for each personnel category as follows: a) Engineer and Management - 4 hours; b) Operating Personnel – 8 hours; c) Maintenance Personnel – 8 hours. In order to train all appropriate personnel, more than one training program of the durations indicated above may be required.

PART 2 PRODUCTS

NOT REQUIRED

PART 3 EXECUTION

NOT REQUIRED

PART 4: MEASUREMENT AND PAYMENT

4.01 BASIC EQUIPMENT MATERIAL AND METHODS:

A. Basic Equipment Material and Methods will not be measured for payment.

B. Basic Equipment Material and Methods will not be paid for directly, but will be considered incidental the Maintenance Building.

END OF SECTION

SECTION 11510

SHOP WORK STATIONS

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. The work specified in this section includes furnishing, installing, and testing workbenches, tables, vises, and other shop workstations at location shown on the Drawings. All wiring, conduit, piping, ductwork, and controls required to connect these shop work stations to building utilities are also a part of the work of this section.

B. Related Documents:

1. Drawings, MTA General Provisions for Construction Contracts, Supplementary General Provisions and Division 1 specification sections apply to the work of this section.

C. Related Sections:

1. Section 01110 – Summary of Work.

2. Section 01450 - Quality Assurance and Quality Control.

3. Section 01780 –Close Out.

4. Section 11005 - Basic Equipment Materials and Methods.

5. Division 15 – Mechanical.

6. Division 16 - Electrical.

1.02 QUALITY ASSURANCE:

A. Comply with the provisions of Section 01450 Quality Assurance and Quality Control.

B. Use adequate numbers of skilled workers who are completely familiar with the specified requirements and the materials and methods necessary for proper performance of the Work of this Section.

C. Reference Standards

1. Occupational Safety and Health Administration (OSHA):

   a. 29 CFR 1910 Occupational Safety and Health Standards.

2. National Fire Protection Association (NFPA):

   a. NFPA 70 National Electrical Code (NEC)

1.03 SUBMITTALS:

A. Pursuant to the provisions of Section 01780, Close Out Requirements and Section 11005, Basic Equipment Materials and Methods the Contractor shall submit:

1. Material and equipment list itemizing products furnished to satisfy the requirements of this section.

2. Product data including catalog cuts, manufacturer's assembly and installation data, manufacturer's certificates of compliance, and samples.

3. Shop drawings.

4. Schedule of work.

5. Operations and maintenance data.

6. List of recommended spare parts and maintenance materials.

7. Evidence of manufacturers and installers experience including names, addresses and phone numbers of reference clients.

8. Calculations and certification specified.

9. Documentation of field tests.

PART 2 PRODUCTS

2.01 HEAVY DUTY WORKBENCH WITH VISE:

A. Equipment Item Nos. MB-6, TS-6, MS-1, and FM-1; total of nineteen required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Heavy Duty Workbench.

   a. Vistamation Inc.

40011 Via View

Temecula, California 92592

Telephone: (888) 884-0939, (760) 284-5886

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Global Equipment Company

11 Harbor Park Dr.

Port Washington, NY 11050

Telephone: 516-625-3663, 888-978-7759

b. Hodge Manufacturing Co.

55 Fisk Avenue

Springfield, MA 01107

Telephone: (800) 336-4986

c. Or Approved Equal

C. Construction Features:

1. Open workbench, all steel construction.

2. Top: 3/8 inch steel plate 12 gauge back plate.

3. All welded legs 2 inch by 2 inch by 1/8 inch.

4. Formed 12 gauge stringer.

D. Dimensions:

1. Overall workbench: 72 inches long by 30 inches deep by 34 inches high.

E. Workbench shall be model H152-630 as manufactured by Vistamation, Inc.

F. Accessories:

1. Machinist's Vise: Each Workbench requires a machinist's vise as specified in Article 11510-2.03; total of nineteen machinist's vises required.

2.02 ELECTROSTATIC WORKBENCH WITH VISE:

A. Equipment Item Nos. ES-1; one required.

B. Acceptable Manufacturers:

1. The products of the following Electrostatic Workbench.

a. Lyon Metal Products

P.O. Box 671

Aurora, IL 60507-0671

Telephone: (708) 892-8941

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Global Equipment Company

11 Harbor Park Dr.

Port Washington, NY 11050

Telephone: 516-625-3663, 888-978-7759

b. Or approved equal

C. Construction Features:

1. Static-dissipative workbench, with ESD plastic laminate top

2. 15 Inch deep plastic laminate shelf

3. Formed stringer

D. Dimensions:

1. Overall workbench: 72 inches long by 34 inches deep with adjustable legs.

E. Workbench shall be model 77624 with Shelf Model 78706 as manufactured by Lyon Metal Products.

F. Accessories:

1. Machinist's Vise: Each Workbench requires a machinist's vise as specified in Article 11510-2.03; one machinist's vises required.

2.03 MACHINIST VISE:

A. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the machinist vise:

a. Wilton Corporation

300 South Hicks Road

Palatine, IL 60067-6900

Telephone: (708) 934-6000

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Reed Manufacturing Company

1425 West 8th Street

P.O. Box 1321

Erie, PA 16512

Telephone: (800) 666-3691 or (814) 452-3691

b. The Rigid Tool Company

400 Clark Street

Elyria, OH 44036-2023

Telephone: (216) 323-5581

B. Construction Features:

1. Locking 360° swivel base.

2. Jaws: 5 inch width with replaceable hardened steel jaw inserts.

3. Maximum Opening: 8 inches.

4. Main stress casing: 60,000 psi ductile iron.

C. Manufacturer's Model No.: 500S as manufactured by Wilton Corporation.

2.04 WELDING TABLE WITH HOOD:

A. Equipment Item No. WS-3; one required.

B. Acceptable Manufacturers for the Welding Table:

1. Products of the following manufacturer are specified as the standard of quality for the Welding Table:

a. FS Industries

PO Box 72659.

Providence, RI 02907

Telephone: (800) 421-0314

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Or Approved Equal.

C. Acceptable Manufacturers for the Fume Hood:

1. Products of the following manufacturer are specified as the standard of quality for the Hood:

a. Monoxivent

1306 Mill St.

Rock Island, IL 61201

Telephone: (309) 794-1000, (877) 608-4383

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Or Approved Equal.

D. Construction Features:

1. Welding Table

a. 12 gauge steel top.

b. 10 gauge steel legs.

c. Removable steel grating.

d. Pull-out tray for debris removal.

2. Fume Hood

a. 18 gauge welded construction

b. Slotted hood performance based on 23rd Edition – Industrial Ventilation Guidelines.

c. Air Flow: 1750 cubic feet per minute

d. Pressure drop 0.82 Inches.

E. Dimensions and Capacities:

1. Welding Table

a. Adjustable Height: 30 Inches to 42 Inches

b. Overall size: 60 inches long by 36 inches deep.

2. Fume Hood

a. Overall size: 58 inches long by 6 inches deep by 63 inches tall.

b. ½ Inch wide slots provided at 4-1/2 inches; 9 inches; 9 inches; 9 inches;

F. Welding Table shall be Model PWB-6036 by FS Industries; Fume hood shall be Model SFH-58 Slotted Fume Hood by Monoxivent.

2.05 SHIPPING TABLE

A. Equipment Item No. PS-9; one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Shipping Table.

a. Global Equipment Company

11 Harbor Park Dr.

Port Washington, NY 11050

Telephone: 516-625-3663, 888-978-7759

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. Vistamation

40011 Via View

Temecula, California 92592

Telephone: (888) 884-0939, (760) 284-5886

b. Or approved equal

C. Construction Features:

1. Durable steel workbench.

2. Legs are height adjustable with adjustable leveling feet.

3. Full width storage shelf under the countertop.

4. Lower shelf includes four 18 inch x 18 inch dividers.

5. Upright kit allows easy installation and height adjustment of overhead storage accessories.

6. Upright kit includes spool/reel holder, 6-outlet power supply, bin holder, 12 inch cantilever shelf with 4 dividers, enclosed shelf with four 12 inch x 18 inch dividers and an overhead shop light fixture.

7. Framing has a light gray finish.

8. Plastic Laminate top with T-mold edge banding for safety.

D. Dimensions and Capacity:

1. Overall workbench: 60 inches long by 30 inches deep.

2. Height: Adjustable from 42 inches to 48 inches.

3. Riser: 60 inches wide by 48 inches high.

E. Shipping Table shall be model number WB249851 as manufactured by Global Equipment Company.

2.06 HYDRAULIC HOSE WORKBENCH:

A. Equipment Item No. MS-11; one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Hydraulic Hose Workbench.

   a. Parker Hannifin Corporation, Hose Products Division

      30242 Lakeland Boulevard

      Telephone: (440) 833-2120

2. Products of equal quality and utility of the following manufacturers will be accepted.

   a. Or Approved Equal

C. Construction Features:

1. 1-1/2 Inch square tube structure

2. Gusseted corner braces

3. 5 Leg design with adjustable feet

4. Laminated wood table top

5. Hose reel / bottom shelf combination

6. Cabinet for fitting storage with 40 openings

7. Hose trough with adjustable hose stop

D. Dimensions:

1. Overall workbench: 72 inches long by 29 inches deep by 34-3/4 inches high.

E. Hydraulic Hose Workbench shall be model TH7-5-C with Model TH7-5-HT Hose Trough, manufactured by Parker Hannifin Corporation, Hose Products Division.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install equipment in strict accordance with the approved shop drawings and manufacturer's installation instructions.

B. Coordinate work with other trades to ensure proper equipment interface with the building structure and utilities.

C. Proceed with start-up, testings and instruction in accordance with Section 11005.

3.02 FIELD QUALITY CONTROL:

A. Provide the services of a qualified manufacturer's representative to perform the following:

1. Supervise preparatory work performed by other trades.

2. Supervise installation.

3. Supervise testing, by the Contractor in the presence of the Engineer to ensure proper operation of the equipment.

3.03 FIELD TESTING:

A. Perform testing of the equipment and system in accordance with the requirements specified in Section 01450 Quality Assurance and Quality Control. Perform and document all testing procedures recommended by the manufacturer.

3.04 OPERATION AND MAINTENANCE MANUALS:

A. Provide operation and maintenance manual in accordance with the requirements specified in Section 11005.

PART 4 : MEASUREMENT AND PAYMENT

4.01 HEAVY DUTY WORKBENCH WITH VISE:

A. Heavy Duty Workbench With Vise (MB-6, TS-6, MS-1, FM-1 and FM-15) will be measured for at the contract unit price bid per each.

B. Heavy Duty Workbench With Vise (MB-6, TS-6, MS-1, FM-1 and FM-15) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.02 ELECTROSTATIC WORKBENCH WITH VISE:

A. Electrostatic Workbench with Vise (ES-1) will be measured for at the contract unit price bid per each.

B. Electrostatic Workbench with Vise (ES-1) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.03 MACHINIST VISE:

A. Machinist Vise (MB-6, TS-6, MS-1, FM-1, FB-1 and ES-1) will not be measured for payment.

B. Machinist Vise (MB-6, TS-6, MS-1, FM-1, FB-1 and ES-1) will not be paid for directly but will be considered incidental to Electrostatic Workbench with Vise and Heavy Duty Workbench with Vise items.

4.04 WELDING TABLE WITH HOOD:

A. Welding Table with Hood (WS-3) will be measured for at the contract unit price bid per each.

B. Welding Table with Hood (WS-3) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.05 SHIPPING TABLE:

A. Shipping Table (PS-9) will be measured for at the contract unit price bid per each.

B. Shipping Table (PS-9) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.06 HYDRAULIC HOSE WORKBENCH:

A. Hydraulic Hose Workbench (MS-11) will be measured for at the contract unit price bid per each.

B. Hydraulic Hose Workbench (MS-11) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

END OF SECTION

SECTION 11520

SHOP EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. The work specified in this section includes furnishing, installing, and testing shop equipment at locations shown on the Drawings. All wiring, conduit, piping, ductwork, and controls required to connect these shop work stations to building utilities are also a part of the work of this section.

B. Related Sections:

1. Section 01300 - Submittals.
2. Section 01450 - Quality Assurance and Quality Control.
3. Section 01780 –Close Out.
4. Section 11005 - Basic Equipment Materials and Methods.
5. Division 15 Mechanical.
6. Division 16 Electrical.

C. Provisions of Section 11005 apply to the work of this Section.

1.02 QUALITY ASSURANCE:

A. References

1. American Institute of Steel Construction, Inc. (AISC)
   a. Manual of Steel Construction.
2. American Welding Society (AWS)
   a. AWS D1.1/D1.1M Structural Welding Code – Steel.
3. Occupational Safety and Health Administration (OSHA)
   a. 29 CFR 1910 Occupational Health and Safety
   b. 29 CFR 1926 Safety and Health Regulations for

Construction.

4. National Fire Protection Association (NFPA)

   a. NFPA 70 National Electrical Code.

   b. NFPA 79 Electrical Standard for Industrial Machinery.

   c. NFPA 91 Standards for Exhaust Systems for Air Conveying of Vapors, Gasses, Mists, and Noncombustible Particulate Solids.

5. National Electrical Manufacturers Association (NEMA)

   a. NEMA 250 – Enclosures for Electrical Equipment (1,000 Volts maximum).

   b. NEMA MG-1 – Motors and Generators.

   c. NEMA MG-2 – Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators.

   d. NEMA MG-10 – Energy Management Guide for Selection and Use of Polyphase Motors.

6. American National Standards Institute (ANSI)

   a. ANSI B30.1 – Jacks, Industrial Rollers, Air Casters and Hydraulic Gantries.

   b. ANSI C50.10 – Rotating Electrical Machinery – Synchronous Machines.

   c. ANSI/ASSE A10.32 Fall Protection Systems for Construction and Demolition Operations.

7. Institute of Electrical and Electronics Engineers (IEEE)

   a. IEEE 112 – Standard Test Procedures for Polyphase Induction Motors and Generators.

8. Underwriter Laboratories, Inc., (UL)

   a. UL 2111 Overheating Protection for Motors.

9. American Railway Engineering and Maintenance-of-Way Association (AREMA)

a. Manual for Railway Engineering.

10. Steel Structures Painting Council (SSPC)

a. Steel Structures Painting Manual.

11. Maryland Boiler and Pressure Vessel Safety Act, Public Safety Article, 12-901 – 12-919.

12. Annotated Code of Maryland.

13. COMAR 09.12.01.

B. Certify that shop equipment furnished and installed complies with applicable OSHA standards.

C. Comply with the provisions of Section 01450 Quality Assurance and Quality Control.

D. Provide services of manufactures representative to perform services specified in Article 3.02.

E. Use adequate numbers of skilled workers who are completely familiar with the specified requirements and the materials and methods necessary for proper performance of the Work of this Section.

1.03 SUBMITTALS:

A. Pursuant to the provisions of Section 01300, Submittals and Section 11005, Equipment General Requirements, submit the following:

1. Material and equipment list itemizing products furnished to satisfy the requirements of this section.

2. Product data including catalog cuts, manufacturer's assembly and installation data, manufacturer's certificates of compliance, and samples.

3. Shop drawings.

4. Schedule of Work.

5. Training program and operations and maintenance manual.

6. List of recommended spare parts and maintenance materials.

7. Evidence of manufacturers and installers experience including names, addresses and phone numbers of reference clients.

8. Documentation of field tests.

1.04 EXPERIENCE:

A. Furnish products only from manufacturers who demonstrate that they have a minimum of five years experience manufacturing items equivalent to those required as the Work of this Section.

PART 2 PRODUCTS

2.01 BUFFER/GRINDER WITH DUST COLLECTOR–8 INCH:

A. Equipment Item No. FM-2and MB-21; total of four required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Buffer/Grinder with Dust Collector.

a. Baldor Electric Company

5711 R.S. Boreham, Jr. St.

P.O. Box 2400

Fort Smith, AR 72901

Telephone: (479) 646-4711

2. Products of equal quality and utility of other approved manufacturers will be accepted.

a. Or approved equal.

C. Construction Features: Provide complete unit with the following appurtenances:

1. Two wheels.

2. Wheel guards and tool rests are cast iron

3. Guards shall be exhaust type

4. Cast iron tool rest.

5. Base mounted off/on switch.

6. Cast iron pedestal.

7. Dust Collector.

D. Dimensions and Capacities:

1. General purpose grinding (36 grit wheel).

2. Wire brush is used to remove scale and rust.

3. Two wheels 8 inches x1 inch x3/4 inches

4. Pedestal Height: 32-7/8 inches.

5. Dust Collector Capacity:

a. Capable of moving a minimum of 440 cubic feet of air per minute in accordance with OSHA Standards.

E. Electrical Requirements:

1. Grinder motor. 0.75HP, 3600RPM, 1PH, 60HZ.

2. Dust Collector motor: 1/2 HP; TEFC.

3. Power Supply: 115 volts, 1 phase, 60 hertz.

F. Dual Grinder with Dust Collector shall be Model No. 8250W Buffer/Grinder with Model DC8 Dust Collector and Model GA16 Pedestal as manufactured by Baldor Electric Company.

2.02 55 TON AIR/HYDRAULIC PRESS:

A. Equipment Item No. MS-3; one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the 55 Ton Air/Hydraulic Press:

a. SPX Corporation

655 Eisenhower Drive

Owatonna, MN 55060

Phone: (800)-533-6127

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Enerpac

13000 W. Silver Spring Drive

Butler, WI 53007

Telephone: (262) 781-6600

b. Dake

724 Robbins Road

Grand Haven, MI 49417

Telephone: (800) 937-3253

C. Construction Features:

1. Side-to-side positioning of ram allows full capacity pressing along entire bolster length without buckling or bending.

2. Cover with a Lifetime Warranty - warrant against defects in materials and workmanship for the life of the product.

3. Hydraulic ram features 13 inches of stroke.

4. Includes single-acting ram with 13 inches stroke

5. Includes air/hydraulic pump

6. Gauge

7. Hose (3/8 inches ID x 10 feet).

8. Pump mounting bracket.

D. Dimensions and Capacities:

1. Dimensions:

a. Overall press frame dimensions (approximate): 36 inches deep x 48.5 inches wide x 72 inches high.

b. Maximum Bed Width: 36 inches

c. Bed Height: 6-42 inches

2. Press Capacity: 55 Ton

3. Cylinder:

a. Stroke: 13 inches.

4. Air/Hydraulic Pump Reservoir Volume: 2 Gallon

E. Utility Requirements:

1. Compressed Air: 9 cubic feet per minute@100 PSI.

F. Accessories:

1. No. 1126 bearing pulling attachment

2. No. 34755 ram pushing adapter with 1 inch dia. shank

3. No. 34756 ram pushing adapter with 1-1/4inch. Dia. shank

4. No. 34808 V-pushing adapter

5. No. 1892 14 inch long V-blocks (pr.)

6. No. 28230 ram forcing cap

7. No. 37368 threaded adapter

G. Spare Parts: Provide spare hydraulic oil and maintenance accessories as recommended by manufacturer.

H. 55 Ton Air/Hydraulic Press shall be Model No.: 1847 with Accessories Model 1882 as manufactured by SPX Corporation.

2.03 USED OIL FILTER CRUSHER:

A. Equipment Item Nos. MB-10; one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Used Oil Filter Crusher:

a. Herkules Equipment Corporation

2760 Ridgeway Court

Walled Lake, MI 48390 - 1662

Telephone: (800) 444-4351 or (248)-960-7100

2. Products of equal quality and utility of the following manufacturers will be accepted.

   a. Bedford Industries, Inc (Oberg)

      14253 169th Drive Southeast, Suite #787

      Monroe, WA 98272

      Telephone: (800) 848-8228

   b. JohnDow Industries

      151 Snyder Ave.

      Barberton, OH 44203

      Telephone: (800) 433-0708

C. Construction Features:

1. Steel construction
2. Free standing unit.
3. Grated top for draining oil prior to crushing.
4. Connection for used oil collection
5. Airline filter and regulator
6. Crushing mechanism: Air Bag
7. Percent oil extracted 95 - 98
8. Cycle time 35 - 55 seconds
9. Timer

D. Dimensions and Capacities:

1. 18 tons crushing force.
2. Crush four smaller or one large heavy duty oil filter at one time.
3. Overall size: 67 inches high x 32 inches wide x 27 3/4 inches deep.
4. Crushing chamber dimensions: 20 inches high x 9 inches wide/deep.

5. Weight: 640 pounds.

E. Utility Requirements:

1. 100-120 psi at 44 cubic feet per minute air pressure

F. Used Oil Filter Crusher shall be Model Number OFC4 by manufactured by Herkules Equipment Corporation.

2.04 DRILL PRESS VARIABLE SPEED – 20 INCH

A. Equipment Item Nos. MS-2 and FM-3; total of two required

B. Acceptable Manufacturers:

1. The products of the following supplier are specified as the standard of quality for the Drill Press Variable Speed – 20 Inch.

a. Clausing Industrial, Inc.

1819 North Pitcher Street

Kalamazoo, Michigan 49007-1886

Telephone: 269-345-7155

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Delta International Machinery

246 Alpha Drive

Pittsburgh, PA 15238

Telephone: (800) 438-2486

b. Or approved equal

C. Construction Features:

1. Handwheel adjustment sets the speeds

2. Full bearing support on quill for maximum spindle stiffness

3. 6" stroke for deep hole application

4. Accurate depth stop for precise hole depths

5. Safety collar

D. Dimensions and Capacities:

1. Capacity, Hand Feed: 1.25 inch diameter.

2. Production Rated, With Optional Power Feed: 11/2 HP Motor 1 inch in Cast Iron;

3. ¾ in Mild Steel

4. Drill to Center Of Circle: 20 inch diameter.

5. Spindle Nose: No. 3MT, 1.74 inch OD

6. Spindle Travel: 6.5 inches

7. Column: Ground Steel 4 inch dia. 3/8 inch Thick Wall

8. Quill (Ground Steel): 2.5 inch dia.

9. Quill Return Spring, Capacity: 40 pounds

10. Table Working Surface: 22 inch x 19.5 inch

11. Table Slots: Two, 15.5 inch long, for .5 inch T-Bolt

12. Table Travel, One Setting: 20 inch

13. Spindle to Table, Maximum: 33.125 inch

14. Base, Working Surface, Ground: 15.5 inch x 13 inch

15. Base T-Slots: Two, 13 inches Long, for .5 inch T-Bolt

16. Spindle to Base, Maximum: 43.375 inch

17. Overall Size: 22 inches wide by 36 inches deep by 69 inches high.

E. Electrical Requirements:

1. Motor: 1.5HP; TEFC; 115 volt; 1 phase; 60 Hertz.

2. Power cord and plug

F. Accessories:

1. Magnetic starter

2. Drill press lamp

3. Key type chuck

4. Arbor

G. Drill Press Variable Speed – 20 Inch shall be Style A with Magnetic Starter Number 2371 manufactured by Clausing Industrial Inc.

2.05 WELDER / PLASMA CUTTER

A. Equipment Item No. WS-2; one required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the Welder / Plasma Cutter:

a. Hobart Welders

Distributed by

Roberts Oxygen

4520-A O'Donnell Street

Baltimore, MD 21224

Phone: (410) 522-7440

2. Products of equal quality and utility of other manufacturers will be accepted.

a. Miller Electric Mfg. Co.

1635 West Spencer Street

Appleton, WI 54914

Telephone: (800) 426-4553

b. Lincoln Electric Company, Inc.

22801 Saint Clair Ave

Cleveland, OH 44117-1199

Telephone: (800) 408-1188 or (216) 481-8100

c. Approved Equal

C. Construction Features:

1. Type: Portable, industrial air plasma cutting system.

2. Inverter Design - Powerful cutting ability

3. Capable with Engine-Driven Welders - Capable of cutting 3/8 to 5/8 in. mild steel when powered by an engine-driven welder with a 240 V generator power outlet of 8 kW or more.

4. Ergonomic Torch - The HP-70 torch is designed for increased comfort, more efficient cooling and economical replacement cutting tips.

5. Post-flow Air Cooling - Cools the torch and tip after cutting, extending life of replaceable tip and electrode.

6. Fan-On-Demand - Runs only when needed reducing dust/debris pulled into unit.

7. Wind Tunnel Technology - Prevents abrasive dust and particles from damaging internal components.

8. Thermal Overload Protection - Built to withstand tough working environments. Rated for 35% duty cycle at 104° Fahrenheit. Duty cycle will increase as environmental temperature decreases.

9. Cable Management Strap - Secures torch, work cable and power cord to make transporting easy and convenient.

10. Line Voltage Compensation (LVC) - Provides peak performance power under variable input voltage conditions (±15%) for steady and cleaner ending cuts.

11. Power Factor Correction - Expands operator's work area via extension cords while minimizing nuisance trips caused by voltage drops.

12. Electrical Input: 208V / 230V, 1 phase, 60 Hz, 33A.

13. Output 40 A, at 140 VDC

D. Dimensions:

1. Overall: 11-1/4 inches high x 8-1/4 inches wide x14-1/4 inches deep.

2. Weight: 31.4 lbs

E. The Welder / Plasma Cutter shall be Model #500546 AirForce™ 700i as manufactured by Hobart Welding.

2.06 WELDER, ARC

A. Equipment Item No. WS-1; one required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the Arc Welder:

a. Lincoln Electric Company, Inc.

22801 Saint Clair Ave

Cleveland, OH 44117-1199

Telephone: (800) 408-1188 or (216) 481-8100

2. Products of equal quality and utility of other manufacturers will be accepted.

a. Miller Electric Mfg., Co.

1635 West Spencer Street

Appleton, WI 54914

Telephone: (800) 426-4553

b. Hobart Welders

Distributed by

Roberts Oxygen

4520-A O'Donnell Street

Baltimore, MD 21224

Phone: (410) 522-7440

C. Construction Features:

1. Provide AC arc welding power from 40–225 Amps and a DC welding output range of 30–125.

2. Can be used as a stick welding power source for maintenance, repair, fabrication, construction, erecting and hardfacing applications.

3. Use for cutting and piercing holes in steel. NEMA rated, UL listed and CSA approved. U.S.A.

4. Include attached input power cable and plug

5. Include front-mounted AC/DC polarity switch and full range amperage selector switch for accurate and dependable procedure setting

6. Compact size for easy storage and handling

7. Smooth arc allows use of a variety of electrodes, including mild steel, low hydrogen, stainless and hardfacing

8. Electrode selection chart on machine case provides quick and easy reference guide.

9. Fan cooled for extra thermal protection.

10. Vermin-resistant mesh bottom.

11. Powder-coat finish.

12. Amps: 40–225

13. Duty Cycle: 20% @ 225 Amps, 25V

14. Amperage Adjustments: 40–225

15. Range Selection: 40–225

16. Weldable Metals Carbon, low alloy, stainless steel and cast iron

17. Weld Thickness: Up to ¼ inch.

18. Electrode Size: 3/16 to 5/32 inches.

19. Electrode Cable Length: 10 feet.

20. Clamp Cable Length: 10 feet.

21. Power Cord: 6 feet.

D. Utility Requirements:

1. 208 Volt, 1 Phase, 50 Amp.

E. Overall Dimensions: 12 inches long x 17 ¼ inches wide x 24 inches high.

F. The Welder, Arc shall be Model #AC/DC 225/125 Arc Welder Model K1297 as manufactured by Lincoln Electric.

2.07 AC REPAIR PORTABLE PLATFORM

A. Equipment Item No. MB-5; two required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the AC Repair Portable Platform.

a. Cotterman Co.

130 Selzer Road

P.O. Boxy 168

Crosswell, MI 48422-0168

Telephone: (810) 679-4400

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal.Construction Features:

1. The lift is quickly elevated to the desired working height with a hand crank winch, and then the user climbs a ladder to the platform.

2. Built in safety features include

a. A friction brake on the winch.

b. Outriggers can be placed in an X pattern or rectangular.

c. A spring loaded mechanical stop engages as soon as tension is released from the cable, preventing a vertical drop in case the cable is cut or snaps.

D. Dimensions and Capacities:

1. Platform Height: 15 inches

2. Retracted Height: 79 inches

3. Capacity: 300 lbs

4. Platform Size: 25.5 inches x 29 inches

5. Base Dimension: 29 inches x 59 inches.

6. Handrail Height: 42 inches.

7. Foot Print 90°: 63 inches x 57 inches.

8. Foot Print 45°: 66 inches x 72 inches.

9. Shipping Weight: 960 lbs.

E. The AC Repair Portable Platform shall be as Maxi-Lift Model ML-15W as manufactured by Cotterman Co.

2.08 CYLINDER LIFT TRUCK

A. Equipment Item No. MS-9; two required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Cylinder Lift Truck.

a. Grainger

2100 Haines St.

Baltimore, MD 21230-3206

Telephone: (800) 323-0620, or (410) 234-0184

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal.Construction Features:

1. Lift and transport cylinders.

2. Hydraulic foot pump elevations method.

3. Locking, hard rubber, swivel 5 inch diameter casters.

4. Upper and lower chain to secure load.

D. Dimensions and Capacities:

1. Load Capacity: 300 pounds.

2. Maximum Height: 40 inches.

3. Size: 20-3/4 inches long by 29-1/4 inches wide by 52 inches high.

E. The Cylinder Lift Truck shall be Wesco Model #1AFD1 as distributed by Grainger.

2.09 CYLINDER SCALE

A. Equipment Item No. MS-7; two required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Cylinder Scale.

a. Scaletron Industries, Ltd.

Bedminster Industrial Park

53 Apple Tree Lane

P.O. Box 365

Plumsteadville, PA 18949

Telephone: (800) 257-5911, (215) 766-2670

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal. Construction Features:

1. Design to weigh 12 inch diameter cylinders and smaller.

2. Two independent weighing discs and digital LCD displays.

3. Accuracy of +/- 0.1% of capacity.

4. Indicator: 3-1/2 digit LCD display

5. Readout in pounds or kilograms.

6. Three point suspension on the weighing platform.

7. Corrosion resistant molded fiberglass reinforced thermoplastic construction.

8. Low profile platform design to increase safety and ease of cylinder handling.

9. Electronic indicator housed in NEMA 4X, UL approved enclosure.

10. Stainless steel load cell.

11. Self-locking tare adjustment knob.

12. Output signal: 4-20 mA.

13. 12 foot of 4 conductor wire cable.

14. Cylinder support and chains.

D. Dimensions and Capacities:

1. Base size: 32 inches long by 18 inches deep.

2. Gross capacity range: 0-349 pounds per disc.

E. The Cylinder Scale shall be Model #2350 as manufactured by Scaletron Industries, Ltd.

2.10 REFRIGERANT LEAK DETECTOR

A. Equipment Item No. MS-10; six required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Refrigerant Leak Detector.

a. Inficon, Distributed by Professional Equipment

PO Box 5197

Janesville, WI 53547-5197 9

Telephone: (800) 334-9291

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal. Construction Features:

1. Use infrared absorption sensing to check for leaks.

2. Sensing cell lifespan: 800 hours.

3. Charging status indicator

4. Sensor failure indicator

5. Powered by NiMH (nickel metal hydride) batteries.

6. Controls: Power: on/off; Sensitivity: high/low

7. Chrome-plated flexible metal probe, approximately 17 inches long.

8. Built in recharger.

9. Certifications:

   a. CE Mark certifying power safety and electromagnetic compatibility (EMC) per IEC 61000-1-2 Electromagnetic compatibility (EMC) - Part 1-2: General - Methodology for the achievement of functional safety of electrical and electronic systems including equipment with regard to electromagnetic phenomena.

   b. Certificate-of-Compliance certifying compliance with The Society of Automotive Engineer's SAE J 1627 Performance Criteria for Electronic Refrigerant Leak detectors.

D. Dimensions and Capacities:

1. 0.10 oz / year sensitivity

2. Sensitive to R-22, R-124a, R-404a, R-410a, R-507,

E. Electrical Requirements: 120V/1Phase

F. Accessories:

1. 120 volt adapter and cord.

2. Storage case.

3. Tip and Filter Kit.

G. The Refrigerant Leak Detector shall be Inficon’s D-Tek Select Refrigerant Leak Detector, Model #G406-1365 manufactured by Inficon and distributed by Professional Equipment.

2.11 REFRIGERANT RECOVERY SYSTEM

A. Equipment Item No. MB-14; four required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Refrigerant Recovery System.

   a. Van Steenburgh Engineering Labs, Inc

      1825 No. Lake Ave.

      Estes Park, CO 80517

      Telephone: (970) 586-8412

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal.Construction Features:

1. Powder coated steel cabinet.

2. One half horsepower hermetic compressor.

3. Patented liquid injection.

4. UL Listed.

5. Capable of recovering the following refrigerants: R-12, R-22, R-2134A, R-401A, R-401B, R-401C, R-402B, R-406A, R-407C, R-407D, R-408A, R-409A, R-411A, R-411B, R-412A, R-500 R-502, R-509.

6. Lab quality pressure gauges.

7. In/Out valves: ¼ inch SAE Maleflares

8. Wheels: 10 inches OD x 3.5 Inches

D. Dimensions and Capacities:

1. Recovery Capacity: 1.1 pounds per minute.

2. Storage Capacity: 30 pound external cylinder.

E. Electrical Requirements: 115/120 Volt, 60 Hertz, 1 Phase. 10 Amp

service required.

F. The Refrigerant Recovery System shall be Model RV-10 as manufactured by Van Steenburgh Engineering Labs, Inc

2.12 VACUUM PUMP

A. Equipment Item No. MS-8; four required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Vacuum Pump.

a. Gardner Denver Thomas, Inc.

Welch Vacuum Technology

5621 W. Howard Street

Niles, IL 60714

Telephone: (847) 676-8800

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Construction Features:

1. Belt-Drive High Vacuum Pump—Two Stage Large

2. "Approval Mark certifying approval by a National Recognized Testing Laboratory (NRTL) such as CSA International..

3. Explosion Proof, TEFC, 3-Phase motors

4. All 115 and 230V single phase motors include thermal overload protection.

5. Two-stage pumps should not be operated continuously at pressures above 10 Torr.

6. Conduit wiring installation required. No cord, plug or switch provided.

D. Dimensions and Capacities

1. Wired for 115V, 60 Hz, 1 PH with N. American 115V Plug.

2. Free Air Displacement

3. Air Flow: 17.7 cubic feet per minute

4. Ultimate Pressure (Torr):1 x 10

5. Gas Ballast

6. Pump RPM: 400

7. Motor Horsepower: 1

8. Oil Capacity: 1.25 quarts.

9. Tubing Needed, I.D.: 1-5/8 inches.

10. Intake, Nipple Thread: 1.75-20

11. Exhaust, Thread Type: 1.75-20

12. Weight: 205 pounds.

13. Dimensions: 26 inches long x 13.7 inches wide x 18 inches high.

14. Ship Weight: 224 pounds.

E. The Vacuum Pump shall be Welch Model #1397B as manufactured by Gardner Denver Thomas, Inc., Welch Vacuum Technology.

2.13 NITROGEN TIRE INFLATION SYSTEM

A. Equipment Item No. TS-10; one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Nitrogen Tire Inflation System.

a. Kaeser Compressors, Inc.

P.O. Box 946

Fredericksburg, Virginia 22404

Telephone: (540) 898-5500

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal.Construction Features:

1. Supply one packaged, powder-coat painted, fully assembled and fully mobile nitrogen tire inflation system.

   a. Unit shall have an integral nitrogen separation system to produce 4 standard cubic feet per minute of 99+% pure nitrogen from 12 standard cubic feet per minute of 105 to 160 psig compressed air, and integral nitrogen storage capacity equivalent to 150 gallons.

   b. Three stages of pre-filtration shall be supplied to protect the nitrogen separator.

   c. Unit shall have a nitrogen purity sampling port, two (2) parallel-piped compressed air inlet ports, and two (2) parallel-piped nitrogen outlet ports.

   d. A panel mounted nitrogen pressure gauge and panel mounted On/Off switch for ease of operation shall be provided.

   e. A mounted gauge for compressed air inlet pressure and a power cord shall be supplied.

2. Unit Mobility:
   a. Unit shall be supplied with four (4) heavy-duty casters, two (2) of which shall be lockable.

   b. The lockable casters shall be mounted at the front of the unit such that they are easily accessible by the unit operator.

   c. A firmly anchored grab-bar, a minimum of 12 inches in length, for ease of maneuvering the unit shall be supplied.

3. Nitrogen Separation System:
   a. The nitrogen separation process shall be pressure swing adsorption to achieve a nitrogen purity of 99+%.

   b. An easily accessible nitrogen purity sampling port having 1/4 inch quick-connect coupling shall be provided.

   c. Due to the 99+% nitrogen purity level that is required to achieve an in-tire purity of 95+% or better, systems employing separation via semi-permeable membrane cannot be considered.

4. Nitrogen Storage: The unit shall have integral storage capacity equivalent to 150 gallons and have the capacity to inflate up to sixty (60) passenger car tires per hour. A pressure relief valve with 165 psig relief set point shall be provided.

5. Three Stage Filtration:

   a. Stage one filtration shall be a liquid separator having integral 5 micron filter element and integral float-style automatic condensate drain. Filter housing shall be 1/4 turn, bayonet style with liquid level sight glass. Filter element and condensate drain shall be replaceable components.

   b. Stage two filtration shall be oil coalescing having integral 0.01 micron filter element and external, manual condensate drain. Filter housing shall be 1/4 turn, bayonet style with liquid level sight glass. Filter element shall be a replaceable component.

   c. Stage three filtration shall be oil vapor adsorption. Filter housing shall be 1/4 turn, bayonet style. Filter element shall be a replaceable component.

6. Connection: A 3/8 inch NPT (F) connection, for both inlet compressed air and outlet purified nitrogen, shall be provided on both the front and back sides of the unit. All four connection ports shall be adequately labeled.

7. Nitrogen Pressure Gauge: Pressure gauge shall have a 2 inch dial having black markings on a white background, and shall be dual scale: 0-200 psig and 0-1400 kPa.

8. Automatic Controls: The unit shall be provided with a Power On/Off switch. Unit operation shall be fully automatic after the switch has been moved to the “On” position. Unit shall be capable of continuous service at full capacity. The unit shall operate on a 15 ampere, 110 volt, single phase, 60 Hz power supply.

D. Dimensions and Capacities

1. Nitrogen Purity: 95.0% / 99.5%

2. Nitrogen Flow: 4 standard cubic feet per minute /8.5 standard cubic feet per minute

3. Air Consumption: 12 standard cubic feet per minute / 17 standard cubic feet per minute

4. Nitrogen Output 4 - 8.5 standard cubic feet per minute

5. Tire Filling Capacity Up to 60 per hour

6. Nitrogen Dew Point -50 ºF

7. Ambient Air Temperature 40-100°F (75°F is optimal)

8. Tank Capacity 150 gal (Surge Capacity Equivalent)

9. Weight 400 lbs

10. Dimensions 32 inches wide x 17 inches deep x 59 inches high

11. Inlet/Outlet Connections 3/8 inch NPT

12. Noise Level 70 dBA

13. Filters: 0.01 micron / 5 micron /Carbon

E. Utility Requirements:

1. Power Supply 115V/1ph/60Hz

a. Power Cord: A pre-wired, 6 foot, 14 AWG, SJT, power cord with 3 prong plug shall be supplied.

2. Inlet Air Pressure 110-160 psig (150 is optimal)

F. Accessories:

1. Air Dryer

2. Ultrafill 99^{+} Nitrogen Purity Analyzer

G. AST 500 Gal Nitrogen (TS-10A; one required)

1. Steel AST shall accommodate Nitrogen storage.

2. Size: 36 inch diameter x 117 inches high.

3. Safety relief valve

4. Manometer (gauge)

H. Nitrogen Tire Inflation System shall be the Ultrafill 99+ with 500 Gallon AST and Accessories by Kaeser Compressors.

2.14 PORTABLE FUME EXHAUSTER

A. Equipment Item No. WS-6; one required.

B. Acceptable Manufacturer:

1. Products of the following manufacturer are specified herein as the standard of quality for the portable fume exhauster.

   a. United Air Specialists, Inc.
      4440 Creek Road
      Cincinnati, OH 45242
      Telephone: (513) 891-0400 or 800-252-4647

2. Products of equal quality and utility of the following manufacturers will be accepted.

   a. Nederman, Inc.
      39115 Warren Road
      Westland, MI 48185
      Telephone: (800) 575-0609

   b. Car-Mon Products, Inc.
      1225 Davis Road
      Elgin, IL 60123-1317
      Telephone: (708) 695-9000

   c. Or Approved Equal

C. Construction Features:

1. Type: Portable fume exhauster consisting of fume extractor arm, fan with prefilter, ionizer, and electrostatic filter collection cell.

2. Prefilter: Reusable, constructed of layered expanded aluminum mesh.

3. Ionizer: Tungsten ionizing wire with ceramic ionizer insulators operating at 12.0 kilovolt nominal voltage.

4. Electrostatic Filter Collection Cell: 20,160 square inches of surface area.

5. Power Pack: Capable of providing 11,000 Volts DC to the ionizer and 6,000 Volts DC to the electrostatic filter collection cell.

6. Power Cord 10 feet in length

7. Removable dust collection drawer.

8. Portability provided by two fixed wheels and two rotatable casters.

D. Dimensions and Capacities:

1. Length: 42 inches.

2. Width: 28 inches.

3. Height: 44 inches.

4. Fume Extractor Arm Diameter: 8 inches.

5. Fume Extractor Arm Length: 7 feet.

E. Utility Requirements:

1. Compressed Air Capacity: 1000 CUBIC FEET PER MINUTE

2. Electrical: 115 Volts, single phase, 60 Hertz, 7.4 Amps, 1 HP

F. Portable Fume Exhauster shall be SMOG-HOG Porta-Clean model with optional 1 HP motor as manufactured by United Air Specialists, Inc.

2.15 PORTABLE WELDING CURTAIN

A. Equipment Item No. WS-5; one required

B. Manufacturers Reference:

1. Products of the following manufacturer are specified herein as the standard of quality for the portable welding curtain.

a. McMaster Carr
200 New Canton way
Robbinsville, NJ 08691
Phone: 609-259-8900 or 609-689-3415

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal.Construction Features:

1. Three panel screen with casters

2. Reinforced nylon boarder to prevent tears

3. Frame: 1 inch square tubular steel

4. Four (4) casters, two (2) per leg

D. Capacities and Dimensions:

1. Overall: 6-feet wide high x 6-feet center x 4-feet end

2. Maximum temperature: 120° F

E. Accessories:

1. Provide one replacement curtain

2. Provide one set of 10 casters.

F. Portable Welding Curtain shall be Model 8480T49 with 8480T37 replacement curtain and Casters Model 5611T93 as manufactured by McMaster Carr.

G. Coolant King Model No. 248632 as manufactured by Graco.

2.16 TABLE WITH HYDRAULIC HOSE CUT-OFF MACHINE:

A. Equipment Item No. MS-12; one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the table with hydraulic hose cut-off machine.

a. Parker Hannifin Corporation, Hose Products Division

30242 Lakeland Boulevard

Wickliffe, Ohio 44092-1747

Telephone: (440) 833-2120

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal.Construction Features:

1. Saw table – steel construction

2. Heavy duty cut-off machine.

D. Dimensions and Capacities:

1. Table: 28 inches wide by 14 inches long by 18 inches high.

2. Capable of cutting multi-braided wire hose including 6 spiral construction up to 2 inch I.D.

E. Electrical Requirements:

1. 230 Volts, 3 Phase, 60 Hertz, 3 HP.

F. Table with Hydraulic Hose Cut-Off Machine shall be Model No. TH7-7 table with Model 339 Hose Cut-Off Machine as manufactured by Parker Hannifin Corporation, Hose Products Division.

2.17 HYDRAULIC HOSE CRIMPER:

A. Equipment Item No. MS-13; one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the hydraulic hose crimper.

a. Parker Hannifin Corporation, Hose Products Division

30242 Lakeland Boulevard

Wickliffe, Ohio 44092-1747

Telephone: (440) 833-2120

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Or approved equal.Dimensions and Capacities:

1. 17 inches wide by 23 inches long by 28 inches high.

2. Capable of crimping 25, 26, 43, 70, 71, 73, 77, 78, 81 and HY series steel and stainless steel fittings.

3. Operating Pressure: 10,000 psi.

D. Electrical Requirements:

1. 115 Volts, 1 Phase, 60 Hertz.

E. Hhydraulic hose crimper shall be Model No. 85C-KKB as manufactured by Parker Hannifin Corporation, Hose Products Division.

2.18 DIESEL FUEL CADDY:

A. Equipment Item No. MB-27; two required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the diesel fuel caddy.

   a. HMC Industries, Inc.

      702 South Third Avenue

      Marshalltown, IA 50158

      Telephone: (515) 957-1502

2. Products of equal quality and utility of other manufacturers will be accepted.

   a. Tank-Depot.com

      Telephone: (866) 926 5603, (954) 783 9668

   b. Or approved equal.

C. Construction Features:

1. Designed to hold diesel fuel

2. Pressure tested 14 gauge seem welded steel tank

3. Epoxy powder coat finish

4. 10" semi-pneumatic tires

5. UL approved gauge

6. An internally grounded fuel hose

7. Machined sand cast aluminum bi-directional pump for siphoning and dispensing

8. Aluminum front pads

9. Drain hole

10. Fire-screened vent and gauge combination

11. Fire-screened 2 Inch filler neck with cap

D. Dimensions and Capacities:

1. Capacity: 30 Gallons

2. Overall Size: 14 Inches wide by 22 inches deep by 45 inches high.

3. Weight: 90 pounds.

E. Diesel Fuel Caddy shall be Model No. GC-30 for Diesel Fuel as manufactured by HMC Industries, Inc..

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install equipment in strict accordance with the approved shop drawings and manufacturer's installation instructions.

B. Coordinate work with other trades to ensure proper equipment interface with the building structure and utilities.

C. Proceed with start-up, testing and instruction in accordance with Section 11005.

3.02 FIELD QUALITY CONTROL:

A. Provide the services of a qualified manufacturer's representative to perform the following:

1. Supervise preparatory work performed by other trades.

2. Supervise installation.

3. Supervise testing, by the Contractor in the presence of the Engineer to ensure proper operation of the equipment, including but not limited to proper adjustment of all clearances, proper operation of guards, and return to safe condition upon loss of power.

3.03 FIELD TESTING:

A. Perform testing of the equipment and system in accordance with the requirements specified in Section 01450. Perform and document all testing procedures recommended by the manufacturer.

3.04 TRAINING PROGRAM AND OPERATION AND MAINTENANCE MANUALS:

A. Provide a training program and operation and maintenance manual in accordance with the requirements specified in Section 11005.

PART 4 : MEASUREMENT AND PAYMENT

4.01 BUFFER/GRINDER WITH DUST COLLECTOR–8 INCH:

A. Buffer/Grinder with Dust Collector–8 Inch (FM-2 and MB-21) will be measured for at the contract unit price bid per each.

B. Buffer/Grinder with Dust Collector–8 Inch (FM-2 and MB-21) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.02 55 TON AIR HYDRAULIC PRESS:

A. 55 Ton Air/Hydraulic Press (MS-3) will be measured for at the contract unit price bid per each.

B. 55 Ton Air Hydraulic Press (MS-3) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.03 USED OIL FILTER CRUSHER:

A. Used Oil Filter Crusher (MB-10)will be measured for at the contract unit price bid per each.

B. Used Oil Filter Crusher (MB-10) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.04 DRILL PRESS VARIABLE SPEED – 15 INCH:

A. Drill Press Variable Speed – 15 Inch (MS-2 and FM-3) will be measured for at the contract unit price bid per each.

B. Drill Press Variable Speed – 15 Inch (MS-2 and FM-3) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.05 WELDER / PLASMA CUTTER:

A. Welder / Plasma Cutter (WS-2) will be measured for at the contract unit price bid per each.

B. Welder / Plasma Cutter (WS-2) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.06 WELDER, ARC:

A. Welder, Arc (WS-1) will be measured for at the contract unit price bid per each.

B. Welder, Arc (WS-1) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.07 AC REPAIR PORTABLE PLATFORM:

A. AC Repair Portable Platform (MB-5) will be measured for at the contract unit price bid per each.

B. AC Repair Portable Platform (MB-5) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.08 CYLINDER LIFT TRUCK:

A. Cylinder Lift Truck (MS-9) will be measured for at the contract unit price bid per each.

B. Cylinder Lift Truck (MS-9) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.09 CYLINDER SCALE:

A. Cylinder Scale (MS-7) will be measured for at the contract unit price bid per each

B. Cylinder Scale (MS-7) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.10 REFRIGERANT LEAK DETECTOR:

A. Refrigerant Leak Detector (MS-10) will be measured for at the contract unit price bid per each.

B. Refrigerant Leak Detector (MS-10) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.11 REFRIGERANT RECOVERY SYSTEM:

A. Refrigerant Recovery System (MB-14) will be measured for at the contract unit price bid per each.

B. Refrigerant Recovery System (MB-14) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.12 VACUUM PUMP:

A. Vacuum Pump (MS-8) will be measured for at the contract unit price bid per each.

B. Vacuum Pump (MS-8) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.13 NITROGEN TIRE INFLATION SYSTEM:

A. Nitrogen Tire Inflation System (TS-10 and TS-10A) will be measured for at the contract unit price bid per each.

B. Nitrogen Tire Inflation System (TS-10 and TS-10A) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.14 TABLE WITH HYDRAULIC HOSE CUT-OFF MACHINE:

A. Table with hydraulic hose cut-off machine (MS-12) will be measured for at the contract unit price bid per each.

B. Table with hydraulic hose cut-off machine (MS-12) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the

item as specified.

4.15 HYDRAULIC HOSE CRIMPER:

A. Hydraulic hose crimper (MS-13) will be measured for at the contract unit price bid per each.

B. Hydraulic hose crimper (MS-13) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.16 DIESEL FUEL CADDY:

A. Diesel fuel caddy (MB-27) will be measured for at the contract unit price bid per each.

B. Diesel fuel caddy (MB-27) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.17 PORTABLE FUME EXHAUSTER:

A. Portable Fume Exhauster (WS-6) will be measured for at the contract unit price bid per each.

B. Portable Fume Exhauster (WS-6) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.18 PORTABLE WELDING CURTAIN:

A. Portable Welding Curtain (WS-5) will be measured for at the contract unit price bid per each.

B. Portable Welding Curtain (WS-5) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

END OF SECTION

SECTION 11535

CLEANING EQUIPMENT

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. The work specified in this section includes furnishing, installing, and testing Cleaning Equipment at location shown on the Drawings. All wiring, conduit, piping, ductwork, and controls required to connect the cleaning equipment to building utilities are also a part of the work of this section.

B. Related Documents:

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

C. Related Sections:

1. Section 11005 – Basic Equipment Materials and Methods.

2. Division 15 – Mechanical.

3. Division 16 – Electrical.

1.02 QUALITY ASSURANCE:

A. References

1. ASTM International (ASTM).

   a. A 240/240M Heat Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

2. Occupational Safety and Health Administration (OSHA)

   a. 29 CFR 1910 Occupational Safety and Health Standards.

3. National Fire Protection Association (NFPA)

   a. 70 National Electrical Code (NEC).

   b. 79 Electrical Standard for Industrial Machinery.

4. American Society of Mechanical Engineers (ASME)

5. Boiler Pressure Vessel Code (BPVC) Section VIII - Rules For Construction of Pressure Vessels Division 1.

B. Certify that cleaning equipment furnished and installed complies with applicable OSHA standards.

C. Comply with the provisions of Section 01450 Quality Assurance and Quality Control.

D. Use adequate numbers of skilled workers who are completely familiar with the specified requirements and the materials and methods necessary for proper performance of the Work of this Section.

E. Provide services of manufacturer's representative to perform services specified in Article 3.02.

1.03 SUBMITTALS:

A. Pursuant to the provisions of Section 01300, Submittals, and Section 11005, Basic Equipment Materials and Methods, submit the following:

1. Material and equipment list itemizing products furnished to satisfy the requirements of this section.

2. Product data including catalog cuts, manufacturer’s assembly and installation data, manufacturer’s certificates of compliance, and samples.

3. Shop drawings.

4. Schedule of Work.

5. Training Program and Operations and Maintenance Manual.

6. List of recommended spare parts and maintenance materials.

7. Evidence of manufacturers and installers experience including names, addresses and phone numbers of reference clients.

8. Working drawings showing cleaning equipment placement and required clearances.

9. Embedded anchor and mounting device requirements.

10. Documentation of testing methods and procedures.

1.04 DELIVERY, STORAGE AND HANDLING:

A. Deliver, store, and handle products without damaging them.

1. Receive, unload, check, protect, and store equipment in facilities suitable to keep it clean, dry, and free from damage, vandalism, and pilferage.

2. Pay demurrage charges and claims for damage resulting from unloading operations.

3. Examine equipment for visible and concealed damage. Report any damage to carrier, supplier, and Engineer as soon as possible.

B. Protect equipment from loss, deterioration, and damage until work is complete.

1. Protect equipment during storage and prior to start-up.

2. Protect exposed finished surfaces with removable coating for film, cover openings to exclude dirt and fouling materials, and protect unfinished surfaces against rust, corrosion, and other damage.

3. Protect equipment from paint or coating spills and spots.

1.05 EXPERIENCE:

A. Furnish products and services only from manufacturers and installers who demonstrate that they have a minimum of five years experience manufacturing and installing items equivalent to those required as the Work of this Section.

PART 2 PRODUCTS

2.01 HIGH PRESSURE WASH WITH 4 REMOTE CONTROL STATIONS AND HOSE REELS:

A. Equipment Item No. CW-2; two required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the High Pressure Wash With 4 Remote Control Stations and Hose Reels.

a. Landa, Inc.

Distributed by Power Clean Systems, Inc.

9981 Lickinghole Road

Ashland, VA 23005

Telephone: (804) 798-7730

2. Products of equal quality and utility of the following manufacturers will be accepted:

a. The Hotsy Corporation

21 Inverness Way East

Englewood, CO 80112-5796

Telephone: (800) 525-1976, (303) 792-5200

b. Sioux Steam Cleaner Corporation

One Sioux Plaza,

Beresford, SD 57004-1500

Telephone: (605) 763-3333

c. Or approved equal.

C. Capacities and Dimensions:

1. Power cleaner with high pressure for full blast power within 60 seconds.

2. Water Heater Output: 400,000 BTU/HR.

3. Exhaust Stack: 10 inch diameter with back draft diverter.

4. Output/Discharge: 3.9 GPM at 3000 PSI.

5. Motor: 8.2 HP, 15 Amps, 480V, 3 Phase, 60 Hz, overloaded and protected, 1.15 service factor.

6. Pump: Triplex, positive displacement pump.

7. Weight: 1030 pounds.

8. Dimensions: 45 inches long x 36 inches wide x 48 inches high

D. Features and Construction:

1. Heating Fuel: Natural Gas.

2. Safety controls: Safety features shall be factory tested, shall have UL approval and shall bear the appropriate UL label. The unit shall be also equipped with combustion controls conforming to Factory Mutual Insurance Company (FM Global) or GE Global Asset Protection (GE GAP) requirements.

   a. Adjustable Temperature Controller

   b. Safety pressure relief valve

   c. Pressure switch

   d. On/Off electric motor switch with overload protection.

   e. Water heater switch

   f. Trigger gun control with cool grip, heavy duty wand with insulated grips.

   g. Detergent valve and automatic, non-contaminating float valve.

   h. Pilot light safety valve

3. Accessories:

   a. Four remote control stations and hose reels. (Equipment Item CW-2A, quantity 4)

   b. Hose Reel:

      i. 50 ft of 3/8” double steel braid high pressure hose with each hose reel. Hose shall be rated for steam service.

      ii. One spray gun for each hose reel.

      iii. One 42” angled wand for each hose reel.

      iv. One 30 degree nozzle extension for each spray wand.

      v. One nozzle with 0, 15, 25 and 40 degree tips, for each spray wand.

c. Remote Control Station:

i. 24 Volt off/on switch mounted in a NEMA 4 box with shut down timer and hour meter.

d. The gun wand holder shall be constructed of minimum 2 inch galvanized pipe, open at both ends, with mounting brackets. Holder shall allow for convenient storage of gun/wand assembly.

E. Exhaust Stack: Shall be a double wall metalbestos type as manufactured by Selkirk, Model DF or equal. Interior jacket shall be constructed of #430 stainless steel, 0.015 inches thick with an exterior jacket constructed of aluminized coated steel 0.025 inches thick. Exhaust stack shall extend a minimum of four (4) feet above the roof and terminate with a raincap and a 10 gauge stainless steel bird screen.

F. Finish: Durable enamel in manufacturer's standard color.

G. Provide all piping, conduit and wiring from the pressure washer to the remote control boxes.

H. The High Pressure Washer with 4 Remote Control Stations and Hose Reels shall be Model No. VNG4-30024C as manufactured by Landa Corporation or approved equal with the above minimum requirements.

2.02 PARTS WASHER

A. Equipment Item No. CW-1; one system required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the Parts Washer.

a. Better Engineering Mfg., Inc

8361 Town Center Court

Baltimore, MD 21236-4964

Telephone: (800)-229-3380

b. Products of equal quality and utility of other approved manufacturers will be accepted

C. Features and Construction:

1. Steel construction
2. Roll-away door.
3. Vertical (seal-less) Pumps
4. Oil Skimmer
5. Jam-proof Turntable Drive
6. Sealed Cleaning Chamber
7. Slide-out Chip Basket

D. Capacities and Dimensions:

1. Turntable Diameter: 27 inches
2. Work Height: 35 inches
3. Weight Capacity: 500 lbs
4. Load Height: 28 Inches
5. Vertical Pump: 3 Horsepower
6. Pump Output: 60 GPM/45 PSI
7. Tank Size: 55 Gallons
8. Heat: 9 kW
9. Heat-Up Time: 1.25 Hours
10. Overall Dimensions: 42 inches wide x 49 inches deep x 79 inches high

E. Utility Requirements:

1. 460Volts, 3Phase, 49 Full Load Amps

F. Parts Washer shall be Model Number G-2000 by Better Engineering.

2.03 SMALL PARTS WASHER

A. Equipment Item No. MB-20; Seven required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the Small Parts Washer.

   a. System One

      8305 N.W. 27th Street

      Suite 107

      Miami, FL 33122

      Telephone: 1-800-711-1414, 305-593-

C. Products of equal quality and utility of other approved manufacturers will be acceptedFeatures and Construction:

1. Construction Powder coated, heavy gauge steel throughout

2. Fuse protection

3. Dual temperature sensor

4. Fusable link

5. Temperature sensitive decal

D. Capacities and Dimensions:

1. Overall Dimension: 32 inches wide x 27 inches deep x 68 inches high

2. Working Space: 32 inches long x 27 inches wide x 24 inches high

3. Operating Fluid Capacity: 20 gallons

E. Utility Requirements:

1. Electric Power 115 VAC, 11.9A

F. Small Parts Washer shall be Model 501 by System One.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install equipment in strict accordance with the approved shop drawings and manufacturer’s installation instructions.

B. Coordinate work with other trades to ensure proper equipment interface

with the building structure and utilities.

C. Provide exhaust ducts and flues where shown or required.

D. Provide drain lines for each item with drain connections and pipe to nearest floor drain.

E. Demonstrate that cleaning equipment performs and operates as specified.

F. Adjust parts requiring adjustment in order to operate as specified.

G. Proceed with start-up, testings and instruction in accordance with Section 11005.

3.02 FIELD QUALITY CONTROL:

A. Provide the services of a qualified manufacturer's representative to perform the following:

1. Supervise preparatory work performed by other trades.

2. Supervise installation.

3. Supervise testing, by the Contractor in the presence of the Engineer to ensure proper operation of the equipment.

3.03 FIELD TESTING:

A. Perform testing of the equipment and system in accordance with the requirements specified in Section 01450. Perform and document all testing procedures recommended by the manufacturer.

3.04 TRAINING PROGRAM AND OPERATION AND MAINTENANCE MANUALS:

A. Provide a training program and operation and maintenance manual in accordance with the requirements specified in section 11005.

PART 4 : MEASUREMENT AND PAYMENT

4.01 HIGH PRESSURE WASH WITH 4 REMOTE CONTROL STATIONS AND HOSE REELS:

A. High Pressure Wash with 4 Remote Control Stations and Hose Reels (CW-2 and CW-2A) will not be measured for payment.

B. High Pressure Wash with 4 Remote Control Stations and Hose Reels (CW-2 and CW-2A) will not be paid directly, but will be included in the

lump sum bid prices for the Maintenance Building.

4.02 PARTS WASHER:

A. Parts Washer (CW-1) will be measured for at the contract unit price bid per each.

B. Parts Washer (CW-1) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

4.03 SMALL PARTS WASHER:

A. Small Parts Washer (MB-20) will be measured for at the contract unit price bid per each.

B. Small Parts Washer (MB-20) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor, and all work incidental to complete the item as specified.

END OF SECTION

SECTION 12491

HORIZONTAL LOUVER BLINDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Horizontal louver blinds with aluminum slats.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.01 HORIZONTAL LOUVER BLINDS

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

1. Comfortex Window Fashions.

2. Levolor Contract; a Newell Rubbermaid company.

3. Springs Window Fashions.

B. Aluminum Slats:

1. Width: 1 inch.

2. Thickness: Manufacturer's standard.

3. Spacing: Manufacturer's standard.

C. Slat Features:

1. Lift-Cord Rout Holes: Minimum size required for lift cord and located near back (outside) edge of slat to maximize slat overlap and minimize light gaps between slats.

D. Headrail:

1. Manual Lift Mechanism:

a. Lift-Cord Lock: Variable; stops lift cord at user-selected

position within blind full operating range.

b. Operator: Extension of lift cord(s) through lift-cord lock mechanism to form cord pull.

2. Manual Tilt Mechanism: Enclosed worm-gear mechanism and linkage rod that adjusts ladders.

a. Tilt: Two-direction, positive stop or lockout limited at an angle of 60 degrees from horizontal, both directions.

b. Operator: Corrosion-resistant steel rod.

3. Manual Lift-Operator and Tilt-Operator Lengths and Locations: Manufacturer's standard unless otherwise indicated.

E. Bottom Rail: Matching slats.

1. Type: Manufacturer's standard.

F. Ladders: Braided cord.

G. Valance: Manufacturer's standard.

H. Mounting Brackets: With spacers and shims required for blind placement and alignment indicated.

1. Type: Wall or soffit extension.

2. Intermediate Support: Provide intermediate support brackets to produce support spacing recommended by blind manufacturer for weight and size of blind.

I. Colors, Textures, Patterns, and Gloss:

1. Slats: As selected by Architect from manufacturer's full range] [As indicated on Drawings.

2. Components: Provide rails, cords, ladders, and materials exposed to view matching or coordinating with slat color unless otherwise indicated.

2.02 HORIZONTAL LOUVER BLIND FABRICATION

A. Product Safety Standard: Fabricate horizontal louver blinds to comply with WCMA A 100.1 including requirements for corded, flexible, looped devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F.

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which blind is installed less 1/4 inch per side or 1/2 inch total, plus or minus 1/8 inch. Length equal to head-to-sill dimension of opening in which blind is installed less 1/4 inch, plus or minus 1/8 inch.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

1. Locate so exterior slat edges are not closer than 1 inch from interior faces of glass and not closer than 1/2 inch from interior faces of glazing frames through full operating ranges of blinds.

2. Install mounting and intermediate brackets to prevent deflection of headrails.

3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

C. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

D. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.

PART 4: MEASUREMENT AND PAYMENT

4.01 HORIZONTAL LOUVER BLINDS:

A. Horizontal Louver Blinds will not be measured for payment.

B. Horizontal Louver Blinds will not be paid directly, but will be included in the lump sum bid prices for maintenance building

END OF SECTION

SECTION 13100

LIGHTNING PROTECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes lightning protection for structures.

1.03 ACTION SUBMITTALS

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

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.

2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.

2. Ground loop conductor.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL or Lightning Protection Institute

(LPI) as a Master Installer/Designer, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.06 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications, and shall maintain roofing warranty.

PART 2 - PRODUCTS

2.01 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I, copper unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. East Coast Lightning Equipment Inc.

b. ERICO International Corporation.

c. Harger.

d. Heary Bros. Lightning Protection Co. Inc.

e. Independent Protection Co.

f. Preferred Lightning Protection.

g. Robbins Lightning, Inc.

h. Thompson Lightning Protection, Inc.

2. Air Terminals More than 24 Inches (600 mm) Long: With brace attached to the terminal at not less than half the height of the terminal.

3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: Copper-clad steel 3/4 inch (19 mm) in diameter by 10 feet (3 m) long.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.

2. Down conductors.

3. Interior conductors.

4. Conductors within normal view of exterior locations at grade within 200 feet (60 m) of building.

D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Cable Connections: Use exothermic-welded connections for all conductor splices and connections between conductors and other components.

1. Exception: In single-ply membrane roofing, exothermic-welded connections may be used only below the roof level.

F. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

G. Bond extremities of vertical metal bodies exceeding 60 feet (18 m) in length to lightning protection components.

H. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches (600 mm) from building foundation.

2. Bond ground terminals to the ground loop.

3. Bond grounded building systems to the ground loop conductor within 12 feet (3.6 m) of grade level.

I. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot (18-m) intervals.

3.02 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 16091 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.03 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.04 FIELD QUALITY CONTROL

A. Notify Architect/Engineer at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

C. LPI System Inspection: Meet requirements to obtain an LPI System Certificate.

PART 4: MEASUREMENT AND PAYMENT

4.01 AIR TERMINALS:

A. Air terminals will be measured for at the contract unit price bid per each.

B. Air terminals will be paid per each complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 #2 BARE COPPER WIRE:

A. #2 bare copper wire will not be measured for payment.

B. #2 bare copper wire will not be paid directly, but will be included in the lump sum bid price for Maintenance Building.

4.03 28 STRAND #17 AWG COPPER MAIN LIGHTNING CONDUCTOR:

A. Strand #17 Awg (per strand) bare copper conductor will not be measured for payment.

B. Strand #17 Awg (per strand) bare copper conductor will not be paid directly, but will be included in the lump sum bid price for Maintenance Building.

END OF SECTION

SECTION 13720

INTRUSION DETECTION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.

2. Integration of other electronic and electrical systems and equipment.

B. Related Sections:

1. Section 16718 "Conductors and Cables for Electronic Safety and Security" for cabling between master control units and field-mounted devices and control units.

2. Section 13760 "Video Surveillance" for CCTV cameras that are used as devices for video motion detection.

1.03 DEFINITIONS

A. CCTV: Closed-circuit television.

B. PIR: Passive infrared.

C. RFI: Radio-frequency interference.

D. UPS: Uninterruptible power supply.

E. Control Unit: System component that monitors inputs and controls outputs through various circuits.

F. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected zones and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.

G. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.

H. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.

I. Standard Intruder: A person who weighs 100 lb (45 kg) or less and whose height is 60 inches (1525 mm) or less; dressed in a long-sleeved shirt, slacks, and shoes.

J. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

K. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.

L. Zone. A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.04 ACTION SUBMITTALS

A. Product Data: Components for sensing, detecting, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify control interface devices and media to be used. Describe characteristics of network and other data communication lines.

a. Indicate methods used to achieve systems integration.

b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.

c. Describe characteristics of network and other data communication lines.

d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.

3. UPS: Sizing calculations.

4. Site and Floor Plans: Indicate final outlet and device locations, routing of raceways, and cables inside and outside the building.

5. Master Control-Unit Console Layout: Show required artwork and device identification.

6. Device Address List: Coordinate with final system programming.

7. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.

8. Details of surge-protection devices and their installation.

9. Sensor detection patterns and adjustment ranges.

C. Equipment and System Operation Description: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For intrusion detection systems integrator.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

D. Other Information Submittals:

1. Test Plan and Schedule: Test plan defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.

2. Examination reports documenting inspections of substrates, areas, and conditions.

3. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Data for each type of product, including features and operating sequences, both automatic and manual.

2. Master control-unit hardware and software data.

1.07 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. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.

2. Fuses: of each kind and size.

3. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.

4. Security Fasteners: Furnish no fewer than 1 box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a technician certified by the National Burglar & Fire Alarm Association.

2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier who has completed systems integration work for installations similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Testing Agency Qualifications: Member company of International Electrical Testing Association (NETA) or an Nationally Recognized Testing Laboratory (NRTL) Program.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with Security Industry Association’s (SIA) CP-01.

F. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.

G. Comply with NFPA 70.

1.09 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 500 feet (152 m).

2. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.

3. Interior, Controlled Environment: System components, except

master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

4. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h)and snow cover up to 24 inches (610 mm) thick.

5. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.

B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.

2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate

system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.

3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.

C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.

D. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

E. Operator Commands:

1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.

2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.

3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.

4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.

5. Protected Zone Test: Initiate operational test of a specific protected zone.

6. System Test: Initiate system-wide operational test.

7. Print reports.

F. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.

G. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:

1. Switch selected lights.

2. Shift elevator control to a different mode.

3. Open a signal path between certain intercommunication stations.

4. Shift sound system to "listening mode" and open a signal path to certain system speakers.

5. Switch signal to selected monitor from CCTV camera in vicinity of sensor signaling an alarm.

H. Printed Record of Events: Print a record of alarm, supervisory, and trouble events on system printer. Sort and report by protected zone, device, and function. When master control unit receives a signal, print a report of alarm, supervisory, or trouble condition. Report type of signal (alarm, supervisory, or trouble), protected zone description, date, and time of occurrence. Differentiate alarm signals from other indications. When system is reset, report reset event with the same information concerning device, location, date, and time. Commands shall initiate the reporting of a list of current alarm, supervisory, and trouble conditions in system or a log of past events.

I. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.

J. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

K. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

L. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.02 SYSTEM COMPONENT REQUIREMENTS

A. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:

1. Door hardware specified in Section 08710 "Door Hardware."

2. Elevators specified in Section 14240 "Hydraulic Elevators."

3. Lighting controls specified in Section 16145 "Lighting Control Devices."

4. Intercom and program systems specified in Section 16722 "Intercommunications and Program Systems."

5. Access control system specified in Section 13730 "Security Access."

6. Fire alarm system specified in Section 13852 "Digital, Addressable Fire-Alarm System."

7. Video surveillance system specified in Section 13760 "Video Surveillance."

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors complying with requirements in Section 16289 "Surge Protection for Low-Voltage Electrical Power Circuits."

2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

C. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.

D. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

E. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

F. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.

G. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.

H. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

I. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.03 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

C. Exterior Electronics: NEMA 250, Type 4X, stainless steel.

D. Corrosion Resistant: NEMA 250, Type 4X, stainless steel.

E. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.04 SECURE AND ACCESS DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bosch Security Systems, Inc.

2. Corby Industries, Inc.

3. Crow Electronic Engineering, Inc.

4. DAQ Electronics, Inc.

5. Digital Security Controls Ltd.; a business unit of Tyco Safety Products.

6. Edwards Signaling & Security Systems; part of GE Security.

7. Honeywell International Inc.; Honeywell Security.

8. Visonic Inc.

B. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.

2.05 DOOR SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aleph America Corporation.

2. General Electric Company; GE Security, Inc.

3. George Risk Industries.

4. Honeywell International Inc.; Honeywell Security.

5. Honeywell International Inc.; Honeywell Video Systems.

6. Optex Inc.

7. Potter Electric Signal, LLC.

B. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

C. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.

D. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.

E. Remote Test: Simulate movement of actuating magnet from master control unit.

2.06 PIR SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aleph America Corporation.

2. Bosch Security Systems, Inc.

3. Crow Electronic Engineering, Inc.

4. Digital Security Controls Ltd.; a business unit of Tyco Safety Products.

5. General Electric Company; GE Security, Inc.

6. Honeywell International Inc.; Honeywell Security.

7. Visonic Inc.

B. Listed and labeled by a qualified testing agency for compliance with Security Industry Association's (SIA) PIR-01.

C. Description: Sensors detect intrusion by monitoring infrared wavelengths emitted from a human body within their protected zone and by being insensitive to general thermal variations.

1. Wall-Mounted Unit Maximum Detection Range: 125 percent of indicated distance for individual units and not less than 50 feet (15 m).

2. Ceiling-Mounted Unit Spot-Detection Pattern: Full 360-degree conical.

3. Ceiling-Mounted Unit Pattern Size: 84-inch (2135-mm) diameter at floor level for units mounted 96 inches (2440 mm) above floor; 18-foot (5.5-m) diameter at floor level for units mounted 25 feet (7.6 m) above floor.

D. Device Performance:

1. Sensitivity: Adjustable pattern coverage to detect a change in temperature of 2 deg F (1 deg C) or less, and standard-intruder movement within sensor's detection patterns at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s) across two adjacent segments of detector's field of view.

2. Test Indicator: LED test indicator that is not visible during normal operation. When visible, indicator shall light when sensor detects an intruder. Locate test enabling switch under sensor housing cover.

3. Remote Test: When initiated by master control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

2.07 MICROWAVE INTRUSION DETECTORS (INTERIOR)

A. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:

1. Bosch Security Systems, Inc.

2. Crow Electronic Engineering, Inc.

3. Digital Security Controls Ltd.; a business unit of Tyco Safety Products.

4. General Electric Company; GE Security, Inc.

5. Visonic Inc.

B. Device Performance: Microwave transmitter establishes an electromagnetic field in an adjustable detection pattern and detects intrusion by monitoring changes in that pattern.

1. Sensitivity: Adjustable, able to detect standard-intruder movement within sensor's detection pattern at any speed between 0.3 to 7.5 fps (0.09 to 2.3 m/s). Sensor sensitivity adjustments shall be accessible only when sensor housing is removed, and sensors shall comply with 47 CFR 15.

2. Activation Indicator: LED indicator shall not be visible during normal operation. Indicator shall light when sensor detects a standard intruder. Locate test-enabling switch under sensor housing cover.

3. Remote Test: When initiated by master control unit, start a test sequence for each detector element that simulates standard-intruder movement within sensor's detection patterns, causing an alarm.

2.08 MASTER CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bosch Security Systems, Inc.

2. DAQ Electronics, Inc.

3. Digital Security Controls, Inc.; a business unit of Tyco Safety Products.

4. General Electric Company; GE Security, Inc.

5. Honeywell International Inc.; Honeywell Security.

6. Honeywell International Inc.; Honeywell Video Systems.

7. Visonic Inc.

B. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.

1. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.

2. Include a real-time clock for time annotation of events on the event recorder and printer.

3. Addressable initiation devices that communicate device identity and status.

4. Control circuits for operation of mechanical equipment in response to an alarm.

C. Construction: Freestanding equipment rack, modular, with separate and independent alarm and supervisory system modules. Arrangements that require removal of field wiring for module replacement are unacceptable.

D. Comply with UL 1076.

E. Console Controls and Displays: Arranged for interface between human operator at master control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: LCD, three line(s) of 80 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

3. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.

4. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of

alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.

5. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:

   a. Acknowledge alarm.

   b. Silence alarm.

   c. System reset.

   d. LED test.

6. Timing Unit: Solid state, programmable, 365 days.

7. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.

8. Alarm Indication: Audible signal sounds and an LED lights at master control unit identifying the protected zone originating the alarm.

9. Alarm activation sounds a bell or siren and strobe.

F. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.

G. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

H. UPS: Comply with Section 16264 "Static Uninterruptible Power Supply." UPS shall be sized to provide a minimum of six hours of master control-unit operation.

I. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate.

Lettering on enclosure nameplate shall not be less than 1 inch (25 mm) high. Identify, with permanent labels, individual components and modules within cabinets.

J. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.

K. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

2.09 SECURITY FASTENERS

A. Operable only by tools produced for use on specific type of fastener by fastener manufacturer or other licensed fabricator. Drive system type, head style, material, and protective coating as required for assembly, installation, and strength.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acument Global Technologies North America.

2. Safety Socket LLC.

3. Tamper-Pruf Screws.

C. Drive System Types: pinned Torx or pinned hex (Allen).

D. Socket Flat Countersunk Head Fasteners:

1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).

2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

E. Socket Button Head Fasteners:

1. Heat-treated alloy steel, ASTM F 835 (ASTM F 835M).

2. Stainless steel, ASTM F 879 (ASTM F 879M), Group 1 CW.

F. Socket Head Cap Fasteners:

1. Heat-treated alloy steel, ASTM A 574 (ASTM A 574M).

2. Stainless steel, ASTM F 837 (ASTM F 837M), Group 1 CW.

G. Protective Coatings for Heat-Treated Alloy Steel:

1. Zinc chromate, , Grade 3 or Grade 4, for exterior applications and interior applications where indicated.

2. Zinc phosphate with oil, ASTM F 1137, Grade I, or black oxide unless otherwise indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.

D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.

2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SYSTEM INTEGRATION

A. Integrate intrusion detection system with the following systems and equipment:

1. Electronic door hardware.

2. Elevators.

3. Network lighting controls.

4. Intercommunications and program systems.

5. Public address and mass notification systems.

6. Access control.

7. Fire-alarm system.

8. Perimeter security system.

9. Video surveillance.

3.03 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

D. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project.

3.04 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Section 16130 "Raceways and Boxes." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 3/4 inch (19 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal

blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.

2. 120-V Power Wiring: Install according to Section 16120 "Conductors and Cables" unless otherwise indicated.

3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 16718 "Conductors and Cables for Electronic Safety and Security."

4. Data and Television Signal Transmission Cables: Install according to Section 16718 "Conductors and Cables for Electronic Safety and Security."

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

F. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 16075 "Electrical Identification."

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with identification requirements in Section 16075 "Electrical Identification."

B. Install instructions frame in a location visible from master control unit.

3.06 GROUNDING

A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.

B. Ground system components and conductor and cable shields to eliminate

shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

D. Install grounding electrodes of type, size, location, and quantity indicated. Comply with installation requirements in Section 16060 "Grounding and Bonding."

3.07 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."

1. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

E. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

F. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

PART 4: MEASUREMENT AND PAYMENT

4.01 INTRUSION DETECTION SYSTEM:

A. Intrusion Detection System will not be measured for payment.

B. Intrusion Detection System will not be paid directly, but will be included in the lump sum bid price for maintenance building.

END OF SECTION

SECTION 13730

SECURITY ACCESS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Card Readers will be furnished and installed by the MTA. The Contractor shall furnish and install the conduit, wiring and remainder of the Security Access System.

B. Section Includes:

1. Security access central-control station.

2. One or more security access networked workstations.

3. Security access operating system and application software.

4. Security access controllers connected to high-speed electronic-data transmission network.

1.03 DEFINITIONS

A. CCTV: Closed-circuit television.

B. CPU: Central processing unit.

C. Credential: Data assigned to an entity and used to identify that entity.

D. dpi: Dots per inch.

E. DTS: Digital Termination Service. A microwave-based, line-of-sight communication provided directly to the end user.

F. GFI: Ground fault interrupter.

G. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

H. I/O: Input/Output.

I. LAN: Local area network.

J. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.

K. PC: Personal computer. Applies to the central station, workstations, and file servers.

L. PCI Bus: Peripheral Component Interconnect. A peripheral bus providing a high-speed data path between the CPU and the peripheral devices such as a monitor, disk drive, or network.

M. PDF: Portable Document Format. The file format used by the Acrobat document-exchange-system software from Adobe.

N. RAS: Remote access services.

O. RF: Radio frequency.

P. ROM: Read-only memory. ROM data are maintained through losses of power.

Q. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

R. TWAIN: Technology without an Interesting Name. A programming interface that lets a graphics application, such as an image editing program or desktop publishing program, activate a scanner, frame grabber, or other image-capturing device.

S. UPS: Uninterruptible power supply.

T. USB: Universal serial bus.

U. WAN: Wide area network.

V. WAV: The digital audio format used in Microsoft Windows.

W. WMP: Windows media player.

X. Wiegand: Patented magnetic principle that uses specially treated wires embedded in the credential card.

Y. Windows: Operating system by Microsoft Corporation.

Z. Workstation: A PC with software that is configured for specific, limited security-system functions.

AA. WYSIWYG: What You See Is What You Get. Text and graphics appear on the screen the same as they will in print.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with Security Industry Association's (SIA) BIO-01.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Diagrams for cable management system.

2. System labeling schedules, including electronic copy of labeling schedules that are part of the cable and asset identification system of the software specified in Parts 2 and 3.

3. Wiring Diagrams. For power, signal, and control wiring. Show typical wiring schematics including the following:

a. Workstation outlets, jacks, and jack assemblies.

b. Patch cords.

c. Patch panels.

4. Cable Administration Drawings: As specified in "Identification" Article.

5. Battery and charger calculations for central station, workstations, and controllers.

C. Samples: For workstation outlets, jacks, jack assemblies, and faceplates. For each exposed product and for each color and texture specified.

D. Other Action Submittals:

1. Project planning documents as specified in Part 3.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Operation and Maintenance Data," include the following:

1. Microsoft Windows software documentation.

2. PC installation and operating documentation, manuals, and software for the PC and all installed peripherals. Software shall include system restore, emergency boot diskettes, and drivers for all installed hardware. Provide separately for each PC.

3. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy submittal.

4. System installation and setup guides with data forms to plan and record options and setup decisions.

1.07 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. Alarm Printer Black/Red Ribbons: Package of 12.

2. Laser Printers: Three toner cassettes and one replacement drum unit.

3. Credential card blanks, ready for printing. Include enough credential cards for all personnel to be enrolled at the site plus an extra 50 percent for future use.

4. Fuses of all kinds, power and electronic, equal to 10 percent of amount installed for each size used, but no fewer than three units.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single

manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70, "National Electrical Code."

E. Comply with Security Industry Association's (SIA) DC-01 and DC-03.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Central Station, Workstations, and Controllers:

1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.

2. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.

3. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.

4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.10 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient conditions of 60 to 85 deg F (16 to 30 deg C) and a relative humidity of 20 to 80 percent, noncondensing.

2. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing.

3. Outdoor Environment: NEMA 250, Type 4X enclosures. System components installed in locations exposed to weather shall be rated

for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick.

4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

5. Corrosive Environment: For system components subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, provide NEMA 250, Type 4X enclosures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Schlage. (Basis of design)

2. Bosch Security Systems, Inc.

3. General Electric Company; GE Security, Inc.

4. Honeywell International Inc; Honeywell Access Systems.

2.02 DESCRIPTION

A. Security Access System: PC-based central station, one or more networked PC-based workstations, and field-installed controllers, connected by a high-speed electronic-data transmission network.

B. System Software: Based on 32-bit, Windows 7 operating system central-station, workstation operating system, server operating system, and application software. Software shall have the following capabilities:

1. Multiuser and multitasking to allow for independent activities and monitoring to occur simultaneously at different workstations.

2. Graphical user interface to show pull-down menus and a menu-tree format that complies with interface guidelines of Microsoft Windows.

3. System license for the entire system including capability for future additions that are within the indicated system size limits specified in this Section.

4. Open-architecture system that allows importing and exporting of data and interfacing with other systems that are compatible with Microsoft Windows.

5. Password-protected operator login and access.

6. Open-database-connectivity compliant.

C. Network connecting the central station and workstations shall be a LAN using Microsoft Windows-based TCP/IP with a capacity of connecting up to 99 workstations. System shall be portable across multiple communication platforms without changing system software.

D. Network(s) connecting PCs and controllers shall consist of one or more of the following:

1. Local area, IEEE 802.3 Fast Ethernet Gigabit-Ethernet, star topology network based on TCP/IP.

2. Direct-connected, RS-232 cable from the COM port of the central station to the first controller, then RS-485 cable to interconnect the remaining controllers at that Location.

3. Dial-up and cable modem connection using a standard cable or dial-up telephone line.

2.03 OPERATION

A. Security access system shall use a single database for access-control and credential-creation functions.

B. Distributed Processing: A fully distributed processing system.

1. Access-control information, including time, date, valid codes, access levels, and similar data, shall be downloaded to controllers so each controller can make access-control decisions.

2. Intermediate controllers for access control are prohibited.

3. In the event that communications with the central controller are lost, controllers shall automatically buffer event transactions until communications are restored, at which time buffered events shall be uploaded to the central station.

C. Number of Locations:

1. Support at least 32,000 separate Locations using a single PC with combinations of direct-connect, dial-up, or TCP/IP LAN connections to each Location.

2. Each Location shall have its own database and history in the central station.

3. Locations may be combined to share a common database.

D. Data Capacity:

1. 130 different card-reader formats.

2. 999 comments.

3. 48 graphic file types for importing maps.

E. Location Capacity:

1. 128 reader-controlled doors.

2. 50,000 total-access credentials.

3. 2048 supervised alarm inputs.

4. 2048 programmable outputs.

5. 32,000 custom action messages per Location to instruct operator on action required when alarm is received.

F. System Network Requirements:

1. System components shall be interconnected and shall provide automatic communication of status changes, commands, field-initiated interrupts, and other communications required for proper system operation.

2. Communication shall not require operator initiation or response and shall return to normal after partial- or total-network interruption such as power loss or transient upset.

3. System shall automatically annunciate communication failures to the operator and shall identify the communications link that has experienced a partial or total failure.

4. Communications controller may be used as an interface between the central-station display systems and the field device network. Communications controller shall provide functions required to attain the specified network communications performance.

G. Central station shall provide operator interface, interaction, display, control, and dynamic and real-time monitoring. Central station shall control system networks to interconnect all system components, including workstations and field-installed controllers.

H. Field equipment shall include controllers, sensors, and controls.

1. Controllers shall serve as an interface between the central station and sensors and controls.

2. Data exchange between the central station and the controllers shall include down-line transmission of commands, software, and databases to controllers.

3. The up-line data exchange from the controller to the central station shall include status data such as intrusion alarms, status reports, and entry-control records.

4. Controllers are classified as alarm-annunciation or entry-control type.

I. System Response to Alarms:

1. Field device network shall provide a system end-to-end response time of one second(s) or less for every device connected to the system.

2. Alarms shall be annunciated at the central station within one second of the alarm occurring at a controller or at a device controlled by a local controller, and within 100 ms if the alarm occurs at the central station.

3. Alarm and status changes shall be displayed within 100 ms after receipt of data by the central station.

4. All graphics shall be displayed, including graphics-generated map displays, on the console monitor within five seconds of alarm receipt at the security console.

5. This response time shall be maintained during system heavy load.

J. False-Alarm Reduction: The design of the central station and controllers shall contain features to reduce false alarms. Equipment and software shall comply with Security Industry Association's (SIA) CP-01.

K. Error Detection:

1. Use a cyclic code method to detect single- and double-bit errors, burst errors of eight bits or fewer, and at least 99 percent of all

other multibit and burst errors between controllers and the central station.

2. Interactive or product error-detection codes alone will not be acceptable.

3. A message shall be in error if one bit is received incorrectly.

4. Retransmit messages with detected errors.

5. Allow for an operator-assigned two-digit decimal number to each communications link representing the number of retransmission attempts.

6. Central station shall print a communication failure alarm message when the number of consecutive retransmission attempts equals the assigned quantity.

7. Monitor the frequency of data transmission failure for display and logging.

L. Data Line Supervision: System shall initiate an alarm in response to opening, closing, shorting, or grounding of data transmission lines.

M. Door Hardware Interface:

1. Comply with requirements in Section 08710 "Door Hardware" (Descriptive Specification)" for door hardware required to be monitored or controlled by the security access system.

2. Electrical characteristics of controllers shall match the signal and power requirements of door hardware.

2.04 APPLICATION SOFTWARE

A. System Software: Based on 32-bit, Microsoft Windows operating system operating system and application software.

1. Multiuser multitasking shall allow independent activities and monitoring to occur simultaneously at different workstations.

2. Graphical user interface shall show pull-down menus and a menu-tree format.

3. Capability for future additions within the indicated system size limits.

4. Open architecture that allows importing and exporting of data and interfacing with other systems that are compatible with operating system.

5. Password-protected operator login and access.

B. Peer Computer Control Software: Detect a failure of a central computer and cause the other central computer to assume control of all system functions without interruption of operation. Both central computers shall have drivers to support this mode of operation.

C. Application Software: Interface between the alarm annunciation and entry-control controllers to monitor sensors, operate displays, report alarms, generate reports, and help train system operators.

1. Reside at the central station, workstations, and controllers as required to perform specified functions.

2. Operate and manage peripheral devices.

3. Manage files for disk I/O, including creating, deleting, and copying files; and automatically maintain a directory of all files, including size and location of each sequential and random-ordered record.

4. Import custom icons into graphics to represent alarms and I/O devices.

5. Globally link I/O so that any I/O can link to any other I/O within the same Location without requiring interaction with the host PC. This operation shall be at the controller.

6. Globally code I/O links so that any access-granted event can link to any I/O with the same Location without requiring interaction with the host PC. This operation shall be at the controller.

7. Messages from PC to controllers and controllers to controllers shall be on a polled network that utilizes check summing and acknowledgment of each message. Communication shall be automatically verified, buffered, and retransmitted if message is not acknowledged.

8. Selectable poll frequency and message time-out settings shall handle bandwidth and latency issues for TCP/IP, RF, and other PC-to-controller communications methods by changing the polling frequency and the amount of time the system waits for a response.

9. Automatic and encrypted backups for database and history backups shall be automatically stored at the central-control PC and encrypted with a nine-character alphanumeric password that must be used to restore or read data contained in backup.

10. Operator audit trail for recording and reporting all changes made to database and system software.

11. Support network protocol and topology, TCP/IP, Novel Netware, Digital Pathworks, Banyan Vines, LAN/WAN, and RAS.

D. Workstation Software:

1. Password levels shall be individually customized at each workstation to allow or disallow operator access to program functions for each Location.

2. Workstation event filtering shall allow user to define events and alarms that will be displayed at each workstation. If an alarm is unacknowledged (not handled by another workstation) for a preset amount of time, the alarm will automatically appear on the filtered workstation.

E. Controller Software:

1. Controllers shall operate as autonomous, intelligent processing units.

a. Controllers shall make decisions about access control, alarm monitoring, linking functions, and door-locking schedules for their operation, independent of other system components.

b. Controllers shall be part of a fully distributed processing-control network.

c. The portion of the database associated with a controller, and consisting of parameters, constraints, and the latest value or status of points connected to that controller, shall be maintained in the controller.

2. The following functions shall be fully implemented and operational within each controller:

a. Monitoring inputs.

b. Controlling outputs.

c. Automatically reporting alarms to the central station.

d. Reporting of sensor and output status to the central station on request.

e. Maintaining real time, automatically updated by the central station at least once a day.

f. Communicating with the central station.

g. Executing controller resident programs.

h. Diagnosing.

i. Downloading and uploading data to and from the central station.

3. Controller Operations at a Location:

a. Up to 64 controllers connected to TIA 485-A communications loop. Globally operating I/O linking and anti-passback functions between controllers within the same Location without central-station or workstation intervention. Linking and anti-passback shall remain fully functional within the same Location even when the central station or workstations are off-line.

b. In the event of communication failure between the central station and a Location, there shall be no degradation in operations at the controllers at that Location. Controllers at each Location shall be connected to a memory buffer with a capacity to store up to 10,000 events; there shall be no loss of transactions in system history files until the buffer overflows.

c. Buffered events shall be handled in a first-in-first-out mode of operation.

4. Individual Controller Operation:

a. Controllers shall transmit alarms, status changes, and other data to the central station when communications circuits are operable. If communications are not available, controllers shall function in a stand-alone mode; operational data, including the status and alarm data normally transmitted to the central station, shall be stored for later transmission to the central station. Storage capacity for the latest 1024 events shall be provided at each controller.

b. Card-reader ports of a controller shall be custom configurable for at least 120 different card-reader or keypad formats. Multiple reader or keypad formats may be used simultaneously at different controllers or within the same controller.

c. Controllers shall provide a response to card readers or keypad entries in less than 0.25 seconds, regardless of system size.

d. Controllers that are reset, or powered up from a nonpowered state, shall automatically request a parameter download and reboot to their proper working state. This shall happen without any operator intervention.

e. Initial Startup: When controllers are brought on-line, database parameters shall be automatically downloaded to them. After initial download is completed, only database changes shall be downloaded to each controller.

f. On failure for any reason, controllers shall perform an orderly shutdown and force controller outputs to a predetermined failure-mode state, consistent with the failure modes shown and the associated control device.

g. After power is restored, following a power failure, startup software shall initiate self-test diagnostic routines, after which controllers shall resume normal operation.

h. After controller failure, if the database and application software are no longer resident, controllers shall not restart but shall remain in the failure mode until repaired. If database and application programs are resident, controllers shall immediately resume operation. If not, software shall be restored automatically from the central station.

5. Communications Monitoring:

a. System shall monitor and report status of TIA 485-A communications loop of each Location.

b. Communication status window shall display which controllers are currently communicating, a total count of missed polls since midnight, and which controller last missed a poll.

c. Communication status window shall show the type of CPU, the type of I/O board, and the amount of RAM for each controller.

6. Operating systems shall include a real-time clock function that maintains seconds, minutes, hours, day, date, and month. The real-time clock shall be automatically synchronized with the central station at least once a day to plus or minus 10 seconds. The time synchronization shall be automatic, without operator action and without requiring system shutdown.

F. PC-to-Controller Communications:

1. Central-station or workstation communications shall use the following:

   a. Direct connection using serial ports of the PC.

   b. TCP/IP LAN interface cards.

   c. Dial-up or cable modems for connections to Locations.

2. Each serial port used for communications shall be individually configurable for "direct communications," "modem communications incoming and outgoing," or "modem communications incoming only," or as an ASCII output port. Serial ports shall have adjustable data transmission rates and shall be selectable under program control.

3. Use multiport communications board if more than two serial ports are needed.

   a. Use a 4-, 8-, or 16-serial port configuration that is expandable to 32- or 64-serial ports.

   b. Connect the first board to an internal PCI bus adapter card.

4. Direct serial, TCP/IP, and dial-up, cable, or satellite communications shall be alike in the monitoring or control of the system except for the connection that must first be made to a dial-up or voice-over IP Location.

5. TCP/IP network interface card (NIV) shall have an option to set the poll-frequency and message-response time-out settings.

6. PC-to-controller and controller-to-controller communications (direct, dial-up, or TCP/IP) shall use a polled-communication protocol that checks sum and acknowledges each message. All communications in this subparagraph shall be verified and buffered, and retransmitted if not acknowledged.

G. Direct Serial or TCP/IP PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-controller communications link.

2. Loss of communications to any controller shall result in an alarm at all PCs running the communication software.

3. When communications are restored, all buffered events shall automatically upload to the PC, and any database changes shall be automatically sent to the controller.

H. Dial-up Modem or Cable Modem PC-to-Controller Communications:

1. Communication software on the PC shall supervise the PC-to-controller communications link during dial-up modem connect times.

2. Communication software shall be programmable to routinely poll each of the remote dial-up or cable modem Locations, collecting event logs and verifying phone lines at operator-selectable time intervals for each Location.

3. System shall be programmable for dialing and connecting to all dial-up or cable modem Locations and for retrieving the accrued history transactions on an automatic basis as often as once every 10 minutes and up to once every 9999 minutes.

4. Failure to communicate to a dial-up Location three times in a row shall result in an alarm at the PC.

5. Time offset capabilities shall be present so that Locations in a different geographical time zone than the host PC will be set to, and maintained at, the proper local time. This feature shall allow for geographical time zones that are ahead of or behind the host PC.

6. The controller connected to a dial-up or cable modem shall automatically buffer all normal transactions until its buffer reaches 80 percent of capacity. When the transaction buffer reaches 80 percent, the controller shall automatically initiate a call to the central station and upload all transactions.

7. Alarms shall be reported immediately.

8. Dial-up or cable modems shall be provided by manufacturer of the system. Modems used at the controller shall be powered by the controller. Power to the modem shall include battery backup if the controller is so equipped.

I. Controller-to-Controller Communications:

1. TIA 485-A, four-wire, point-to-point, regenerative (repeater) communications network methodology.

2. TIA 485-A communications signal shall be regenerated at each controller.

J. Database Downloads:

1. All data transmissions from PCs to a Location, and between

controllers at a Location, shall include a complete database checksum to check the integrity of the transmission. If the data checksum does not match, a full data download shall be automatically retransmitted.

2. If a controller is reset for any reason, it shall automatically request and receive a database download from the PC. The download shall restore data stored at the controller to their normal working state and shall take place with no operator intervention.

3. Software shall provide for setting downloads via dial-up connection to once per 24-hour period, with time selected by the operator.

4. Software shall provide for setting delays of database downloads for dial-up connections. Delays change the download from immediately to a delay ranging from one to 999 minutes.

K. Operator Interface:

1. Inputs in system shall have two icon representations, one for the normal state and one for the abnormal state.

2. When viewing and controlling inputs, displayed icons shall automatically change to the proper icon to display the current system state in real time. Icons shall also display the input's state, whether armed or bypassed, and if the input is in the armed or bypassed state due to a time zone or a manual command.

3. Outputs in system shall have two icon representations, one for the secure (locked) state and one for the open (unlocked) state.

4. Icons displaying status of the I/O points shall be constantly updated to show their current real-time condition without prompting by the operator.

5. The operator shall be able to scroll the list of I/Os and press the appropriate toolbar button, or right click, to command the system to perform the desired function.

6. Graphic maps or drawings containing inputs, outputs, and override groups shall include the following:

a. Database to import and store full-color maps or drawings and allow for input, output, and override group icons to be placed on maps.

b. Maps to provide real-time display animation and allow for control of points assigned to them.

c. System to allow inputs, outputs, and override groups to be placed on different maps.

d. Software to allow changing the order or priority in which maps will be displayed.

7. Override Groups Containing I/Os:

a. System shall incorporate override groups that provide the operator with the status and control over user-defined "sets" of I/Os with a single icon.

b. Icon shall change automatically to show the live summary status of points in that group.

c. Override group icon shall provide a method to manually control or set to time-zone points in the group.

d. Override group icon shall allow the expanding of the group to show icons representing the live status for each point in the group, individual control over each point, and the ability to compress the individual icons back into one summary icon.

8. Schedule Overrides of I/Os and Override Groups:

a. To accommodate temporary schedule changes that do not fall within the holiday parameters, the operator shall have the ability to override schedules individually for each input, output, or override group.

b. Each schedule shall be composed of a minimum of two dates with separate times for each date.

c. The first time and date shall be assigned the override state that the point shall advance to when the time and date become current.

d. The second time and date shall be assigned the state that the point shall return to when the time and date become current.

9. Copy command in database shall allow for like data to be copied and then edited for specific requirements, to reduce redundant data entry.

L. Operator Access Control:

1. Control operator access to system controls through three password-protected operator levels. System operators and managers with

appropriate password clearances shall be able to change operator levels for operators.

2. Three successive attempts by an operator to execute functions beyond their defined level during a 24-hour period shall initiate a software tamper alarm.

3. A minimum of 32 passwords shall be available with the system software. System shall display the operator's name or initials in the console's first field. System shall print the operator's name or initials, action, date, and time on the system printer at login and logoff.

4. The password shall not be displayed or printed.

5. Each password shall be definable and assignable for the following:

   a. Selected commands to be usable.

   b. Access to system software.

   c. Access to application software.

   d. Individual zones that are to be accessed.

   e. Access to database.

M. Operator Commands:

1. Command Input: Plain-language words and acronyms shall allow operators to use the system without extensive training or data-processing backgrounds. System prompts shall be a word, a phrase, or an acronym.

2. Command inputs shall be acknowledged and processing shall start in not less than one second(s).

3. Tasks that are executed by operator's commands shall include the following:

   a. Acknowledge Alarms: Used to acknowledge that the operator has observed the alarm message.

   b. Place Zone in Access: Used to remotely disable intrusion-alarm circuits emanating from a specific zone. System shall be structured so that console operator cannot disable tamper circuits.

   c. Place Zone in Secure: Used to remotely activate intrusion-alarm circuits emanating from a specific zone.

d. System Test: Allows the operator to initiate a system-wide operational test.

e. Zone Test: Allows the operator to initiate an operational test for a specific zone.

f. Print reports.

g. Change Operator: Used for changing operators.

h. Security Lighting Controls: Allows the operator to remotely turn on or turn off security lights.

i. Display Graphics: Used to show any graphic displays implemented in the system. Graphic displays shall be completed within 20 seconds from time of operator command.

j. Run system tests.

k. Generate and format reports.

l. Request help with the system operation.

i. Include in main menus.

ii. Provide unique, descriptive, context-sensitive help for selections and functions with the press of one function key.

iii. Provide navigation to specific topic from within the first help window.

iv. Help shall be accessible outside the application program.

m. Entry-Control Commands:

i. Lock (secure) or unlock (open) each controlled entry and exit up to four times a day through time-zone programming.

ii. Arm or disarm each monitored input up to four a day through time-zone programming.

iii. Enable or disable readers or keypads up to two times a day through time-zone programming.

iv. Enable or disable cards or codes up to four times a day per entry point through access-level programming.

4. Command Input Errors: Show operator input assistance when a command cannot be executed because of operator input errors. Assistance screen shall use plain-language words and phrases to explain why the command cannot be executed. Error responses that require an operator to look up a code in a manual or other document are not acceptable. Conditions causing operator assistance messages include the following:

   a. Command entered is incorrect or incomplete.

   b. Operator is restricted from using that command.

   c. Command addresses a point that is disabled or out of service.

   d. Command addresses a point that does not exist.

   e. Command is outside the system's capacity.

N. Alarms:

1. System Setup:

   a. Assign manual and automatic responses to incoming-point status change or alarms.

   b. Automatically respond to input with a link to other inputs, outputs, or operator-response plans; unique sound with use of WAV files; and maps or images that graphically represent the point location.

   c. Sixty-character message field for each alarm.

   d. Operator-response-action messages shall allow message length of at least 65,000 characters, with database storage capacity of up to 32,000 messages. Setup shall assign messages to access point.

   e. Secondary messages shall be assignable by the operator for printing to provide further information and shall be editable by the operator.

   f. Allow 25 secondary messages with a field of four lines of 60 characters each.

   g. Store the most recent 1000 alarms for recall by the operator using the report generator.

2. Software Tamper:

a. Annunciate a tamper alarm when unauthorized changes to system database files are attempted. Three consecutive unsuccessful attempts to log onto system shall generate a software tamper alarm.

b. Annunciate a software tamper alarm when an operator or other individual makes three consecutive unsuccessful attempts to invoke functions beyond the authorization level.

c. Maintain a transcript file of the last 5000 commands entered at each central station to serve as an audit trail. System shall not allow write access to system transcript files by any person, regardless of their authorization level.

d. Allow only acknowledgment of software tamper alarms.

3. Read access to system transcript files shall be reserved for operators with the highest password authorization level available in system.

4. Animated Response Graphics: Highlight alarms with flashing icons on graphic maps; display and constantly update the current status of alarm inputs and outputs in real time through animated icons.

5. Multimedia Alarm Annunciation: WAV files to be associated with alarm events for audio annunciation or instructions.

6. Alarm Handling: Each input may be configured so that an alarm cannot be cleared unless it has returned to normal, with options of requiring the operator to enter a comment about disposition of alarm. Allow operator to silence alarm sound when alarm is acknowledged.

7. Alarm Automation Interface: High-level interface to central-station alarm automation software systems. Allows input alarms to be passed to and handled by automation systems in the same manner as burglar alarms, using a TIA 232-F ASCII interface.

8. CCTV Alarm Interface: Allow commands to be sent to CCTV systems during alarms (or input change of state) through serial ports.

9. Camera Control: Provides operator ability to select and control cameras from graphic maps.

O. Alarm Monitoring: Monitor sensors, controllers, and DTS circuits and notify operators of an alarm condition. Display higher-priority alarms first and, within alarm priorities, display the oldest unacknowledged alarm

first. Operator acknowledgment of one alarm shall not be considered acknowledgment of other alarms nor shall it inhibit reporting of subsequent alarms.

1. Displayed alarm data shall include type of alarm, location of alarm, and secondary alarm messages.

2. Printed alarm data shall include type of alarm, location of alarm, date and time (to nearest second) of occurrence, and operator responses.

3. Maps shall automatically display the alarm condition for each input assigned to that map if that option is selected for that input location.

4. Alarms initiate a status of "pending" and require the following two handling steps by operators:

    a. First Operator Step: "Acknowledged." This action shall silence sounds associated with the alarm. The alarm remains in the system "Acknowledged" but "Un-Resolved."

    b. Second Operator Step: Operators enter the resolution or operator comment, giving the disposition of the alarm event. The alarm shall then clear.

5. Each workstation shall display the total pending alarms and total unresolved alarms.

6. Each alarm point shall be programmable to disallow the resolution of alarms until the alarm point has returned to its normal state.

7. Alarms shall transmit to the central station in real time except for allowing connection time for dial-up locations.

8. Alarms shall be displayed and managed from a minimum of four different windows.

    a. Input Status Window: Overlay status icon with a large red blinking icon. Selecting the icon will acknowledge the alarm.

    b. History Log Transaction Window: Display name, time, and date in red text. Selecting red text will acknowledge the alarm.

    c. Alarm Log Transaction Window: Display name, time, and date in red. Selecting red text will acknowledge the alarm.

d. Graphic Map Display: Display a steady colored icon representing each alarm input location. Change icon to flashing red when the alarm occurs. Change icon from flashing red to steady red when the alarm is acknowledged.

9. Once an alarm is acknowledged, the operator shall be prompted to enter comments about the nature of the alarm and actions taken. Operator's comments may be manually entered or selected from a programmed predefined list, or a combination of both.

10. For locations where there are regular alarm occurrences, provide programmed comments. Selecting that comment shall clear the alarm.

11. The time and name of the operator who acknowledged and resolved the alarm shall be recorded in the database.

12. Identical alarms from the same alarm point shall be acknowledged at the same time the operator acknowledges the first alarm. Identical alarms shall be resolved when the first alarm is resolved.

13. Alarm functions shall have priority over downloading, retrieving, and updating database from workstations and controllers.

14. When a reader-controlled output (relay) is opened, the corresponding alarm point shall be automatically bypassed.

P. Monitor Display: Display text and graphic maps that include zone status integrated into the display. Colors are used for the various components and current data. Colors shall be uniform throughout the system.

1. Color Code:

a. FLASHING RED: Alerts operator that a zone has gone into an alarm or that primary power has failed.

b. STEADY RED: Alerts operator that a zone is in alarm and alarm has been acknowledged.

c. YELLOW: Advises operator that a zone is in access.

d. GREEN: Indicates that a zone is secure and that power is on.

2. Graphics:

a. Support 32,000 graphic display maps and allow import of maps from a minimum of 16 standard formats from another drawing or graphics program.

b. Allow I/O to be placed on graphic maps by the drag-and-drop method.

c. Operators shall be able to view the inputs, outputs, and the point's name by moving the mouse cursor over the point on the graphic map.

d. Inputs or outputs may be placed on multiple graphic maps. The operator shall be able to toggle to view graphic maps associated with I/Os.

e. Each graphic map shall have a display-order sequence number associated with it to provide a predetermined order when toggled to different views.

f. Camera icons shall have the ability to be placed on graphic maps that, when selected by an operator, will open a video window, display the camera associated with that icon, and provide pan-tilt-zoom control.

g. Input, output, or camera placed on a map shall allow the ability to arm or bypass an input, open or secure an output, or control the pan-tilt-zoom function of the selected camera.

Q. System test software enables operators to initiate a test of the entire system or of a particular portion of the system.

1. Test Report: The results of each test shall be stored for future display or printout. The report shall document the operational status of system components.

R. Report-Generator Software: Include commands to generate reports for displaying, printing, and storing on disk and tape. Reports shall be stored by type, date, and time. Report printing shall be the lowest-priority activity. Report-generation mode shall be operator selectable but set up initially as periodic, automatic, or on request. Include time and date printed and the name of operator generating the report. Report formats may be configured by operators.

1. Automatic Printing: Setup shall specify, modify, or inhibit the report to be generated; the time the initial report is to be generated; the time interval between reports; the end of the period; and the default printer.

2. Printing on Request: An operator may request a printout of any report.

3. Alarm Reports: Reporting shall be automatic as initially set up. Include alarms recorded by system over the selected time and information about the type of alarm (such as door alarm, intrusion alarm, tamper alarm, etc.), the type of sensor, the location, the time, and the action taken.

4. Access and Secure Reports: Document zones placed in access, the time placed in access, and the time placed in secure mode.

5. Custom Reports: Reports tailored to exact requirements of who, what, when, and where. As an option, custom report formats may be stored for future printing.

6. Automatic History Reports: Named, saved, and scheduled for automatic generation.

7. Cardholder Reports: Include data, or selected parts of the data, as well as the ability to be sorted by name, card number, imprinted number, or by any of the user-defined fields.

8. Cardholder by Reader Reports: Based on who has access to a specific reader or group of readers by selecting the readers from a list.

9. Cardholder by Access-Level Reports: Display everyone that has been assigned to the specified access level.

10. Who Is "In" (Muster) Report:

    a. Emergency Muster Report: One-click operation on toolbar launches report.

    b. Cardholder Report. Contain a count of persons who are "In" at a selected Location and a detailed listing of name, date, and time of last use, sorted by the last reader used or by the group assignment.

11. Panel Labels Reports: Printout of control-panel field documentation including the actual location of equipment, programming parameters, and wiring identification. Maintain system installation data within system database so that data are available on-site at all times.

12. Activity and Alarm On-Line Printing: Activity printers for use at workstations; prints all events, or alarms only.

13. History Reports: Custom reports that allow the operator to select any date, time, event type, device, output, input, operator,

Location, name, or cardholder to be included or excluded from the report.

a. Initially store history on the hard disk of the host PC.

b. Permit viewing of the history on workstations or print history to any system printer.

c. The report shall be definable by a range of dates and times with the ability to have a daily start and stop time over a given date range.

d. Each report shall depict the date, time, event type, event description, and device; or I/O name, cardholder group assignment, and cardholder name or code number.

e. Each line of a printed report shall be numbered to ensure that the integrity of the report has not been compromised.

f. Total number of lines of the report shall be given at the end of the report. If the report is run for a single event such as "Alarms," the total shall reflect how many alarms occurred during that period.

14. Reports shall have the following four options:

a. View on screen.

b. Print to system printer. Include automatic print spooling and "Print To" options if more than one printer is connected to the system.

c. "Save to File" with full path statement.

d. System shall have the ability to produce a report indicating status of system inputs and outputs or of inputs and outputs that are abnormal, out of time zone, manually overridden, not reporting, or in alarm.

15. Custom Code List Subroutine: Allow the access codes of system to be sorted and printed according to the following criteria:

a. Active, inactive, or future activate or deactivate.

b. Code number, name, or imprinted card number.

c. Group, Location access levels.

d. Start and stop code range.

e. Codes that have not been used since a selectable number of days.

f. In, out, or either status.

g. Codes with trace designation.

16. The reports of system database shall allow options so that every data field may be printed.

17. The reports of system database shall be constructed so that the actual position of the printed data shall closely match the position of the data on the data-entry windows.

S. Anti-Passback:

1. System shall have global and local anti-passback features, selectable by Location. System shall support hard and soft anti-passback.

2. Hard Anti-Passback: Once a credential holder is granted access through a reader with one type of designation (IN or OUT), the credential holder may not pass through that type of reader designation until the credential holder passes through a reader of opposite designation.

3. Soft Anti-Passback: Should a violation of the proper IN or OUT sequence occur, access shall be granted, but a unique alarm shall be transmitted to the control station, reporting the credential holder and the door involved in the violation. A separate report may be run on this event.

4. Timed Anti-Passback: A controller capability that prevents an access code from being used twice at the same device (door) within a user-defined amount of time.

5. Provide four separate zones per Location that can operate without requiring interaction with the host PC (done at controller). Each reader shall be assignable to one or all four anti-passback zones. In addition, each anti-passback reader can be further designated as "Hard," "Soft," or "Timed" in each of the four anti-passback zones. The four anti-passback zones shall operate independently.

6. The anti-passback schemes shall be definable for each individual door.

7. The Master Access Level shall override anti-passback.

8. System shall have the ability to forgive (or reset) an individual credential holder or the entire credential-holder population anti-passback status to a neutral status.

T. Visitor Assignment:

1. Provide for and allow an operator to be restricted to only working with visitors. The visitor badging subsystem shall assign credentials and enroll visitors. Allow only those access levels that have been designated as approved for visitors.

2. Provide an automated log of visitor name, time and doors accessed, and name of person contacted.

3. Allow a visitor designation to be assigned to a credential holder.

4. Security access system shall be able to restrict the access levels that may be assigned to credentials issued to visitors.

5. Allow operator to recall visitors' credential-holder file once a visitor is enrolled in the system.

6. The operator may designate any reader as one that deactivates the credential after use at that reader. The history log shall show the return of the credential.

7. System shall have the ability to use the visitor designation in searches and reports. Reports shall be able to print all or any visitor activity.

U. Time and Attendance:

1. Time and attendance reporting shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.

2. Shall be provided to match IN and OUT reads and display cumulative time in for each day and cumulative time in for length designated in the report.

3. System software setup shall allow designation of selected access-control readers as time and attendance hardware to gather the clock-in and clock-out times of the users at these readers.

a. Reports shall show in and out times for each day, total time in for each day, and a total time in for period specified by the user.

b. Allow the operator to view and print the reports, or save the reports to a file.

c. Alphabetically sort reports on the person's last name, by Location or location group. Include all credential holders or optionally select individual credential holders for the report.

V. Training Software: Enables operators to practice system operation, including alarm acknowledgment, alarm assessment, response force deployment, and response force communications. System shall continue normal operation during training exercises and shall terminate exercises when an alarm signal is received at the console.

W. Entry-Control Enrollment Software: Database management functions that allow operators to add, delete, and modify access data as needed.

1. The enrollment station shall not have alarm response or acknowledgment functions.

2. Provide multiple, password-protected access levels. Database management and modification functions shall require a higher operator access level than personnel enrollment functions.

3. The program shall provide means to disable the enrollment station when it is unattended, to prevent unauthorized use.

4. The program shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations. In the case of personnel identity-verification subsystems, this shall include biometric data. Allow entry of personnel identifying information into the system database using menu selections and data fields. The data field names shall be customized during setup to suit user and site needs. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.

5. Cardholder Data: Provide 99 user-defined fields. System shall have the ability to run searches and reports using any combination of these fields. Each user-defined field shall be configurable, using any combination of the following features:

a. MASK: Determines a specific format with which data must comply.

b. REQUIRED: Operator is required to enter data into field before saving.

c. UNIQUE: Data entered must be unique.

d. DEACTIVATE DATE: Data entered will be evaluated as an additional deactivate date for all cards assigned to this cardholder.

e. NAME ID: Data entered will be considered a unique ID for the cardholder.

6. Personnel Search Engine: A report generator with capabilities such as search by last name, first name, group, or any predetermined user-defined data field; by codes not used in definable number of days; by skills; or by seven other methods.

7. Multiple Deactivate Dates for Cards: User-defined fields to be configured as additional stop dates to deactivate any cards assigned to the cardholder.

8. Batch card printing.

9. Default card data can be programmed to speed data entry for sites where most card data are similar.

10. Enhanced ASCII File Import Utility: Allows the importing of cardholder data and images.

11. Card Expire Function: Allows readers to be configured to deactivate cards when a card is used at selected devices.

2.05 SYSTEM DATABASE

A. Database and database management software shall define and modify each point in database using operator commands. Definition shall include parameters and constraints associated with each system device.

B. Database Operations:

1. System data management shall be in a hierarchical menu-tree format, with navigation through expandable menu branches and manipulated with use of menus and icons in a main menu and system toolbar.

2. Navigational Aids:

a. Toolbar icons for add, delete, copy, print, capture image, activate, deactivate, and muster report.

b. Point and click feature to facilitate data manipulation.

c. Next and previous command buttons visible when editing database fields to facilitate navigation from one record to the next.

d. Copy command and copy tool in the toolbar to copy data from one record to create a new similar record.

3. Data entry shall be automatically checked for duplicate and illegal data and shall be verified for valid format.

4. System shall generate a memo or note field for each item that is stored in database, allowing the storing of information about any defining characteristics of the item. Memo field is used for noting the purpose for which the item was entered, reasons for changes that were made, and the like.

C. File Management:

1. File management shall include database backup and restoration system, allowing selection of storage media, including 3.5-inch floppy disk, Zip and Jaz drives, and designated network resources.

2. Operations shall be both manual and automatic modes. The number of automatic sequential backups before the oldest backup will be overwritten; FIFO mode shall be operator selectable.

3. Backup program shall provide manual operation from any PC on the LAN and shall operate while system remains operational.

D. Operator Passwords:

1. Support up to 32,000 individual system operators, each with a unique password.

2. One to eight alphanumeric characters.

3. Allow passwords to be case sensitive.

4. Passwords shall not be displayed when entered.

5. Passwords shall have unique and customizable password profile, and allow several operators to share a password profile. Include the following features in the password profile:

a. Predetermine the highest-level password profile for access to all functions and areas of program.

b. Allow or disallow operator access to any program operation, including the functions of View, Add, Edit, and Delete.

c. Restrict doors to which an operator can assign access.

6. Operators shall use a user name and password to log on to system. This user name and password shall be used to access database areas and programs as determined by the associated profile.

7. Make provision to allow the operator to log off without fully exiting program. User may be logged off but program will remain running while displaying the login window for the next operator.

E. Access Card/Code Operation and Management: Access authorization shall be by card, by a manually entered code (PIN), or by a combination of both (card plus PIN).

1. Access authorization shall verify the facility code first, the card or card-and-PIN validation second, and the access level (time of day, day of week, date), anti-passback status, and number of uses last.

2. Use data-entry windows to view, edit, and issue access levels. Access-authorization entry-management system shall maintain and coordinate all access levels to prevent duplication or the incorrect creation of levels.

3. Allow assignment of multiple cards/codes to a cardholder.

4. Allow assignment of up to four access levels for each Location to a cardholder. Each access level may contain any combination of doors.

5. Each door may be assigned four time zones.

6. Access codes may be up to 11 digits in length.

7. Software shall allow the grouping of locations so cardholder data can be shared by all locations in the group.

8. Visitor Access: Issue a visitor badge for data tracking or photo ID purposes without assigning that person a card or code.

9. Cardholder Tracing: Allow for selection of cardholder for tracing. Make a special audible and visible annunciation at control station when a selected card or code is used at a designated code reader. Annunciation shall include an automatic display of the cardholder image.

10. Allow each cardholder to be given either an unlimited number of uses or a number from one to 9999 that regulates the number of times the card can be used before it is automatically deactivated.

11. Provide for cards and codes to be activated and deactivated manually or automatically by date. Provide for multiple deactivate

dates to be preprogrammed.

F. Security Access Integration:

1. Photo ID badging and photo verification shall use the same database as the security access and may query data from cardholder, group, and other personal information to build a custom ID badge.

2. Automatic or manual image recall and manual access based on photo verification shall also be a means of access verification and entry.

3. System shall allow sorting of cardholders together by group or other characteristic for a fast and efficient method of reporting on, and enabling or disabling, cards or codes.

G. Key control and tracking shall be an integrated function of cardholder data.

1. Provide the ability to store information about which conventional metal keys are issued and to whom, along with key construction information.

2. Reports shall be designed to list everyone who possesses a specified key.

H. Facility Codes: System shall accommodate up to 2048 facility codes per Location, with the option of allowing facility codes to work at all doors or only at particular doors.

I. Operator Comments:

1. With the press of one appropriate button on the toolbar, the user shall be permitted to enter operator comments into the history at any time.

2. Automatic prompting of operator comment shall occur before the resolution of each alarm.

3. Operator comments shall be recorded by time, date, and operator number.

4. Comments shall be sorted and viewed through reports and history.

5. The operator may enter comments in two ways; either or both may be used:

a. Manually entered through keyboard data entry (typed), up to 65,000 characters per each alarm.

b. Predefined and stored in database for retrieval on request.

6. System shall have a minimum of 999 predefined operator comments with up to 30 characters per comment.

J. Group:

1. Group names may be used to sort cardholders into groups that allow the operator to determine the tenant, vendor, contractor, department, division, or any other designation of a group to which the person belongs.

2. System software shall have the capacity to assign one of 32,000 group names to an access authorization.

3. Make provision in software to deactivate and reactivate all access authorizations assigned to a particular group.

4. Allow sorting of history reports and code list printouts by group name.

K. Time Zones:

1. Each zone consists of a start and stop time for seven days of the week and three holiday schedules. A time zone is assigned to inputs, outputs, or access levels to determine when an input shall automatically arm or disarm, when an output automatically opens or secures, or when access authorization assigned to an access level will be denied or granted.

2. Up to four time zones may be assigned to inputs and outputs to allow up to four arm or disarm periods per day or four lock or unlock periods per day; up to three holiday override schedules may be assigned to a time zone.

3. Data-entry window shall display a dynamically linked bar graph showing active and inactive times for each day and holiday, as start and stop times are entered or edited.

4. System shall have the capacity for 2048 time zones for each Location.

L. Holidays:

1. Three different holiday schedules may be assigned to a time zone. Holiday schedule consists of date in format MM/DD/YYYY and a description. When the holiday date matches the current date of the time zone, the holiday schedule replaces the time-zone schedule for that 24-hour period.

2. System shall have the capacity for 32,000 holidays.

3. Three separate holiday schedules may be applied to a time zone.

4. Holidays have an option to be designated as occurring on the designated date each year. These holidays remain in the system and will not be purged.

5. Holidays not designated to occur each year shall be automatically purged from the database after the date expires.

M. Access Levels:

1. System shall allow for the creation of up to 32,000 access levels.

2. One level shall be predefined as the Master Access Level. The Master Access Level shall work at all doors at all times and override any anti-passback.

3. System shall allow for access to be restricted to any area by reader and by time. Access levels shall determine when and where an Identifier is authorized.

4. System shall be able to create multiple door and time-zone combinations under the same access level so that an Identifier may be valid during different time periods at different readers even if the readers are on the same controller.

N. User-Defined Fields:

1. System shall provide a minimum of 99 user-defined fields, each with up to 50 characters, for specific information about each credential holder.

2. System shall accommodate a title for each field; field length shall be 20 characters.

3. A "Required" option may be applied to each user-defined field that, when selected, forces the operator to enter data in the user-defined field before the credential can be saved.

4. A "Unique" option may be applied to each user-defined field that, when selected, will not allow duplicate data from different credential holders to be entered.

5. Data format option may be assigned to each user-defined field that will require the data to be entered with certain character types in specific spots in the field entry window.

6. A user-defined field, if selected, will define the field as a deactivate date. The selection shall automatically cause the data to be formatted with the windows MM/DD/YYYY date format. The credential of the holder will be deactivated on that date.

7. A search function shall allow any one user-defined field or combination of user-defined fields to be searched to find the appropriate cardholder. The search function shall include a search for a character string.

8. System shall have the ability to print cardholders based on and organized by the user-defined fields.

O. Code Tracing:

1. System shall perform code tracing selectable by cardholder and by reader.

2. Any code may be designated as a "traced code" with no limit to how many codes can be traced.

3. Any reader may be designated as a "trace reader" with no limit to which or how many readers can be used for code tracing.

4. When a traced code is used at a trace reader, the access-granted message that usually appears on the monitor window of the central station shall be highlighted with a different color than regular messages. A short singular beep shall occur at the same time the highlighted message is displayed on the window.

5. The traced cardholder image (if image exists) shall appear on workstations when used at a trace reader.

2.06 SURGE AND TAMPER PROTECTION

A. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor-entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 16289 "Surge Protection for Low-Voltage Electrical Power Circuits."

2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 16289 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being

protected.

B. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station control-unit alarm display shall identify tamper alarms and indicate locations.

2.07 CENTRAL-STATION HARDWARE

A. Central-Station Computer: Standard unmodified PC of modular design. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66GHz.

1. Memory: 256 MB of usable installed memory, expandable to a minimum of 1024 MB without additional chassis or power supplies.

2. Power Supply: Minimum capacity of 250 W.

3. Real-Time Clock:

a. Accuracy: Plus or minus one minute per month.

b. Time-Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.

c. Clock shall function for one year without power.

d. Provide automatic time correction once every 24 hours by synchronizing clock with the Time Service Department of the U.S. Naval Observatory.

4. Serial Ports: Provide two TIA 232-F serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.

5. Parallel Port: An enhanced parallel port.

6. LAN Adapter Card: 10/100 Mbps PCI bus, internal network interface card.

7. Sound Card: For playback and recording of digital WAV sound files that are associated with audible warning and alarm functions.

8. Color Monitor: Not less than 17 inches (430 mm), with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28 mm. The video card shall support at

least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70 Hz.

9. Keyboard: With a minimum of 64 characters, standard ASCII character set based on the International Committee for Information Technology Standards (INCITS) ANSI/INCITS 154.

10. Mouse: Standard, compatible with the installed software.

11. Special-function keyboard attachments or special-function keys to facilitate data input of the following operator tasks:

    a. Help.

    b. Alarm Acknowledge.

    c. Place Zone in Access.

    d. Place Zone in Secure.

    e. System Test.

    f. Print Reports.

    g. Change Operator.

12. Disk storage shall include the following, each with appropriate controller:

    a. Minimum 160 GB hard disk, maximum average access time of 10 ms.

    b. Floppy Disk Drive: High density, 3-1/2-inch (90-mm) size.

    c. PCMCIA slot with removable 500 MB media.

    d. 100 MB Iomega Zip drive.

    e. 250 MB Iomega Jaz drive.

13. Magnetic Tape System: 4-mm cartridge magnetic tape system with minimum 20 GB formatted capacity per tape. Provide 10 tapes, each in a rigid cartridge with spring-loaded cover and operator-settable write-protect feature.

14. Modem: 56,600 bps, full duplex for asynchronous communications. With error detection, auto answer/autodial, and call-in-progress detection. Modem shall comply with requirements in the International Telecommunication Union (ITU) ITU-T V.34, ITU-T V.42 for error correction, and ITU-T V.42 BIS for data

compression standards; and shall be suitable for operating on unconditioned voice-grade telephone lines complying with 47 CFR 68.

15. Audible Alarm: Manufacturer's standard.

16. CD-ROM Drive:

    a. Nominal storage capacity of 650MB.

    b. Data Transfer Rate: 1.2 Mbps.

    c. Average Access Time: 150 ms.

    d. Cache Memory: 256 KB.

    e. Data Throughput: 1 MB/second, minimum.

17. Dot Matrix Alarm Printer:

    a. Connected to the central station.

    b. Minimum of 96 characters, standard ASCII character set based on the International Committee for Information Technology Standards (INCITS) ANSI/INCITS 154, and with graphics capability and programmable top-of-form control.

    c. Prints in both red and black without ribbon change.

    d. Adjustable sprockets for paper width up to 11 inches.

    e. 80 columns per line, minimum speed of 200 characters per second.

    f. Character Spacing: Selectable at 10, 12, or 17 characters per inch.

    g. Paper: Sprocket-fed fan fold paper.

18. Report Printer:

    a. Connected to the central station and designated workstations.

    b. Laser printer with minimum resolution of 600 dpi.

    c. RAM: 2 MB, minimum.

    d. Printing Speed: Minimum 12 pages per minute.

e. Paper Handling: Automatic sheet feeder with 250-sheet paper cassette and with automatic feed.

19. Interface: Bidirectional parallel, and universal serial bus.

20. LAN Adapter Card: 10/100 Mbps internal network interface card.

B. Redundant Central Computer: One identical redundant central computer, connected in a hot standby, peer configuration. This computer shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant computer in near real time. If central computer fails, redundant computer shall assume control immediately and automatically.

C. UPS: Self-contained; complying with requirements in Section 16264 "Static Uninterruptible Power Supply."

1. Size: Provide a minimum of six hours of operation of the central-station equipment, including two hours of alarm printer operation.

2. Batteries: Sealed, valve regulated, recombinant, lead calcium.

3. Accessories:

a. Transient voltage suppression.

b. Input-harmonics reduction.

c. Rectifier/charger.

d. Battery disconnect device.

e. Static bypass transfer switch.

f. Internal maintenance bypass/isolation switch.

g. External maintenance bypass/isolation switch.

h. Output isolation transformer.

i. Remote UPS monitoring.

j. Battery monitoring.

k. Remote battery monitoring.

2.08 STANDARD WORKSTATION HARDWARE

A. Workstation shall consist of a standard unmodified PC with accessories and peripherals that configure the workstation for a specific duty.

B. Workstation Computer: Standard unmodified PC of modular design. The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66 GHz.

1. Memory: 512 MB of usable installed memory, expandable to a minimum of 8 GB without additional chassis or power supplies.

2. Power Supply: Minimum capacity of 250 W.

3. Real-Time Clock:

a. Accuracy: Plus or minus one minute per month.

b. Time-Keeping Format: 24-hour time format including seconds, minutes, hours, date, day, and month; resettable by software.

c. Provide automatic time correction once every 24 hours by synchronizing clock with the central station.

4. Serial Ports: Provide two TIA 232-F USB serial ports for general use, with additional ports as required. Data transmission rates shall be selectable under program control.

5. Parallel Port: An enhanced parallel port.

6. Sound Card: For playback and recording of digital WMP sound files that are associated with audible warning and alarm functions.

7. Color Monitor: Not less than 17 inches (430 mm), with a minimum resolution of 1280 by 1024 pixels, noninterlaced, and a maximum dot pitch of 0.28 mm. The video card shall support at least 256 colors at a resolution of 1280 by 1024 at a minimum refresh rate of 70 Hz.

8. Keyboard: With a minimum of 64 characters, standard ASCII character set based on the International Committee for Information Technology Standards (INCITS) ANSI/INCITS 154.

9. Mouse: Standard, compatible with the installed software. Minimum resolution shall be 400 dpi.

10. Disk storage shall include the following, each with appropriate controller:

a. Minimum 20 GB hard disk, maximum average access time of 10 ms.

b. Floppy Disk Drive: High density, 3-1/2-inch (90-mm) size.

11. CD-ROM/CD-RW Drive:

a. Nominal Storage Capacity: 700 MB.

b. Data Transfer Rate: 3.6 Mbps.

c. Average Access Time: 150 ms.

d. Cache Memory: 512 KB.

e. Data Throughput: 3.6 MB/second, minimum.

f. Read Speed: 48x.

g. Write Speed: 32x.

12. DVD/DVD-RW Drive:

a. Nominal Storage Capacity: 4.7 GB.

b. Data Transfer Rate: 3.6 Mbps.

c. Cache Memory: 512 KB.

d. Read Speed: 24x.

e. Write Speed: 6x.

13. Printer:

a. Connected to the central station and designated workstations.

b. Laser printer with minimum resolution of 600 dpi.

c. RAM: 8 MB, minimum.

d. Printing Speed: Minimum 12 pages per minute.

e. Paper Handling: Automatic sheet feeder with 250-sheet paper cassette and with automatic feed.

14. Interface: Bidirectional parallel, and universal serial bus.

15. LAN Adapter Card: 10/100 Mbps internal network interface card.

C. Redundant Workstation: One identical redundant workstation, connected in a hot standby, peer configuration. This workstation shall automatically maintain its own copies of system software, application software, and data files. System transactions and other activities that alter system data files shall be updated to system files of redundant workstation in near real time. If its associated workstation fails, redundant workstation shall assume control immediately and automatically.

D. UPS: Self-contained, complying with requirements in Section 16264 "Static Uninterruptible Power Supply."

1. Size: Provide a minimum of six hours of operation of the central-station equipment, including two hours of alarm printer operation.

2. Batteries: Sealed, valve regulated, recombinant, lead calcium.

3. Accessories:

a. Transient voltage suppression.

b. Input-harmonics reduction.

c. Rectifier/charger.

d. Battery disconnect device.

e. Static bypass transfer switch.

f. Internal maintenance bypass/isolation switch.

g. External maintenance bypass/isolation switch.

h. Output isolation transformer.

i. Remote UPS monitoring.

j. Battery monitoring.

k. UPS operation monitoring.

l. Abnormal operation. Visible and audible indication.

m. Remote battery monitoring.

2.09 COMMUNICATIONS WORKSTATION

A. Standard workstation, modified as follows:

1. Four additional TIA 232-F serial port(s). The CPU word size shall be 32 bytes or larger; the CPU operating speed shall be at least 66

MHz. Multiplexed serial ports shall be expandable with eight-character transmit and receive buffers for each port. Total-buffer size shall be a minimum of 1 MB.

2. Redundant workstation is not required.

3. Printer is not required.

2.10 CONTROLLERS

A. Controllers: Intelligent peripheral control unit, complying with UL 294, that stores time, date, valid codes, access levels, and similar data downloaded from the central station or workstation for controlling its operation.

B. Subject to compliance with requirements in this article, manufacturers may use multipurpose controllers.

C. Battery Backup: Sealed, lead acid; sized to provide run time during a power outage of 90 minutes, complying with UL 924.

D. Alarm Annunciation Controller:

1. The controller shall automatically restore communication within 10 seconds after an interruption with the field device network.

a. Inputs: Monitor dry contacts for changes of state that reflect alarm conditions. Provides at least eight alarm inputs, which are suitable for wiring as normally open or normally closed contacts for alarm conditions.

b. Alarm-Line Supervision:

i. Supervise the alarm lines by monitoring each circuit for changes or disturbances in the signal by monitoring for abnormal open, grounded, or shorted conditions using dc change measurements. System shall initiate an alarm in response to an abnormal current, which is a dc change of 10 percent or more for longer than 500 ms.

ii. Transmit alarm-line-supervision alarm to the central station during the next interrogation cycle after the abnormal current condition.

c. Outputs: Managed by central-station software.

2. Auxiliary Equipment Power: A GFI service outlet inside the controller enclosure.

E. Entry-Control Controller:

1. Function: Provide local entry-control functions including one- and two-way communications with access-control devices such as card readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.

   a. Operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the controller and the field-device network.

   b. Accept information generated by the entry-control devices; automatically process this information to determine valid identification of the individual present at the portal:

      i. On authentication of the credentials or information presented, check privileges of the identified individual, allowing only those actions granted as privileges.

      ii. Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control.

   c. Maintain a date-, time-, and Location-stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

2. Inputs:

   a. Data from entry-control devices; use this input to change modes between access and secure.

   b. Database downloads and updates from the central station that include enrollment and privilege information.

3. Outputs:

   a. Indicate success or failure of attempts to use entry-control devices and make comparisons of presented information with stored identification information.

   b. Grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.

c. Maintain a date-, time-, and Location-stamped record of each transaction and transmit transaction records to the central station.

d. Door Prop Alarm: If a portal is held open for longer than 20 seconds, alarm sounds.

4. With power supplies sufficient to power at voltage and frequency required for field devices and portal-control devices.

5. Data Line Problems: For periods of loss of communication with the central station, or when data transmission is degraded and generating continuous checksum errors, the controller shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal-control devices.

a. Store up to 1000 transactions during periods of communication loss between the controller and access-control devices for subsequent upload to the central station on restoration of communication.

6. Controller Power: NFPA 70, Class II power-supply transformer, with 12- or 24-V ac secondary, backup battery and charger.

a. Backup Battery: Premium, valve-regulated, recombinant-sealed, lead-calcium battery; spill proof; with a full one-year warranty and a pro rata 19-year warranty. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.

b. Backup Battery: Valve-regulated, recombinant-sealed, lead-acid battery; spill proof. With single-stage, constant-voltage-current, limited battery charger, comply with battery manufacturer's written instructions for battery terminal voltage and charging current recommendations for maximum battery life.

c. Backup Power-Supply Capacity: 90 minutes of battery supply. Submit battery and charger calculations.

d. Power Monitoring: Provide manual, dynamic battery-load test, initiated and monitored at the control center; with automatic disconnection of the controller when battery voltage drops below controller limits. Report by using local controller-mounted digital displays and by communicating status to central station. Indicate normal

power on and battery charger on trickle charge. Indicate and report the following:

i. Trouble Alarm: Normal power-off load assumed by battery.

ii. Trouble Alarm: Low battery.

iii. Alarm: Power off.

2.11 CARD READERS, CREDENTIAL CARDS, AND KEYPADS

A. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not dissipate more than 5 W.

B. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

C. Enclosure: Suitable for surface, semi-flush, pedestal, or weatherproof mounting. Mounting types shall additionally be suitable for installation in the following locations:

1. Indoors, controlled environment.

2. Indoors, uncontrolled environment.

3. Outdoors, with built-in heaters or other cold-weather equipment to extend the operating temperature range as needed for operation at the site.

D. Display: Digital visual indicator shall provide visible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

E. Stripe Swipe Readers: Bidirectional, reading cards swiped in both directions, powered by the controller. Reader shall be set up for ABA Track.

1. ABA Track: Magnetic stripe that is encoded on track 2, at 75-bpi density in binary-coded decimal format; for example, 5-bit, 16-character set.

2. Readers for outdoors shall be in a polymeric plastic enclosure with all electronics potted in plastic. Rated for operation in ambient conditions of minus 40 to plus 160 deg F (minus 40 to plus 70 deg C) in a humidity range of 10 to 90 percent.

F. Wiegand Swipe Reader: Set up for 33-bit data cards. Comply with Security Industry Association's (SIA) AC-01.

G. Wiegand Key-Insert Reader: Set up for 33-bit data cards.

H. Bar-Code Reader: Set up for Code 128.

I. Insert Readers: Requiring the card to be inserted from the side, powered by the controller.

J. Touch-Plate and Proximity Readers:

1. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card.

2. Passive-detection proximity card readers shall use a swept-frequency, RF field generator to read the resonant frequencies of tuned circuits laminated into compatible credential cards. The resonant frequencies read shall constitute a unique identification code number.

3. The card reader shall read proximity cards in a range from direct contact to at least 6 inches (150 mm) from the reader.

K. Keypads:

1. Entry-control keypads shall use a unique combination of alphanumeric and other symbols as an Identifier.

2. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII-code ordinal sequence.

3. Communication protocol shall be compatible with the local processor.

L. Keypad Display:

1. Keypads shall include a digital visual indicator and shall provide visible status indications and user prompts.

2. Display shall indicate power on or off and whether user passage requests have been accepted or rejected.

3. Design of the keypad display or keypad enclosure shall limit viewing angles of the keypad as follows:

a. Maximum Horizontal Viewing Angle: Plus or minus 5

degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.

b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

M. Keypad Response Time:

1. The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 ms or less from the time the last alphanumeric symbol is entered until a response signal is generated.

N. Keypad Power:

1. The keypad shall be powered from the source as shown and shall not dissipate more than 150 W.

O. Keypad Mounting Method:

1. Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

P. Keypad Duress Codes:

1. Keypads shall provide a means for users to indicate a duress situation by entering a special code.

Q. Keypad and Wiegand-Swipe-Reader Combination: Designed to require an entry on the keypad before presenting the credential card.

1. Keypad: Allow the entry of four numeric digits that are associated with a specific credential. Keypads shall contain an integral alphanumeric/special symbol keyboard with symbols arranged in ascending ASCII-code ordinal sequence. Keypad display or enclosure shall limit viewing angles of the keypad as follows:

a. Maximum Horizontal Viewing Angle: Plus or minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display.

b. Maximum Vertical Viewing Angle: Plus or minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

2. Wiegand Swipe Reader: Set up for **33**-bit data cards to generate a unique card identification code. Comply with Security Industry Association's (SIA) AC-01.

R. Communication Protocol: Compatible with local processor.

S. Touch-Plate and Contactless Card Reader: The reader shall have "flash" download capability to accommodate card format changes. The card reader shall have capability of transmitting data to security control panel and shall comply with the International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) ISO/IEC 7816 series.

T. Credential Card Modification: Entry-control cards shall be able to be modified by lamination direct print process during the enrollment process without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the badge holder used at the site.

U. Card Size and Dimensional Stability: Credential cards shall be 2-1/8 by 3-3/8 inches (54 by 86 mm). The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

V. Card Material: Abrasion resistant, nonflammable, nontoxic, and impervious to solar radiation and effects of ultraviolet light.

W. Card Construction:

1. Core and laminate or monolithic construction.

2. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.

3. Incorporate holographic images as a security enhancement.

4. Furnish equipment for on-site assembly and lamination of credential cards.

2.12 ENROLLMENT CENTER

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Applied Wireless Identifications Group, Inc.

2. Autostar Technology Pte Ltd.

3. Digital Monitoring Products.

4. IDenticard Systems.

5. ISONAS, Inc.

6. Ultra Electronics.

7. Schalgeme.

B. Equipment for enrolling personnel into, and removing personnel from, system database, using central-station equipment.

1. Include equipment to enroll selected biometric credentials.

C. Enrollment equipment shall support encoding of credential cards including cryptographic and other internal security checks as required for system.

1. Allow only authorized entry-control enrollment personnel to access the enrollment equipment using passwords.

2. Include enrollment-subsystem configuration controls and electronic diagnostic aids for subsystem setup and troubleshooting with the central station.

3. Enrollment-station records printer shall meet requirements of the report printer.

D. Entry-Control Enrollment Software:

1. Shall include database management functions for the system, and shall allow an operator to change and modify the data entered in the system as needed.

2. Software shall not have alarm response or acknowledgment functions as a programmable function.

3. Multiple, password-protected access levels shall be provided at the enrollment station.

4. Database management and modification functions shall require a higher operator-access level than personnel enrollment functions.

5. Software shall provide a means for disabling the enrollment station when it is unattended, to prevent unauthorized use.

6. Software shall provide a method to enter personnel identifying information into the entry-control database files through enrollment stations to include a credential unit in use at the installation.

7. In the case of personnel identity-verification subsystems, this data shall include biometric data.

8. Software shall allow entry of this data into the system database files through the use of simple menu selections and data fields.

The data field names shall be customized to suit user and site needs.

9. Personnel identity-verification subsystems selected for use with the system shall fully support the enrollment function and shall be compatible with the entry-control database files.

E. Accessories:

1. Steel desk-type console, swivel chair on casters, and equipment racks.

2. Console and Equipment Racks: Comply with EIA/ECA-310-E.

3. Equipment, with the exception of the printers, shall be rack mounted in the console and equipment racks.

4. Storage Cabinet: Locking cabinet approximately 72 inches (1830 mm) high, 36 inches (915 mm) wide, and 24 inches (610 mm) deep, with three adjustable shelves and two storage racks for storage of disks, tapes, printouts, printer paper, ribbons, manuals, and other documentation.

F. System Capacity: Number of badges shall be limited only by hard disk space. Badge templates and images shall be in color, supporting the maximum color capability of Microsoft Windows.

G. Badge Configuration:

1. Software for badge template creation shall include a template consisting of background and predetermined locations of photographs, text objects and data fields for text, and bar-code and biometric information. Include automatic sizing of data fields placed on a badge to compensate for names, which may otherwise be too large to fit in the area designated.

2. Allow different badge templates to be used for each department, tenant, or visitor.

3. As a setup option, templates shall be automatically selected for the badge, based on the group to which the credential holder is assigned. Allow the operator to override the automatic template selection and use a template chosen by the operator for creating a badge.

4. Setup shall determine which graphics and credential-holder information will be displayed and where on the card it will be placed. All data in the security access system, such as name, code, group, access level, and any of the 99 user-defined fields, shall be

selectable, with the ability to place them anywhere on the card.

5. System shall include an importing, filing, and recall system of stored images and shapes that can be placed on the badge.

6. Allow multiple images on the same badge, including, but not limited to, bar codes, digital photos, and signatures.

7. Support transparent backgrounds so that image is only surrounded by the intended background and not by its immediate background.

H. Photo Imaging: Integral to security access.

1. Import images from bitmap file formats, digital cameras, TWAIN cameras, or scanners. Allow image cropping and editing, WYSIWYG badge-building application, and badge print-preview and printing capabilities.

2. System shall support multiple images stored for each credential holder, including signatures, portrait views, and profile views.

I. Text Objects: Badge configuration shall provide for creation of custom text as an object, allowing font selection, typing, scaling, and formatting of the text object. Formatting options shall include changing font, font size, text flow, and text alignment; bending or curving the text object into a circle or semicircle; applying 3-D effects; and applying predefined effects such as tilt, extrusion, or beveling. Text shall be placed and optionally automatically centered within any region of the badge layout.

J. Badges and Credential Cards:

1. Badges are credential cards that do not contain data to be read by card readers.

2. Credential cards shall store uniquely coded data used by card readers as an Identifier.

a. Magnetic-Stripe Cards: Comply with ISO/IEC 7810, ISO/IEC 7811-1, ISO/IEC 7811-2, ISO/IEC 7811-6, and ISO/IEC 7811-7. Use single-layer magnetic tape material that is coated with a plastic, slick protective coat and affixed to the back of the credential card near the top.

b. Wiegand Wire-Effect Cards: Ferromagnetic wires laminated into the credential card using binary digits specified for Wiegand readers to generate a unique credential card identification code.

c. Proximity Cards: Use proximity detection without physical

contact with the reader for proper operation.

3. Allow entry-control card to be modified by lamination or direct print process during the enrollment process for use as a picture and identification badge without reduction of readability. The design shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type of badge holder used at the site.

a. Card Size and Dimensional Stability: Standard size, 2-1/8 by 3-3/8 inches (54 by 86 mm); dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

b. Card Material: Abrasion resistant, nonflammable, and nontoxic; and impervious to solar radiation and effects of ultraviolet light.

c. Card Construction: Core and laminate or monolithic construction. Lettering, logos, and other markings shall be hot stamped into the credential material or direct printed.

i. Incorporate holographic images as a security enhancement.

ii. Furnish equipment for on-site assembly and lamination of credential cards.

d. Card Durability and Maintainability: Designed and constructed to yield a useful lifetime of at least five years or 5000 insertions or swipes, whichever results in a longer period of time. Allow credential cards to be cleaned by wiping with a sponge or cloth wetted with soap and water.

K. Card-Making Equipment: Consisting of a workstation, video camera, video-imaging equipment, and a printer.

1. Camera: NTSC color standard, RGB video output, 470 lines minimum horizontal resolution, and automatic white balance with full rated output under illumination of 0.5 fc (5 lx).

2. Video Imaging: Live-image capture software and hardware and a digital signature capture pad.

3. Standard workstation, modified as follows:

a. Redundant workstation is not required.

b. Printer is not required.

c. UPS is not required.

d. Sound card is not required.

4. Printer: Dye-sublimation resin thermal transfer, 300 dpi resolution, 16.7 million colors, accepting cards ranging in size from 2.1 by 3 inchesto 2.6 by 3.7 inches (53 by 76 mm to 66 by 94 mm) and having card thickness ranging from 0.020 to 0.060 inch (0.5 to 1.5 mm). Printer shall have options for encoding magnetic stripe using tracks 1, 2, and 3. Throughput shall be not less than **60** seconds per card.

2.13 PUSH-BUTTON SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Securitron Magnalock Corporation; an ASSA ABLOY Group company.

B. Push-Button Switches: Momentary-contact back-lighted push buttons with stainless-steel switch enclosures.

C. Electrical Ratings:

1. Minimum continuous current rating of 10 A at 120-V ac or 5 A at 240-V ac.

2. Contacts that will make 720 VA at 60 A and that will break at 720 VA at 10 A.

D. Enclosures: Flush or surface mounting. Push buttons shall be suitable for flush mounting in the switch enclosures.

E. Enclosures shall additionally be suitable for installation in the following locations:

1. Indoors, controlled environment.

2. Indoors, uncontrolled environment.

3. Outdoors.

F. Power: Push-button switches shall be powered from their associated controller, using dc control.

2.14 DOOR AND GATE HARDWARE INTERFACE

A. Exit Device with Alarm: Operation of the exit device shall generate an alarm and annunciate a local alarm. Exit device and alarm contacts are

specified in Section 08710 "Door Hardware."

B. Exit Alarm: Operation of a monitored door shall generate an alarm. Exit devices and alarm contacts are specified in Section 08710 "Door Hardware."

C. Electric Door Strikes: Use end-of-line resistors to provide power-line supervision. Signal switches shall transmit data to controller to indicate when the bolt is not engaged and the strike mechanism is unlocked, and they shall report a forced entry. Power and signal shall be from the controller. Electric strikes are specified in Section 08710 "Door Hardware."

D. Electromagnetic Locks: End-of-line resistors shall provide power-line supervision. Lock status sensing signal shall positively indicate door is secure. Power and signal shall be from the controller. Electromagnetic locks are specified in Section 08710 "Door Hardware."

2.15 FIELD-PROCESSING SOFTWARE

A. Operating System:

1. Local processors shall contain an operating system that controls and schedules that local processor's activities in real time.

2. Local processor shall maintain a point database in its memory that includes parameters, constraints, and the latest value or status of all points connected to that local processor.

3. Execution of local processor application programs shall utilize the data in memory resident files.

4. Operating system shall include a real-time clock function that maintains the seconds, minutes, hours, date, and month, including day of the week.

5. Local processor real-time clock shall be automatically synchronized with the central station at least once per day to plus or minus 10 seconds (the time synchronization shall be accomplished automatically, without operator action and without requiring system shutdown).

B. Startup Software:

1. Causes automatic commencement of operation without human intervention, including startup of all connected I/O functions.

2. Local processor restart program based on detection of power failure at the local processor shall be included in the local

processor software.

3. Initiates operation of self-test diagnostic routines.

4. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made.

5. If the database and application programs are resident, the local processor shall immediately resume operation.

C. Operating Mode:

1. Local processors shall control and monitor inputs and outputs as specified, independent of communications with the central station or designated workstations.

2. Alarms, status changes, and other data shall be transmitted to the central station or designated workstations when communications circuits are operable.

3. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station or designated workstations, shall be stored for later transmission to the central station or designated workstations.

4. Storage for the latest 4000 events shall be provided at local processors, as a minimum.

5. Local processors shall accept software downloaded from the central station.

6. Panel shall support flash ROM technology to accomplish firmware downloads from a central location.

D. Failure Mode: Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure-mode) state, consistent with the failure modes shown and the associated control device.

E. Functions:

1. Monitoring of inputs.

2. Control of outputs.

3. Reporting of alarms automatically to the central station.

4. Reporting of sensor and output status to central station upon request.

5. Maintenance of real time, automatically updated by the central station at least once a day.

6. Communication with the central station.

7. Execution of local processor resident programs.

8. Diagnostics.

9. Download and upload data to and from the central station.

2.16 FIELD-PROCESSING HARDWARE

A. Alarm Annunciation Local Processor:

1. Respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.

2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.

3. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.

4. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.

5. Local processor shall report line supervision alarms to the central station.

6. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 milliseconds.

7. Alarm condition shall be transmitted to the central computer during the next interrogation cycle.

8. Local processor outputs shall reflect the state of commands issued by the central station.

9. Outputs shall be a form C contact and shall include normally open

and normally closed contacts.

10. Local processor shall have at least four command outputs.

11. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.

B. Processor Power Supply:

1. Local processor and sensors shall be powered from an uninterruptible power source.

2. Uninterruptible power source shall provide eight hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored.

3. If the facility is without an emergency generator, the uninterruptible power source shall provide 24 hours of battery backup power.

4. There shall be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa.

5. Batteries shall be sealed, non-outgassing type.

6. Power supply shall be equipped with an indicator for ac input power and an indicator for dc output power.

7. Loss of primary power shall be reported to the central station as an alarm.

C. Auxiliary Equipment Power: A GFI service outlet shall be furnished inside the local processor's enclosure.

D. Entry-Control Local Processor:

1. Entry-control local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station, and change outputs based on commands received from the central station.

2. Local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.

3. Entry-control local processor shall provide local entry-control functions including communicating with field devices such as card

readers, keypads, biometric personnel identity-verification devices, door strikes, magnetic latches, gate and door operators, and exit push buttons.

4. Processor shall also accept data from entry-control field devices as well as database downloads and updates from the central station that include enrollment and privilege information.

5. Processor shall send indications of successful or failed attempts to use entry-control field devices and shall make comparisons of presented information with stored identification information.

6. Processor shall grant or deny entry by sending control signals to portal-control devices and mask intrusion-alarm annunciation from sensors stimulated by authorized entries.

7. Entry-control local processor shall use inputs from entry-control devices to change modes between access and secure.

8. Local processor shall maintain a date-time- and location-stamped record of each transaction and transmit transaction records to the central station.

9. Processor shall operate as a stand-alone portal controller using the downloaded database during periods of communication loss between the local processor and the central station.

10. Processor shall store a minimum of 4000 transactions during periods of communication loss between the local processor and the central station for subsequent upload to the central station upon restoration of communication.

11. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions.

12. Local processor shall have at least eight alarm inputs which allow wiring contacts as normally open or normally closed for alarm conditions; and shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements.

13. Local processor shall report line supervision alarms to the central station.

14. Alarms shall be reported for any condition that remains abnormal at an input for longer than 500 ms.

15. Alarm condition shall be transmitted to the central station during the next interrogation cycle.

16. Entry-control local processor shall include the necessary software drivers to communicate with entry-control field devices. Information generated by the entry-control field devices shall be accepted by the local processor and automatically processed to determine valid identification of the individual present at the portal.

17. Upon authentication of the credentials or information presented, the local processor shall automatically check privileges of the identified individual, allowing only those actions granted as privileges.

18. Privileges shall include, but are not limited to, time of day control, day of week control, group control, and visitor escort control. The local processor shall maintain a date-time- and location-stamped record of each transaction.

19. Transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

20. Local processor outputs shall reflect the state of commands issued by the central station.

21. Outputs shall be a form C contact and shall include normally open and normally closed contacts.

22. Local processor shall have at least four addressable outputs.

23. The entry-control local processor shall also provide control outputs to portal-control devices.

24. Local processor shall be able to communicate with the central station via RS-485 or TCP/IP as a minimum.

25. The system manufacturer shall provide strategies for downloading database information for panel configurations and cardholder data to minimize the required download time when using IP connectivity.

2.17 TIA 232-F ASCII INTERFACE SPECIFICATIONS

A. ASCII interface shall allow TIA 232-F connections to be made between the control station operating as the host PC and any equipment that will accept TIA 232-F ASCII command strings, such as CCTV switches, intercoms, and paging systems.

1. Alarm inputs in system shall allow for individual programming to output up to four unique ASCII character strings through two different COM ports on the host PC.

2. Inputs shall have the ability to be defined to transmit a unique ASCII string for alarm and one for restore through one COM port, and a unique ASCII string for a nonalarm, abnormal condition and one for a normal condition through the same or different COM port.

3. Predefined ASCII character strings shall have the ability to be up to 420 characters long with full use of all the ASCII control characters, such as return or line feed. Character strings shall be defined in the system database and then assigned to the appropriate inputs.

4. COM ports of the host PC used to interface with external equipment shall be defined in the setup portion of the software. COM port's baud rate, word length, stop bits, and parity shall be definable in the software to match that of the external equipment.

B. Pager-System Interface: Alarms shall be able to activate a pager system with customized message for each input alarm.

1. TIA 232-F output shall be capable of connection to a pager interface that can be used to call a paging system or service and send a signal to a portable pager. System shall allow an individual alphanumeric message per alarm input to be sent to the paging system. This interface shall support both numeric and alphanumeric pagers.

C. Alarm-System Interface:

1. TIA 232-F output shall be capable of transmitting alarms from other monitoring and alarm systems to central-station automation software.

2. Alternatively, alarms that are received by this access-control system are to be transferred to the alarm automation system as if they were sent through a digital alarm receiver.

a. System shall be able to transmit an individual message from any alarm input to a burglar-alarm automation monitoring system.

b. System shall be able to append to each message a predefined set of character strings as a prefix and a suffix.

2.18 FLOOR-SELECT ELEVATOR CONTROL

A. Elevator access control shall be integral to security access.

1. System shall be capable of providing full elevator security and control through dedicated controllers without relying on the control-station host PC for elevator control decisions.

2. Access-control system shall enable and disable car calls on each floor and floor-select buttons in each elevator car, restricting passengers' access to the floors where they have been given access.

3. System setup shall, through programming, automatically and individually secure and unsecure each floor-select button of a car by time and day. Each floor-select button within a car shall be separately controlled so that some floors may be secure while others remain unsecure.

4. When a floor-select button is secure, it shall require the passenger to use his or her access code and gain access to that floor before the floor-select button will operate. The passenger's credential shall determine which car call and floor-select buttons are to be enabled, restricting access to floors unless authorized by the system's access code database. Floor-select button shall be enabled only in the car where the credential holder is the passenger.

B. Security access system shall record which call button is pressed, along with credential and time information.

1. System controller shall record elevator access data.

2. The controller shall reset all additional call buttons that may have been enabled by the user's credential.

3. The floor-select elevator control shall allow for manual override from a workstation PC either by individual floor or by cab.

2.19 REAL-TIME GUARD TOUR

A. Guard tour module shall provide the ability to plan, track, and route tours. Module shall input an alarm during tour if guard fails to make a station. Tours can be programmed for sequential or random tour-station order.

1. Guard tour setup shall define specific routes or tours for the guard to take, with time restrictions in which to reach every predefined tour station.

2. Guard tour activity shall be automatically logged to the central-

station PC's hard drive.

3. If the guard is early or late to a tour station, a unique alarm per station shall appear at the central station to indicate the time and station.

4. Guard tour setup shall allow the tours to be executed sequentially or in a random order with an overall time limit set for the entire tour instead of individual times for each tour station.

5. Setup shall allow recording of predefined responses that will display for the operator at the control station should a "Failed to Check In" alarm occur.

B. Guard tour module shall allow proprietary direct-connected systems to use security access-control hardware to perform guard tour management in real time.

C. A tour station is a physical location where a guard shall go and perform an action indicating that he or she has arrived. This action, performed at the tour station, shall be one of 13 different events with any combination of station types within the same tour. An event at a tour station shall be one of the following types:

1. Access Granted.

2. Access Denied Code.

3. Access Denied Card plus PIN.

4. Access Denied Time Zone.

5. Access Denied Level.

6. Access Denied Facility.

7. Access Denied Code Timer.

8. Access Denied Anti-Passback.

9. Access Granted Passback Violation.

10. Alarm.

11. Restored.

12. Input Normal.

13. Input Abnormal.

D. Guard tour and other system features shall operate simultaneously with no interference.

E. Guard Tour Module Capacity: 999 possible guard tour definitions with each tour having up to 99 tour stations. System shall allow all 999 tours to be running at the same time.

2.20 VIDEO AND CAMERA CONTROL

A. Control station or designated workstation displays live video from a CCTV source.

1. Control Buttons: On the display window, with separate control buttons to represent Left, Right, Up, Down, Zoom In, Zoom Out, Scan, and a minimum of two custom-command auxiliary controls.

2. Provide at least seven icons to represent different types of cameras, with ability to import custom icons. Provide option for display of icons on graphic maps to represent their physical location.

3. Provide the alarm-handling window with a command button that will display the camera associated with the alarm point.

B. Display mouse-selectable icons representing each camera source, to select source to be displayed. For CCTV sources that are connected to a video switcher, control station shall automatically send control commands through a COM port to display the requested camera when the camera icon is selected.

C. Allow cameras with preset positioning to be defined by displaying a different icon for each of the presets. Provide control with Next and Previous buttons to allow operator to cycle quickly through the preset positions.

2.21 CABLES

A. General Cable Requirements: Comply with requirements in Section 16718 "Conductors and Cables for Electronic Safety and Security" and as recommended by system manufacturer for integration requirement.

B. PVC-Jacketed, TIA 232-F Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; PVC jacket.

2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

3. NFPA 70, Type CM.

4. Flame Resistance: UL 1581 vertical tray.

C. Plenum-Type, TIA 232-F Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum-foil/polyester-tape shielded pairs with 100 percent shield coverage; plastic jacket.

2. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

3. NFPA 70, Type CMP.

4. Flame Resistance: NFPA 262 flame test.

D. PVC-Jacketed, TIA 485-A Cables: Two pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.

E. Plenum-Type, TIA 485-A Cables:

1. Two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.

2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.

F. Multiconductor, PVC, Reader and Wiegand Keypad Cables:

1. No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CMG.

3. Flame Resistance: UL 1581 vertical tray.

4. For TIA 232-F applications.

G. Paired, PVC, Reader and Wiegand Keypad Cables:

1. Three pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum-

foil/polyester-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CM.

3. Flame Resistance: UL 1581 vertical tray.

H. Paired, PVC, Reader and Wiegand Keypad Cables:

1. Three pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum-foil/polyester-tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CM.

3. Flame Resistance: UL 1581 vertical tray.

I. Paired, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Three pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum-foil/polypropylene-tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.

2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.

J. Multiconductor, Plenum-Type, Reader and Wiegand Keypad Cables:

1. Six conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum-foil/polyester-tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.

2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.

K. Paired, Lock Cables:

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

2. NFPA 70, Type CMG.

3. Flame Resistance: UL 1581 vertical tray.

L. Paired, Plenum-Type, Lock Cables:

1. One pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.

M. Paired, Lock Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

2. NFPA 70, Type CMG.

3. Flame Resistance: UL 1581 vertical tray.

N. Paired, Plenum-Type, Lock Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.

2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.

O. Paired, Input Cables:

1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum-foil/polyester-tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.

2. NFPA 70, Type CMR.

3. Flame Resistance: UL 1666 riser flame test.

P. Paired, Plenum-Type, Input Cables:

1. One pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum-foil/polyester-tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.

2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.

Q. Paired, AC Transformer Cables:

1. One pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.

2. NFPA 70, Type CMG.

R. Paired, Plenum-Type, AC Transformer Cables:

1. One pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.

2. NFPA 70, Type CMP.

3. Flame Resistance: NFPA 262 flame test.

S. Elevator Travel Cables:

1. Steel center core with shielded, twisted pairs, No. 20 AWG conductor size.

2. Steel center core support shall be preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.

3. Shielded pairs shall be insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.

4. Electrical grade, dry jute filler.

5. Helically wound synthetic fiber binder.

6. Rayon or cotton braid applied with 95 percent coverage.

7. 60 deg C PVC jacket specifically compounded for flexibility and abrasion resistance; and complying with UL VW-1 and CSA FT1 flame rated.

T. LAN Cabling:

1. Comply with requirements in Section 16718 "Conductors and Cables for Electronic Safety and Security."

2. NFPA 262.

2.22 TRANSFORMERS

A. NFPA 70, Class II control transformers, NRTL listed. Transformers for security access-control system shall not be shared with any other system.

2.23 CABLE AND ASSET MANAGEMENT SOFTWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenlee Textron Inc.; a subsidiary of Textron Inc.

2. Total Wire Software Company, Inc.

B. Computer-based cable and asset management system, with fully integrated database and graphic capabilities, complying with requirements in TIA/EIA 606-A.

1. Document physical characteristics by recording the network, asset, user, TIA/EIA details, device configurations, and exact connections between equipment and cabling.

a. Manage the physical layer of security system.

b. List device configurations.

c. List and display circuit connections.

d. Record firestopping data.

e. Record grounding and bonding connections and test data.

2. Information shall be presented in database view, schematic plans, or technical drawings.

a. Microsoft Visio Technical Drawing shall be used as drawing and schematic plans software. Drawing symbols, system layout, and design shall comply with SIA/IAPSC AG-01.

3. System shall interface with the following testing and recording devices:

a. Direct-upload tests from circuit testing instrument into the PC.

b. Direct-download circuit labeling into labeling printer.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with TIA/EIA 606-A, "Administration Standard for Commercial Telecommunications Infrastructure."

C. Obtain detailed Project planning forms from manufacturer of access-control system; develop custom forms to suit Project. Fill in all data available from Project plans and specifications and publish as Project planning documents for review and approval.

1. Record setup data for control station and workstations.

2. For each Location, record setup of controller features and access requirements.

3. Propose start and stop times for time zones and holidays, and match up access levels for doors.

4. Set up groups, facility codes, linking, and list inputs and outputs for each controller.

5. Assign action message names and compose messages.

6. Set up alarms. Establish interlocks between alarms, intruder detection, and video surveillance features.

7. Prepare and install alarm graphic maps.

8. Develop user-defined fields.

9. Develop screen layout formats.

10. Propose setups for guard tours and key control.

11. Discuss badge layout options; design badges.

12. Complete system diagnostics and operation verification.

13. Prepare a specific plan for system testing, startup, and demonstration.

14. Develop acceptance test concept and, on approval, develop specifics of the test.

D. In meetings with Architect and Owner, present Project planning documents and review, adjust, and prepare final setup documents. Use final documents to set up system software.

3.03 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Construction."

B. Install cables and wiring according to requirements in Section 16718 "Conductors and Cables for Electronic Safety and Security."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5E rating of components and fiber-optic rating of components, and that ensure Category 6 and fiber-optic performance of completed and linked signal paths, end to end.

F. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

G. Install end-of-line resistors at the field device location and not at the controller or panel location.

3.04 CABLE APPLICATION

A. Comply with TIA 569-B, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. TIA 232-F Cabling: Install at a maximum distance of 50 ft. (15 m).

D. TIA 485-A Cabling: Install at a maximum distance of 4000 ft. (1220 m).

E. Card Readers and Keypads:

1. Install number of conductor pairs recommended by manufacturer for the functions specified.

2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft. (75 m), and install No. 20 AWG wire if maximum distance is 500 ft. (150 m).

3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.

4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

F. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 250 ft. (75 m).

G. Install minimum No. 18 AWG ac power wire from transformer to controller, with a maximum distance of 25 ft. (8 m).

3.05 GROUNDING

A. Comply with Section 16060 "Grounding and Bonding."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:

1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.

2. Bus: Mount on wall of main equipment room with standoff insulators.

3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.06 INSTALLATION

A. Push Buttons: Where multiple push buttons are housed within a single switch enclosure, they shall be stacked vertically with each push-button switch labeled with 1/4-inch- (6.4-mm-) high text and symbols as required. Push-button switches shall be connected to the controller associated with the portal to which they are applied, and shall operate the appropriate electric strike, electric bolt, or other facility release device.

B. Install card readers, keypads, push buttons, and biometric readers.

3.07 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Section 16075 "Electrical Identification" and with TIA/EIA 606-A.

B. Using software specified in "Cable and Asset Management Software" Article, develop cable administration drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.

C. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.

2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

D. At completion, cable and asset management software shall reflect as-built conditions.

3.08 SYSTEM SOFTWARE AND HARDWARE

A. Develop, install, and test software and hardware, and perform database tests for the complete and proper operation of systems involved. Assign software license to Owner.

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 5 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA 568-B.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for UTP cables must comply with minimum criteria in TIA/EIA 568-B.1.

2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Devices and circuits will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved

procedures that were developed in "Preparation" Article and with manufacturer's written instructions.

2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

3.11 PROTECTION

A. Maintain strict security during the installation of equipment and software. Rooms housing the control station, and workstations that have been powered up shall be locked and secured with an activated burglar alarm and access-control system reporting to a central station complying with UL 1610, "Central-Station Burglar-Alarm Units," during periods when a qualified operator in the employ of Contractor is not present.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain security access system. See Section 01820 "Demonstration and Training."

B. Develop separate training modules for the following:

1. Computer system administration personnel to manage and repair the LAN and databases and to update and maintain software.

2. Operators who prepare and input credentials to man the control station and workstations and to enroll personnel.

3. Security personnel.

4. Hardware maintenance personnel.

5. Corporate management.

PART 4: MEASUREMENT AND PAYMENT

4.01 SECURITY ACCESS SYSTEM:

A. Security Access System will not be measured for payment.

B. Security Access System will not be paid for directly, but will be included in the lump sum bid price for Maintenance Building.

4.02 POWER SUPPLIES:

A. Power supplies will be measured for at the contract unit price bid per each.

B. Power supplies will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 13760

VIDEO SURVEILLANCE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. CCTV Cameras, control station and flat screen TV monitors will be furnished and installed by the MTA. The Contractor shall furnish and install the control staion rack, conduit, wiring, camera supports and remainder of the Video Surveillance System. The CCTV camera details provided in the Specification are for informational purposes to facilitate installation of the camera supports, the conduit and wiring.

B. Section includes a video surveillance system consisting of cameras, network video recorders (NVR) and data transmission wiring.

C. Video surveillance system shall be integrated with monitoring and control system specified in Section 13720 "Intrusion Detection," Section 13730 "Security Access," which specifies systems integration.

1.03 DEFINITIONS

A. AGC: Automatic gain control.

B. BNC: Bayonet Neill-Concelman - type of connector.

C. B/W: Black and white.

D. CCD: Charge-coupled device.

E. FTP: File transfer protocol.

F. IP: Internet protocol.

G. LAN: Local area network.

H. MPEG: Moving picture experts group.

I. NTSC: National Television System Committee.

J. PC: Personal computer.

K. PTZ: Pan-tilt-zoom.

L. RAID: Redundant array of independent disks.

M. TCP: Transmission control protocol - connects hosts on the Internet.

N. UPS: Uninterruptible power supply.

O. WAN: Wide area network.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Video surveillance system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For video surveillance. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Functional Block Diagram: Show single-line interconnections between components for signal transmission and control. Show cable types and sizes.

3. Dimensioned plan and elevations of equipment racks, control panels, and consoles. Show access and workspace requirements.

4. UPS: Sizing calculations.

5. Wiring Diagrams: For power, signal, and control wiring.

C. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit

output responses to an alarm.

1.06 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For video surveillance, cameras, camera-supporting equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

C. Warranty: Sample of special warranty.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cameras, power supplies, infrared illuminators, monitors, videotape recorders, digital video recorders, video switches, and control-station components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Lists of spare parts and replacement components recommended to be stored at the site for ready access.

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NECA 1.

C. Comply with NFPA 70.

D. Electronic data exchange between video surveillance system with an access-control system shall comply with SIA TVAC.

1.09 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following

environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Control Station: Rated for continuous operation in ambient temperatures of 60 to 85 deg F (16 to 29 deg C) and a relative humidity of 20 to 80 percent, noncondensing.

2. Interior, Controlled Environment: System components, except central-station control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient temperatures of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. Use NEMA 250, Type 1 enclosures.

3. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph (137 km/h) and snow cover up to 24 inches (610 mm) thick. Use NEMA 250, Type 4X enclosures.

4. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers shall be rated, listed, and installed according to NFPA 70.

5. Corrosive Environment: System components subject to corrosive fumes, vapors, and wind-driven salt spray in coastal zones. Use NEMA 250, Type 4X enclosures.

6. Security Environment: Camera housing for use in high-risk areas where surveillance equipment may be subject to physical violence.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of cameras, equipment related to camera operation, and control-station equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SYSTEM REQUIREMENTS

A. Video-signal format shall comply with NTSC standard, composite interlaced video. Composite video-signal termination shall be 75 ohms.

B. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor's entry connection to components.

1. Minimum Protection for Power Connections 120 V and More: Auxiliary panel suppressors complying with requirements in Section 16289 "Surge Protection for Low-Voltage Electrical Power Circuits."

2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Connections: Comply with requirements in Section 16289 "Surge Protection for Low-Voltage Electrical Power Circuits" as recommended by manufacturer for type of line being protected.

C. Tamper Protection: Tamper switches on enclosures, control units, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled. Control-station, control-unit alarm display shall identify tamper alarms and indicate locations.

2.02 STANDARD CAMERAS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sony (Basis of Design)

2. Panasonic Corporation of North America; Panasonic Security Systems.

3. Pelco.

4. Samsung Opto-Electronics.

B. B/W Camera:

1. Comply with UL 639.

2. Pickup Device: CCD interline transfer, 252,000 512(H) by 492(V) pixels.

3. Horizontal Resolution: 380 lines.

4. Signal-to-Noise Ratio: Not less than 46 dB.

5. With AGC, manually selectable on or off.

6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.

7. Manually selectable modes for backlight compensation or normal lighting.

8. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

9. Motion Detector: Built-in digital.

C. Color Camera shall meet the minimum specifications of the SONY DH-180 camera:

1. Comply with UL 639.

2. Pickup Device: CCD interline transfer, 380,000 771(H) by 492(V) pixels.

3. Horizontal Resolution: 480 lines.

4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.

5. With AGC, manually selectable on or off.

6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.

7. Manually selectable modes for backlight compensation or normal lighting.

8. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

9. White Balance: Auto-tracing white balance, with manually settable fixed balance option.

10. Motion Detector: Built-in digital.

D. Automatic Color Dome Camera: Assembled and tested as a manufactured unit, containing dome assembly, color camera, motorized pan and tilt, zoom lens, and receiver/driver.

1. Comply with UL 639.

2. Pickup Device: CCD interline transfer, 380,000 768(H) by 494(V) pixels.

3. Horizontal Resolution: 480 lines.

4. Signal-to-Noise Ratio: Not less than 50 dB, with camera AGC off.

5. With AGC, manually selectable on or off.

6. Sensitivity: Camera shall deliver 1-V peak-to-peak video signal at the minimum specified light level. Illumination for the test shall be with lamps rated at approximately 2200-K color temperature, and with camera AGC off.

7. Manually selectable modes for backlight compensation or normal lighting.

8. Pan and Tilt: Direct-drive motor, 360-degree rotation angle, and 180-degree tilt angle. Pan-and-tilt speed shall be controlled by operator. Movement from preset positions shall be not less than 300 degrees per second.

9. Preset Positioning: Eight user-definable scenes, each allowing 16-character titles. Controls shall include the following:

a. In "sequence mode," camera shall continuously sequence through preset positions, with dwell time and sequencing under operator control.

b. Motion detection shall be available at each camera position.

c. Up to four preset positions may be selected to be activated by an alarm. Each of the alarm positions may be programmed to output a response signal.

10. Scanning Synchronization: Determined by external synch over the coaxial cable. Camera shall revert to internally generated synchronization on loss of external synch signal.

11. White Balance: Auto-tracing white balance, with manually settable fixed balance option.

12. Motion Detector: Built-in digital.

13. Dome shall support multiplexed control communications using coaxial cable recommended by manufacturer.

2.03 LENSES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sony (Basis of design)

2. Panasonic Corporation of North America; Panasonic Security Systems.

3. Pelco.

4. Samsung Opto-Electronics.

5. Fujitsu.

B. Description: Optical-quality coated lens, designed specifically for video-surveillance applications and matched to specified camera. Provide color-corrected lenses with color cameras.

1. Auto-Iris Lens: Electrically controlled iris with circuit set to maintain a constant video level in varying lighting conditions.

2. Fixed Lens: With calibrated focus ring.

3. Zoom Lens: Motorized, remote-controlled unit, rated as "quiet operating." Features include the following:

a. Electrical Leads: Filtered to minimize video signal interference.

b. Motor Speed: Variable.

c. Lens shall be available with preset positioning capability to recall the position of specific scenes.

2.04 POWER SUPPLIES

A. Low-voltage power supplies matched for voltage and current requirements of cameras and accessories, and of type as recommended by manufacturer of camera**,** infrared illuminator**,** and lens.

1. Enclosure: NEMA 250, Type 1, unless otherwise indicated.

2.05 INFRARED ILLUMINATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Honeywell International Inc.; Honeywell Video Systems.

2. International Space Optics; Rainbow CCTV products.

3. Merit Li-Lin (USA) Corp.

4. Visiontech.

5. Watec America Corporation.

B. Description: Lighting fixtures that emit light only in the infrared spectrum, suitable for use with cameras indicated, for nighttime surveillance, without emitting visible light.

1. Field-Selectable Beam Patterns: Narrow, medium, and wide.

2. Rated Lamp Life: More than 8000 hours.

3. Power Supply: 12-V ac/dc.

C. Area Coverage: Illumination to 150 feet (50 m) in a narrow beam pattern.

D. Exterior housings shall be suitable for same environmental conditions as the associated camera.

2.06 CAMERA-SUPPORTING EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sony.(Basis of design)

2. Panasonic Corporation of North America; Panasonic Security Systems.

3. Pelco.

4. Samsung Opto-Electronics.

B. Minimum Load Rating: Rated for load in excess of the total weight supported times a minimum safety factor of two.

C. Mounting Brackets for Fixed Cameras: Type matched to items supported and mounting conditions. Include manual pan-and-tilt adjustment.

D. Protective Housings for Fixed and Movable Cameras: Steel or 6061 T6 aluminum enclosures with internal camera mounting and connecting provisions that are matched to camera/lens combination and mounting and installing arrangement of camera to be housed.

1. Tamper switch on access cover sounds an alarm signal when unit is opened or partially disassembled. Central-control unit shall identify tamper alarms and indicate location in alarm display. Tamper switches and central-control unit are specified in Section 13720 "Intrusion Detection."

2. Camera Viewing Window: Lexan window, aligned with camera lens.

3. Duplex Receptacle: Internally mounted.

4. Alignment Provisions: Camera mounting shall provide for field aiming of camera and permit removal and reinstallation of camera lens without disturbing camera alignment.

5. Built-in, thermostat-activated heater and blower units. Units shall be automatically controlled so the environmental limits of the camera equipment are not exceeded.

6. Sun shield shall not interfere with normal airflow around the housing.

7. Mounting bracket and hardware for wall or ceiling mounting of the housing. Bracket shall be of same material as the housing; mounting hardware shall be stainless steel.

8. Finish: Housing and mounting bracket shall be factory finished using manufacturer's standard finishing process suitable for the environment.

2.07 NETWORK VIDEO RECORDERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sony.(Basis of Design)

2. Panasonic Corporation of North America; Panasonic Security Systems.

3. Pelco.

4. Samsung Opto-Electronics.

B. External storage or internal 250-1, 500-GB hard disk drive and shall meet thespecifications for the Aralia servers (ARA32000).

1. Video and audio recording over TCP/IP network.

2. Video recording of MPEG-2 and MPEG-4 streams.

3. Video recording up to 48 Mbps for internal storage and up to 100 Mbps for external storage.

4. Duplex Operation: Simultaneous recording and playback.

5. Continuous and alarm-based recording.

6. Full-Featured Search Capabilities: Search based on camera, time, or date.

7. Automatic data replenishment to ensure recording even if network is down.

8. Digital certification by watermarking.

9. Internal RAID storage or non-RAID storage of up to 1500 GB.

10. Capable of adding external RAID storage up to 7000 GB for models with no internal storage.

11. Full integration with LAN, Intranet, or Internet through standard Web browser or video management software.

12. Integrated Web server FTP server functionality.

13. Supports up to 16**,** 32, or 64 devices.

2.08 DIGITAL SWITCHERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. Sony.(Basis of design)

2. Panasonic Corporation of North America; Panasonic Security Systems.

3. Pelco.

4. Samsung Opto-Electronics.

B. Quad Switch: For displaying images from four cameras on a single

monitor. Provide color switcher if one or more cameras or monitors are in color.

1. Controls: Unit-mounted front panel.

2. Resolution: 720 by 480 lines.

3. Modes: Auto, manual, and alarm. In manual mode, each channel can also be viewed in single display mode. In the event of an alarm, alarming channel shall automatically switch to full screen. If several alarms are activated, channels in alarm shall be in auto-switching mode.

4. Channel Loss Alarm: Audible buzzer; occurrence details shall be recorded.

5. Time: Indicate date and time.

6. Timing of Auto-Switcher: 1 to 30 seconds, selectable.

7. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E, or freestanding desktop.

C. Manual Switch Bank: Low-loss, high-isolation, multiple-video switch to allow manual switching of multiple quad switches and cameras to a single output. Switches shall be illuminated.

D. Sequential Switchers: Automatically sequence outputs of multiple cameras to single monitor and videotape recorder.

1. Switching Time Interval: Continuously adjustable, 5 to 20 seconds minimum, with manual override.

2. Skip-Sequential-Hold Switch: One for each camera, with LED to indicate active camera.

3. Camera Identification Legend: Either on-screen message or label at skip-sequential switch.

4. Alarm Switching: In the event of an alarm, alarming channel shall automatically switch the monitor to full screen.

5. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.

2.09 IP VIDEO SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following and will interface with the Aralia

Systems:

1. Sony.

2. Panasonic Corporation of North America; Panasonic Security Systems.

3. Pelco.

4. Samsung Opto-Electronics.

B. Description:

1. System shall provide high-quality delivery and processing of IP-based video, audio, and control data using standard Ethernet-based networks.

2. System shall have seamless integration of all video surveillance and control functions.

3. Graphical user interface software shall manage all IP-based video matrix switching and camera control functions, two-way audio communication, alarm monitoring and control, and recording and archive/retrieval management. IP system shall also be capable of integrating into larger system environments.

4. System design shall include all necessary compression software for high-performance, dual-stream, MPEG-2/MPEG-4 video. Unit shall provide connections for all video cameras, camera PTZ control data, bidirectional audio, discreet sensor inputs, and control system outputs.

5. All camera signals shall be compressed, encoded, and delivered onto the network for processing and control by the IP video-management software.

6. Camera system units shall be ruggedly built and designed for extreme adverse environments, complying with NEMA Type environmental standards.

7. Encoder/decoder combinations shall place video, audio, and data network stream that can be managed from multiple workstations on the user's LAN or WAN.

8. All system interconnect cables, workstation PCs, PTZ joysticks, and network intermediate devices shall be provided for full performance of specified system.

2.10 VIDEO MOTION SENSORS (INTERIOR)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AXCESS International Inc.

2. ICU Security, Inc.

3. Tyco International Limited; Sensormatic products.

4. Visiontech.

B. Device Performance: Detect changes in video signal within a user-defined protected zone. Video inputs shall be composite video as defined in SMPTE 170M. Provide an alarm output for each video input.

1. Detect movement within protected zone of intruders wearing clothing with a reflectivity that differs from that of background scene by a factor of two. Reject all other changes in video signal.

2. Modular design that allows for expansion or modification of number of inputs.

3. Controls:

a. Size of detection zones.

b. Sensitivity of detection of each protected zone.

4. Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.

2.11 CONTROL STATIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sony.(Basis of design)

2. Panasonic Corporation of North America; Panasonic Security Systems.

3. Pelco.

4. Samsung Opto-Electronics.

B. Description: Heavy-duty, freestanding, modular, metal furniture units arranged to house electronic equipment. Coordinate component

arrangement and wiring with components and wiring of other systems.

C. Equipment Mounting: Standard 19-inch (483-mm) rack complying with CEA 310-E.

D. Normal System Power Supply: 120 V, 60 Hz, through a locked disconnect device and an isolation transformer in central-station control unit. Central-station control unit shall supply power to all components connected to it unless otherwise indicated.

E. Power Continuity for Control Station: Batteries in power supplies of central-station control units and individual system components shall maintain continuous system operation during outages of both normal and backup ac system supply.

1. Batteries: Rechargeable, valve-regulated, recombinant, sealed, lead-acid type with nominal 10-year life expectancy. Capacity adequate to operate portions of system served including audible trouble signal devices for up to four hours and audible and visual alarm devices under alarm conditions for an additional 10 minutes.

2. Battery Charger: Solid-state, fully automatic, variable-charging-rate type. Charger shall recharge fully discharged battery within 24 hours.

F. Annunciation: Indicate change in system condition and switching of system or component to backup power.

G. The Contractor shall provide the control station rack. The control station rack shall be a Mid-Atlantic #WMRK-4242SVR, or equal.

2.12 SIGNAL TRANSMISSION COMPONENTS

A. Cable: CAT5E and CAT6 cable . Comply with requirements in Section 16718 "Conductors and Cables for Electronic Safety and Security."

B. Video Surveillance CAT5E and CAT6 Cable Connectors: Comply with requirements in Section 16718 "Conductors and Cables for Electronic Safety and Security.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.

B. Examine roughing-in for LAN, WAN, and IP network before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 WIRING

A. Comply with requirements in Section 16130 "Raceways and Boxes."

B. Wiring Method: Install cables in raceways unless otherwise indicated.

1. Except raceways are not required in accessible indoor ceiling spaces and attics.

2. Except raceways are not required in hollow gypsum board partitions.

3. Conceal raceways and wiring except in unfinished spaces.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

E. For LAN connection and fiber-optic and copper communication wiring, comply with Section 16716 "Communications Backbone Cabling" and Section 16717 "Communications Horizontal Cabling."

F. Grounding: Provide independent-signal circuit grounding recommended in writing by manufacturer.

3.03 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras and infrared illuminators level and plumb.

B. Install cameras with 84-inch- (2134-mm-) minimum clear space below cameras and their mountings. Change type of mounting to achieve required clearance.

C. Set pan unit and pan-and-tilt unit stops to suit final camera position and to obtain the field of view required for camera. Connect all controls and alarms, and adjust.

D. Install power supplies and other auxiliary components at control stations unless otherwise indicated.

E. Install tamper switches on components indicated to receive tamper switches, arranged to detect unauthorized entry into system-component enclosures and mounted in self-protected, inconspicuous positions.

F. Avoid ground loops by making ground connections only at the control station.

1. For 12- and 24-V dc cameras, connect the coaxial cable shields only at the monitor end.

G. Identify system components, wiring, cabling, and terminals according to Section 16075 "Electrical Identification."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Inspection: Verify that units and controls are properly installed, connected, and labeled, and that interconnecting wires and terminals are identified.

2. Pretesting: Align and adjust system and pretest components, wiring, and functions to verify that they comply with specified requirements. Conduct tests at varying lighting levels, including day and night scenes as applicable. Prepare video-surveillance equipment for acceptance and operational testing as follows:

a. Prepare equipment list described in "Informational Submittals" Article.

b. Verify operation of auto-iris lenses.

c. Set back-focus of fixed focal length lenses. At focus set to

infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Adjust until image is in focus with and without the filter.

d. Set back-focus of zoom lenses. At focus set to infinity, simulate nighttime lighting conditions by using a dark glass filter of a density that produces a clear image. Additionally, set zoom to full wide angle and aim camera at an object 50 to 75 feet (17 to 23 m) away. Adjust until image is in focus from full wide angle to full telephoto, with the filter in place.

e. Set and name all preset positions; consult Owner's personnel.

f. Set sensitivity of motion detection.

g. Connect and verify responses to alarms.

h. Verify operation of control-station equipment.

3. Test Schedule: Schedule tests after pretesting has been successfully completed and system has been in normal functional operation for at least 14 days. Provide a minimum of 10 days' notice of test schedule.

4. Operational Tests: Perform operational system tests to verify that system complies with Specifications. Include all modes of system operation. Test equipment for proper operation in all functional modes.

E. Video surveillance system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.05 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Tasks shall include, but are not limited to, the following:

1. Check cable connections.

2. Check proper operation of cameras and lenses. Verify operation of auto-iris lenses and adjust back-focus as needed.

3. Adjust all preset positions; consult Owner's personnel.

4. Recommend changes to cameras, lenses, and associated equipment to improve Owner's use of video surveillance system.

5. Provide a written report of adjustments and recommendations.

3.06 CLEANING

A. Clean installed items using methods and materials recommended in writing by manufacturer.

B. Clean video-surveillance-system components, including camera-housing windows, lenses, and monitor screens.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain video-surveillance equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 VIDEO SURVEILLANCE SYSTEM:

A. Video Surveillance System will not be measured for payment.

B. Video Surveillance System will not be paid for directly, but will be included in the lump sum bid price for Maintenance Building.

END OF SECTION

SECTION 13830

DOOR VIDEO INTERCOM SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes a security access system consisting of "AIPHONE" hands free color video intercom and door release system. The security system shall have the following:

1. Access Control:

   a. Regulating access through doors via vandal resistant color fixed video door stations.

   b. Electrical door strikes.

2. Monitoring:

   a. Hands-free color pantilt video master monitor with picture memory.

   b. Hands-free color pantilt video sub monitor.

3. System components:

   a. Surface mount box for color pantilt video door station.

   b. 24V DC power supply.

   c. Desk stand for "Aiphone" monitors.

   d. Selective door release adaptor.

   e. Motion detector interface for analog video systems.

   f. External signaling relay.

   g. Call extension speaker.

B. Furnish and install all materials, labor, equipment, permits, etc., to provide

security access system as described herein and illustrated on the Drawings for a complete operating system.

C. Where applicable visit the site, verify all existing items shown on plans, or specified, and be familiar with the working conditions, hazards, and local requirements involved; submission of bids shall be deemed evidence of such visit. All proposals shall take these existing conditions into consideration and the lack of specific information on the Drawings shall not relieve the Contractor of any responsibility.

D. All materials, unless otherwise specified, shall be new, free from any defects, and of the best quality of their respective kinds. All like materials used shall be of the same manufacture, model, and quality, unless otherwise specified.

E. All manufactured articles, material, and equipment shall be applied, installed connected, erected, used, cleaned, adjusted, and conditioned as recommended by the manufacturers, or as indicated in their published literature, unless specifically herein specified to the contrary.

F. All work shall be performed by competent workmen and executed in a neat and workmanlike manner providing a thorough and complete installation. Work shall be properly protected during construction, including the shielding of soft or fragile materials. At completion, the installation shall be thoroughly cleaned and all tools, equipment, obstructions, or debris present as a result of this portion of work shall be removed from the premises.

1.03 DEFINITIONS

A. CCTV: Closed-circuit television..

B. dpi: Dots per inch.

C. GFI: Ground fault interrupter.

D. I/O: Input/Output.

E. LAN: Local area network.

F. LED: Light-emitting diode.

G. RF: Radio frequency.

H. ROM: Read-only memory. ROM data are maintained through losses of power.

I. RS-232: An TIA/EIA standard for asynchronous serial data

communications between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

J. RS-485: An TIA/EIA standard for multipoint communications.

K. UPS: Uninterruptible power supply.

L. WAN: Wide area network.

1.04 PERFORMANCE REQUIREMENTS

A. Supply and install a complete fully integrated security access system capable of providing a complete operational system, as indicated on the Drawings and Specifications herein. All features and capabilities of the system shall be provided as specified herein. All features may or may not be activated at the time the system is placed in service

B. System Features:

1. Two color Pan Tilt camera door stations.

2. Three inside monitor stations.

3. Motion-sensor camera.

4. Hands-free communication, voice operated exchange (VOX).

5. Instant voice call-in with image.

6. Press-to-talk (PTT) operation, can override VOX if necessary.

7. Built-in video output.

8. All call to all inside stations.

9. Visual monitoring with audio.

10. Two door release contacts for selective control.

11. Built-in picture memory.

12. Transfer of door station call to other inside stations.

13. White LED illuminator turns on in low-light conditions.

1.05 SUBMITTALS

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

characteristics, furnished specialties, and accessories. Reference each product to a location on Drawings.

B. Shop Drawings: Submit signed and sealed by a qualified professional engineer layout drawings of integrated security access system, components, and accessories.

1. Equipment Details: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.

2. Specification sheets shall be submitted on all items including cable types.

3. Wiring diagram: Power, signal, and control wiring. Include the following:

a. Identify terminals to facilitate installation, operation, and maintenance.

b. Single-line diagram showing interconnection of components.

c. Cabling diagram showing cable routing.

C. Qualification Data: For Installer.

D. Submit a certificate of completion of installation and service training from the system manufacturer.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

1. Cable installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

2. The contractor shall have on its regular staff a licensed Master Electrician.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

C. All items of equipment including wire and cable shall be designed by the

manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70, "National Electrical Code."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Door stations, monitoring stations and system components:

1. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F (10 and 30 deg C), and not more than 80 percent relative humidity, noncondensing.

2. Open each container; verify contents against packing list, and file copy of packing list, complete with container identification for inclusion in operation and maintenance data.

3. Mark packing list with designations that have been assigned to materials and equipment for recording in the system labeling schedules that are generated by cable and asset management system specified in Part 2.

4. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.08 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Interior, Controlled Environment: System components installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F (2 to 50 deg C) dry bulb and 20 to 90 percent relative humidity, noncondensing. NEMA 250, Type 1 enclosure.

2. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F (minus 34 to plus 50 deg C) dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain

as specified in NEMA 250, winds up to 85 mph (137 km/h). NEMA 250, Type 4X enclosures.

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 SECURITY ACCESS SYSTEM

A. Manufacturers:

1. Provide AX Series AIPHONE System.

2. The system shall consists of the Door Stations, Master Monitoring Station, Sub-Master Monitoring Stations, Door Release adaptors and Components, Power Supply, Relays, and all other necessary auxiliary devices to provide the operation specified herein.

2.03 COLOR PANTILT VIDEO DOOR STATION

A. Provide AX-DVF vandal resistant flush mount color fixed video door station designed for use with Aiphone's AX Series integrated audio and video systems.

B. The door station shall have Fixed CCD camera with infrared illumination, and voice communication with the inside station.

C. Door station faceplate shall be constructed of 1/8" thick stainless steel, and the camera cover shall be shatter resistant "Lexan".

D. The unit shall be equipped with a speaker/microphone for 2-way communication with the inside stations.

E. Features:

1. Video door station with Fixed, CCD camera.

2. Camera shall be capable of moving to view 70" horizontally and 35" vertically.

3. Infrared illumination for low light viewing (1 lux).

4. Camera cover shall be Lexan – flame and shatter resistant.

F. Power Source: Supplied by main or video adaptor.

G. Scanning lines: 525 lines.

H. Calling; Chime or call tone heard at inside station(s). Monitor(s) turn on when call button is pressed.

I. Communication: Hands free at camera unit.

J. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

K. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations.

2.04 MASTER MONITORING STATION WITH PICTURE MEMORY

A. Provide one hands free color pantilt master monitoring station at location indicated on the drawings. The master station shall be AX-8MV.

B. Description: Open voice/video monitoring station with 3.5” direct view TFT color LCD and the following features:

1. Max 8 doors stations
2. VOX or PTT communication.
3. All call to other units.
4. Door release contact.
5. Multi color call-in LED.
6. Receive volume control.
7. Chime tone volume control.
8. Instant-on when door calls.
9. Monitor the door station.
10. Picture memory.

C. An inside monitoring station answers a call-in from a door station by momentary pressing the TALK button to activate the VOX mode or pressing and holding the TALK button while speaking.

D. The entry area(s) can be monitored (audio and video) by pressing the “monitor” button on any room stations, staying on for approximately 1

minute. Pressing the “monitor” repeatedly cycles through the door stations. The door release button can be used to activate an electric door strike. To selectively release video doors RY-3DL adaptor shall be added.

E. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

2.05 SUB MASTER MONITORING STATION

A. Provide two hands free color pantilt sub master monitoring station at locations indicated on the drawings. The master station shall be AX-8MV.

B. Description: Open voice/video monitoring station with 3.5” direct view TFT color LCD and the following features:

1. Max 8 doors
2. VOX or PTT communication.
3. All call to other units.
4. Door release contact.
5. Multi color call-in LED.
6. Receive volume control.
7. Chime tone volume control.
8. Instant-on when door calls.
9. Monitor the door station.

C. An inside monitoring station answers a call-in from a door station by momentary pressing the TALK button to activate the VOX mode or pressing and holding the TALK button while speaking.

D. The entry area(s) can be monitored (audio and video) by pressing the “monitor” button on any room stations, staying on for approximately 1 minute. Pressing the “monitor” repeatedly cycles through the door stations. The door release button can be used to activate an electric door strike. To selectively release video doors RY-3DL adaptor shall be added.

E. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

2.06 SECURITY ACCESS SYSTEM COMPONENTS

A. DC power supply for Aiphone intercom system: Provide 24V DC, 2A

power supply – Aiphone, model PS-2420UL, with the following specifications:

1. Power source: AC 100V-240V, 50/60Hz;

2. Power consumption: 60W/100-125VA.

3. Secondary output voltage: DC 24V.

4. Secondary output current: 2A.

5. Dimensions: 6-9/16”H x 3-9/16”W x 2”D.

B. Desk stands for master and sub monitors: Provide Aiphone desk mount stands for video monitors.

C. Central Exchange Unit: Provide Aiphone AX-084C central exchange unit for 8 doors and 4 masters.

2.07 WIRING

A. Door station to Central Exchange Unit: Category 5e.

B. Master and Sub Master Monitoring Stations to Central Exchange Unit: Category 5e.

2.08 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

2.09 GROUNDING

A. Comply with Division 16 Section "Grounding and Bonding."

2.10 INSTALLATION

A. Wiring Methods: Install wiring in raceways except within consoles, desks, and counters. Conceal cables and raceways except in unfinished spaces.

B. Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.

C. Identification of conductors and Cables: Color code conductors and apply

wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

D. Conductor sizing: Provide conductor type and size as per manufacturer specifications.

E. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

2.11 IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in Division 16 Section "Electrical Identification" and with TIA/EIA-606.

2.12 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports:

1. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.

2. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Remove and replace malfunctioning devices and circuits and retest as specified above.

2.13 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according

to approved procedures that were developed with manufacturer's written instructions.

2.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain security access system.

2.15 WARRANTY

A. Standard manufacturer warranty of one, two or three years, depending on the product.

B. Use only Aiphone wires in order to extend standard product warranty by one year.

PART 3 EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 AI PHONE SYSTEM:

A. AI Phone system will be measured for at the contract unit price bid lump sum.

B. AI Phone system will be paid per lump sum, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 13852

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Notification appliances.
5. Firefighters' two-way telephone communication service.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. System printer.

1.03 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.04 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

B. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to

fire-alarm service only.

1.05 ACTION SUBMITTALS

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

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.

2. Include voltage drop calculations for notification appliance circuits.

3. Include battery-size calculations.

4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.

6. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

7. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.

2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.

b. NICET-certified fire-alarm technician, Level III minimum.

c. Licensed or certified by authorities having jurisdiction.

D. Delegated-Design Submittal: For smoke and heat detectors 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. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.

2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," deliver copies to authorities having jurisdiction and include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.

3. Record copy of site-specific software.

4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

   a. Frequency of testing of installed components.

   b. Frequency of inspection of installed components.

   c. Requirements and recommendations related to results of maintenance.

   d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.

6. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.08 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. Lamps for Remote Indicating Lamp Units: Quantity equal to **10** percent of amount installed, but no fewer than 1 unit.

2. Lamps for Strobe Units: Quantity equal to **10** percent of amount installed, but no fewer than 1 unit.

3. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.

4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.

5. Keys and Tools: One extra set for access to locked and tamperproofed components.

6. Audible and Visual Notification Appliances: One of each type installed.

7. Fuses: Two of each type installed in the system.

1.09 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of fire-alarm service.

2. Do not proceed with interruption of fire-alarm service without Construction Manager's written permission.

1.11 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.12 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within **two** years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMSECO - a Potter brand; Potter Electric Signal Company.

2. Bosch Security Systems.

3. Commercial Products Group/CPG Life Safety Signals.

4. Faraday; Siemens Building Technologies, Inc.

5. Federal Signal Corporation.

6. Fire Control Instruments, Inc.; a Honeywell company.

7. Fire Lite Alarms; a Honeywell company.

8. GAMEWELL; a Honeywell company.

9. GE Infrastructure; a unit of General Electric Company.

10. Gentex Corporation.

11. Harrington Signal, Inc.

12. NOTIFIER; a Honeywell company.

13. Siemens Building Technologies, Inc.; Fire Safety Division.

14. Silent Knight; a Honeywell company.

15. SimplexGrinnell LP; a Tyco International company.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.

2. Smoke detectors.

3. Duct smoke detectors.

4. Verified automatic alarm operation of smoke detectors.

5. Automatic sprinkler system water flow.

6. Heat detectors in elevator shaft and pit.

7. Fire-extinguishing system operation.

8. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.

2. Identify alarm at fire-alarm control unit and remote annunciators.

3. Transmit an alarm signal to the remote alarm receiving station.

4. Unlock electric door locks in designated egress paths.

5. Release fire and smoke doors held open by magnetic door holders.

6. Activate voice/alarm communication system.

7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.

8. Activate smoke-control system (smoke management) at firefighter smoke-control system panel.

9. Activate stairwell and elevator-shaft pressurization systems.

10. Close smoke dampers in air ducts of designated air-conditioning duct systems.

11. Recall elevators to primary or alternate recall floors.

12. Activate emergency lighting control.

13. Activate emergency shutoffs for gas and fuel supplies.

14. Record events in the system memory.

15. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.

2. Low-air-pressure switch of a dry-pipe sprinkler system.

3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.

2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.

3. Loss of primary power at fire-alarm control unit.

4. Ground or a single break in fire-alarm control unit internal circuits.

5. Abnormal ac voltage at fire-alarm control unit.

6. Break in standby battery circuitry.

7. Failure of battery charging.

8. Abnormal position of any switch at fire-alarm control unit or annunciator.

9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators Record the event on system printer.

2.03 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.

   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.

   b. Include a real-time clock for time annotation of events on the event recorder and printer.

2. Addressable initiation devices that communicate device identity and status.

   a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.

   b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 1 line(s) of 40 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line

Circuits: NFPA 72, Class A.

a. Initiating Device Circuits: Style D.

b. Notification Appliance Circuits: Style Z.

c. Signaling Line Circuits: Style 2.

d. Install no more than 50 addressable devices on each signaling line circuit.

2. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class B.

a. Initiating Device Circuits: Style A

b. Notification Appliance Circuits: Style W .

c. Install no more than 50 addressable devices on each signaling line circuit.

3. Serial Interfaces: Two RS-232 ports for printers.

D. Stairwell Pressurization: Provide an output signal using an addressable relay to start the stairwell pressurization system. Signal shall remain on until alarm conditions are cleared and fire-alarm system is reset. Signal shall not stop in response to alarm acknowledge or signal silence commands.

1. Pressurization starts when any alarm is received at fire-alarm control unit.

2. Alarm signals from smoke detectors at pressurization air supplies have a higher priority than other alarm signals that start the system.

E. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.

2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.

3. Record events by the system printer.

4. Sound general alarm if the alarm is verified.

5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall.

a. Elevator lobby detectors except the lobby detector on the designated floor.

b. Smoke detector in elevator machine room.

c. Smoke detectors in elevator hoistway.

2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.

3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.

a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided in a separate cabinet located in the fire command center.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.

a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to

the other zones selectively or in any combination.

b. Programmable tone and message sequence selection.

c. Standard digitally recorded messages for "Evacuation" and "All Clear."

d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.

2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.

3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

K. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters and digital alarm radio transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

L. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

M. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.04 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

2. Station Reset: Key- or wrench-operated switch.

3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.05 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.

2. In first subparagraph below, retain first option for additions to existing four-wire systems or if detector auxiliary contacts are used for critical control functions such as air-handler shutdowns. Otherwise, retain type based on class of initiating device circuit.

3. Detectors shall be four-wire type.

4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

5. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.

6. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

7. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

8. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

   a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.

   b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

   c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.

   b. Device type.

   c. Present average value.

   d. Present sensitivity selected.

   e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.

b. Device type.

c. Present average value.

d. Present sensitivity selected.

e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.

4. Each sensor shall have multiple levels of detection sensitivity.

5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.06 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

E. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-(25-mm-) high letters on the lens.

1. Rated Light Output:

a. **75** cd.

b. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.

3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

4. Flashing shall be in a temporal pattern, synchronized with other units.

5. Strobe Leads: Factory connected to screw terminals.

6. Mounting Faceplate: Factory finished, red.

F. Voice/Tone Notification Appliances:

1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.

2. High-Range Units: Rated 2 to 15 W.

3. Low-Range Units: Rated 1 to 2 W.

4. Mounting: surface mounted and bidirectional.

5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.07 FIREFIGHTERS' TWO-WAY TELEPHONE COMMUNICATION SERVICE

A. Dedicated, two-way, supervised, telephone voice communication links between fire-alarm control unit, the fire command center, and remote firefighters' telephone stations. Supervised telephone lines shall be connected to talk circuits by controls in a control module. Provide the following:

1. Common-talk type for firefighter use only.

2. Selective-talk type for use by firefighters and fire wardens.

3. Controls to disconnect phones from talk circuits if too many phones are in use simultaneously.

4. Audible Pulse and Tone Generator, and High-Intensity Lamp: When a remote telephone is activated, it causes audible signal to sound and high-intensity lamp to flash.

5. Selector panel controls shall provide for simultaneous operation of up to six telephones in selected zones. Indicate ground faults and open or shorted telephone lines on the panel front by individual LEDs.

6. Display: Liquid-crystal digital to indicate location of caller.

7. Remote Telephone Cabinet: Flush- or surface-mounted cabinet as indicated, factory-standard red finish, with handset.

   a. Install one-piece handset to cabinet with vandal-resistant armored cord. Silk-screened or engraved label on cabinet door, designating "Fire Warden Phone" or "Fire Emergency Phone."

   b. With "break-glass" type door access lock.

2.08 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf (111-N) holding force.

2. Wall-Mounted Units: Flush mounted unless otherwise indicated.

3. Rating: 24-V ac or dc.

4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.09 REMOTE ANNUNCIATOR

A. Manufactureres: Subject to compliance with requirements, provide products by one of the following.

1. GE UTC Fire & Security; A united Technology

2. Harrington Signal, Inc.

3. Keltron Corportation

4. Mircom Technologies, Ltd.

5. Siemens Industry, Inc. Fire Safety Division

6. SimplexGrinnel LP.

B. Graphic Annunciator Panel: Mounted in an aluminum frame with nonglare, minimum 3/16-inch (4.76 mm) thick, clear acrylic cover over graphic representation of the facility.LED locations shall be as indicated on the plans. Normal system operation shall be indicated by a lighted, green LED> Trouble and supervisiory alarms shall be represented by an amber LED.

1. Comply with UL 864.

2. Operating voltage shall be 24-V dc provided by a local power supply provided with the annunciator.

3. Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and a lamp test switch.

4. Surface mounted in a NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.

5. Graphic representation of the facility shall be a CAD drawing and each detector shall be represented by an LED in its actual location. CAD drawing shall be at 1/8 inc per foot scale or larger.

6. The LED representing a detector shall flash two times per second while detector is an alarm.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration

to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.

2. Programming device.

3. LED display.

4. Manual test report function and manual transmission clear indication.

5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.

2. Address of the supervisory signal.

3. Address of the trouble-initiating device.

4. Loss of ac supply or loss of power.

5. Low battery.

6. Abnormal test signal.

7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.12 SYSTEM PRINTER

A. Printer shall be listed and labeled by an NRTL as an integral part of fire-alarm system.

2.13 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.

2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Comply with requirements for concrete base specified in Section 03300 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

D. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

E. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.

2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 30 feet (9 m).

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined

according to Appendix A or Appendix B in NFPA 72.

5. HVAC: Locate detectors not closer than 3 feet (1 m) from air-supply diffuser or return-air opening.

6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

H. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

I. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

J. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

K. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

L. Device Location-Indicating Lights: Locate in public space near the device they monitor.

M. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

N. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.02 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08710 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighter smoke-control system panel.

2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.

3. Smoke dampers in air ducts of designated air-conditioning duct systems.

4. Alarm-initiating connection to elevator recall system and components.

5. Alarm-initiating connection to activate emergency lighting control.

6. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

7. Supervisory connections at valve supervisory switches.

8. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

9. Supervisory connections at elevator shunt trip breaker.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.04 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.05 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.

b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

PART 4: MEASUREMENT AND PAYMENT

4.01 SMOKE DETECTORS AND DUCT SMOKE DETECTORS:

A. Smoke detectors and duct smoke detectors will be measured for at the contract unit price bid per each.

B. Smoke detectors and duct smoke detectors will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 STROBES:

A. Strobes will be measured for at the contract unit price bid per each.

B. Strobes will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.03 HORN/STROBE COMBINATION:

A. Horn/strobe combinations will be measured for at the contract unit price per each..

B. Horn/strobe combinations will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.04 PULL STATIONS:

A. Pull stations will be measured for at the contract unit price bid per each.

B. Pull stations will be paid per each, complete in place, accepted, which

price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.05 FIRE ALARM CONTROL PANEL

A. Fire Alarm Control Panels will be measured for at the contract unit price bid per each.

B. Fire Alarm Control Panels will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.06 FIRE ALARM ANNUNCIATOR PANEL

A. Fire Alarm Annunciator Panels will be measured for at the contract unit price bid per each.

B. Fire Alarm Annunciator Panels will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 13930

WET-PIPE FIRE-SUPPRESSION SPRINKLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. Section Includes:

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

B. Related Sections:

1. Section 13974 "Fire-Suppression Standpipes" for standpipe piping.
2. Section 15072 “Vibration and Seismic Controls for Fire Suppression Piping and Equipment” for seismic control.
3. Section 15091 “Sleeves and Sleeve Seals for Fire-Suppression Piping” for sleeve installations.
4. Section 15096 “Escutcheons for Fire-Suppression Piping” for escutcheon installations.

1.03 DEFINITIONS:

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

1.04 SYSTEM DESCRIPTIONS:

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping

containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.05 PERFORMANCE REQUIREMENTS:

A. Standard-Pressure Piping System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:

a. Date and Time: March 31st, 2010 10:30 a.m.

b. Performed by: City of Baltimore, test number 10-03-036.

c. Location of Residual Fire Hydrant R: 2257 Kirk Avenue.

d. Location of Flow Fire Hydrant F: Curtain and Kirk Avenues, South West Corner.

e. Static Pressure at Residual Fire Hydrant R: 102 psig.

f. Measured Flow at Flow Fire Hydrant F: 3260 gpm.

g. Residual Pressure at Residual Fire Hydrant R: 84 psig.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

2. Sprinkler Occupancy Hazard Classifications:

a. Parking Areas: Ordinary Hazard, Group 1.

b. Building Service Areas: Ordinary Hazard, Group 1.

c. Electrical Equipment Rooms: Ordinary Hazard, Group 1.

d. General Storage Areas: Ordinary Hazard, Group 1.

e. Shops: Ordinary Hazard, Group 2.

f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.

g. Office and Public Areas: Light Hazard.

h. Repair Garages: Ordinary Hazard, Group 2.

i. Solvent Cleaning Areas: Extra Hazard, Group 2.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.

b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.

c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.

e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.

f. Special Occupancy Hazard: As determined by authorities having jurisdiction.

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

a. Light-Hazard Occupancies: 100 gpm for 30 minutes.

b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7 .

1.06 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 wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the building components including mechanical electrical and plumbing systems are shown and coordinated with each other, using input from installers of the items involved.

E. Qualification Data: For qualified Installer and professional engineer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

G. Welding certificates.

H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

I. Field quality-control reports.

J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE:

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for

intended location and application.

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

1. NFPA 13, "Installation of Sprinkler Systems."

1.08 COORDINATION:

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

1.09 EXTRA MATERIALS:

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS:

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

2.02 STEEL PIPE AND FITTINGS:

A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized- and Black-Steel Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized- and Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Galvanized- and Black-Steel, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Grooved-Joint, Steel-Pipe Appurtenances:

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. Anvil International, Inc.

b. Victaulic Company.

2. Pressure Rating: 175 psig (1200 kPa) minimum.

3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.03 PIPING JOINING MATERIALS:

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.04 LISTED FIRE-PROTECTION VALVES:

A. General Requirements:

1. Valves shall be UL listed or FM approved.

2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).

B. Ball Valves:

1. 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. Anvil International, Inc.

b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.

3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.

4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.

5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. 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. Milwaukee Valve Company.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Bronze.

5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. 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. Anvil International, Inc.

b. Kennedy Valve; a division of McWane, Inc.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Victaulic Company.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Cast or ductile iron.

5. End Connections: Grooved.

E. Check Valves:

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. AFAC Inc.

b. Kennedy Valve; a division of McWane, Inc.

c. Milwaukee Valve Company.

d. Mueller Co.; Water Products Division.

e. NIBCO INC.

f. Potter Roemer.

g. Reliable Automatic Sprinkler Co., Inc.

h. Victaulic Company.

i. Viking Corporation.

2. Standard: UL 312.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

4. Type: Swing check.

5. Body Material: Cast iron.

6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

1. 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. Milwaukee Valve Company.

b. NIBCO INC.

c. United Brass Works, Inc.

2. Standard: UL 262.

3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Bronze.

5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

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. Hammond Valve.

b. Milwaukee Valve Company.

c. Mueller Co.; Water Products Division.

d. NIBCO INC.

e. United Brass Works, Inc.

2. Standard: UL 262.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

4. Body Material: Cast or ductile iron.

5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

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. Anvil International, Inc.

b. Kennedy Valve; a division of McWane, Inc.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Victaulic Company.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Valves NPS 2 (DN 50) and Smaller:

   a. Valve Type: Ball or butterfly.

   b. Body Material: Bronze.

   c. End Connections: Threaded.

5. Valves NPS 2-1/2 (DN 65) and Larger:

   a. Valve Type: Butterfly.

   b. Body Material: Cast or ductile iron.

   c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch with visual indicating device.

I. NRS Gate Valves:

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. American Cast Iron Pipe Company; Waterous Company Subsidiary.

   b. American Valve, Inc.

   c. Clow Valve Company; a division of McWane, Inc.

   d. Kennedy Valve; a division of McWane, Inc.

   e. Mueller Co.; Water Products Division.

   f. NIBCO INC.

2. Standard: UL 262.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

4. Body Material: Cast iron with indicator post flange.

5. Stem: Nonrising.

6. End Connections: Flanged or grooved.

2.05 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 (1200 kPa) minimum.

B. Angle Valves:

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. Fire Protection Products, Inc.

b. United Brass Works, Inc.

C. Ball Valves:

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. Conbraco Industries, Inc.; Apollo Valves.

b. Kennedy Valve; a division of McWane, Inc.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Potter Roemer.

f. Victaulic Company.

D. Globe Valves:

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. Fire Protection Products, Inc.

b. United Brass Works, Inc.

E. Plug Valves:

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. Southern Manufacturing Group.

2.06 SPECIALTY VALVES:

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.

3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.

5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. 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. AFAC Inc.

b. Reliable Automatic Sprinkler Co., Inc.

c. Victaulic Company.

d. Viking Corporation.

2. Standard: UL 193.

3. Design: For horizontal or vertical installation.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

5. Drip Cup Assembly: Pipe drain without valves and separate from

main drain piping.

C. Automatic (Ball Drip) Drain Valves:

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. AFAC Inc.

b. Reliable Automatic Sprinkler Co., Inc.

2. Standard: UL 1726.

3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Type: Automatic draining, ball check.

5. Size: NPS 3/4 (DN 20).

6. End Connections: Threaded.

2.07 FIRE-DEPARTMENT CONNECTIONS:

A. Flush-Type, Fire-Department Connection:

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. AFAC Inc.

b. Elkhart Brass Mfg. Company, Inc.

c. Guardian Fire Equipment, Inc.

d. Potter Roemer.

2. Standard: UL 405.

3. Type: Flush, for wall mounting.

4. Pressure Rating: 175 psig (1200 kPa) minimum.

5. Body Material: Corrosion-resistant metal.

6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or

clappers.

7. Caps: Brass, lugged type, with gasket and chain.

8. Escutcheon Plate: Rectangular, brass, wall type.

9. Outlet: With pipe threads.

10. Body Style: Horizontal.

11. Number of Inlets: Three.

12. Outlet Location: Back.

13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."

14. Finish: Polished chrome plated.

15. Outlet Size: NPS 8 (DN 200).

2.08 SPRINKLER SPECIALTY PIPE FITTINGS:

A. Branch Outlet Fittings:

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. Anvil International, Inc.

b. Victaulic Company.

2. Standard: UL 213.

3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

5. Type: Mechanical-T and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

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. Reliable Automatic Sprinkler Co., Inc.

b. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

C. Branch Line Testers:

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. Elkhart Brass Mfg. Company, Inc.

b. Fire-End & Croker Corporation.

c. Potter Roemer.

2. Standard: UL 199.

3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Brass.

5. Size: Same as connected piping.

6. Inlet: Threaded.

7. Drain Outlet: Threaded and capped.

8. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

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. Victaulic Company.

   b. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Body Material: Cast- or ductile-iron housing with sight glass.

5. Size: Same as connected piping.

6. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

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. CECA, LLC.

   b. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

4. Body Material: Steel pipe with EPDM-rubber O-ring seals.

5. Size: Same as connected piping.

6. Length: Adjustable.

7. Inlet and Outlet: Threaded.

2.09 SPRINKLERS:

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. AFAC Inc.

2. Reliable Automatic Sprinkler Co., Inc.

3. Victaulic Company.

4. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating for Residential Sprinklers: 175 psig (1200 kPa) maximum.

3. Pressure Rating for Automatic Sprinklers: 175 psig (1200 kPa) minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.

2. Nonresidential Applications: UL 199.

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

D. Sprinkler Finishes:

1. Chrome plated.

2. Bronze.

3. Painted.

E. Special Coatings:

1. Wax.

2. Lead.

3. Corrosion-resistant paint.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, two piece, with 1-inch

(25-mm) vertical adjustment.

2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

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. Reliable Automatic Sprinkler Co., Inc.

b. Victaulic Company.

c. Viking Corporation.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler.

2.10 ALARM DEVICES:

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

B. Electrically Operated Alarm Bell:

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. Fire-Lite Alarms, Inc.; a Honeywell company.

b. Notifier; a Honeywell company.

c. Potter Electric Signal Company.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.

4. Size: 10-inch (250-mm) diameter.

5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

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. McDonnell & Miller; ITT Industries.

b. Potter Electric Signal Company.

c. System Sensor; a Honeywell company.

d. Viking Corporation.

2. Standard: UL 346.

3. Water-Flow Detector: Electrically supervised.

4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

5. Type: Paddle operated.

6. Pressure Rating: 250 psig (1725 kPa).

7. Design Installation: Horizontal or vertical.

D. 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. AFAC Inc.

b. Detroit Switch, Inc.

c. Potter Electric Signal Company.

d. System Sensor; a Honeywell company.

e. 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.

E. 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. Fire-Lite Alarms, Inc.; a Honeywell company.

b. Kennedy Valve; a division of McWane, Inc.

c. Potter Electric Signal Company.

d. 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 controlled valve is in other than fully open position.

F. Indicator-Post 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. Potter Electric Signal Company.

b. 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 controlled indicator-post valve is in other than fully open position.

2.11 PRESSURE GAGES:

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.

B. Standard: UL 393.

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

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

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

PART 3: EXECUTION

3.01 SERVICE-ENTRANCE PIPING:

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping in Section 02510 "Water Distribution."

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Comply with requirements for backflow preventers in Section 02510 "Water Distribution."

3.02 PIPING INSTALLATION:

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

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

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

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 (DN 50) and smaller.

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

end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with 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. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

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.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Fill sprinkler system piping with water.

O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15091 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15091 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15096 "Escutcheons for Fire-Suppression Piping."

3.03 JOINT CONSTRUCTION:

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless

otherwise indicated.

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

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

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING:

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.05 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, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.06 SPRINKLER INSTALLATION:

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.07 FIRE-DEPARTMENT CONNECTION INSTALLATION:

A. Install wall-type, fire-department connections.

B. Install protective pipe bollards around each fire-department connection. Comply with requirements for bollards in Section 05500 "Metal Fabrications."

C. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.08 IDENTIFICATION:

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

3.09 FIELD QUALITY CONTROL:

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.

5. Coordinate with fire-alarm tests. Operate as required.

6. Verify that equipment hose threads are same as local fire-department equipment.

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

D. Prepare test and inspection reports.

3.10 CLEANING:

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the system.

3.12 PIPING SCHEDULE:

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 (DN 50) and smaller,

shall be one of the following:

1. Exposed or within the maintenance areas:

   a. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

   b. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Concealed:

   a. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

   b. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:

1. Exposed or within the maintenance areas:

   a. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

   b. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Concealed:

   a. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

   b. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be one of the following:

1. Exposed piping:

   a. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

   b. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Concealed:

   a. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

   b. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.13 SPRINKLER SCHEDULE:

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.

2. Rooms with Suspended Ceilings: Pendent sprinklers.

3. Wall Mounting: Sidewall sprinklers.

4. Spaces Subject to Freezing: Dry sprinklers.

5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

2. Flush Sprinklers: Bright chrome, with painted white escutcheon.

3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

PART 4: MEASUREMENT AND PAYMENT

4.01 WET-PIPE FIRE SUPPRESSION SPRINKLER:

A. Wet-Pipe Fire Suppression Sprinklers will not be measured for payment.

B. Wet-Pipe Fire Suppression Sprinklers will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 13967

CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.01 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. Section 15072 “Vibration and Seismic Controls for Fire Suppression Piping and Equipment” for seismic control.

2. Section 15091 “Sleeves and Sleeve Seals for Fire-Suppression Piping” for sleeve installations.

3. Section 15096 “Escutcheons for Fire-Suppression Piping” for escutcheon installations.

1.02 SUMMARY

A. Section Includes:

1. Piping and piping specialties.

2. Extinguishing-agent containers.

3. Extinguishing agent.

4. Detection and alarm devices.

5. Control and alarm panels.

6. Accessories.

7. Connection devices for and wiring between system components.

8. Connection devices for power and integration into building's fire-alarm system.

1.03 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPO: Emergency Power Off.

1.04 ACTION SUBMITTALS

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

B. Shop Drawings: For clean-agent fire-extinguishing system signed and sealed by a qualified professional engineer.

1. Include plans, elevations, sections, details, and attachments to other work.

2. Include design calculations.

3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

4. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For clean-agent fire-extinguishing system signed and sealed by the qualified professional engineer.

1. Indicate compliance with performance requirements and design criteria, including analysis data.

2. Include design calculations for weight, volume, and concentration of extinguishing agent required for each hazard area.

3. Indicate the Following on Reflected Ceiling Plans:

a. Ceiling penetrations and ceiling-mounted items.

b. Extinguishing-agent containers if mounted above floor, piping and discharge nozzles, detectors, and accessories.

c. Method of attaching hangers to building structure.

d. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.

4. Indicate the Following on Plans:

a. Controls and alarms.

b. Extinguishing-agent containers, piping, discharge nozzles space, detectors, and accessories.

c. Equipment and furnishings.

d. Method of supporting piping.

e. Other equipment located in the space that is being protected including sprinkler piping, HVAC equipment, raceways, or conduit.

1.05 INFORMATIONAL SUBMITTALS

A. 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. Items Penetrating Finished Ceiling Include the Following:

a. Lighting fixtures.

b. Air outlets and inlets.

B. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, that have been approved by authorities having jurisdiction. Include design calculations.

C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For special agent system to include in emergency, operation, and maintenance manuals.

1.07 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. Deliver extra materials to Owner.

1. Detection Devices: Not less than 20 percent of amount of each type installed.

2. Container Valves: Not less than 10 percent of amount of each size and type installed.

3. Nozzles: Not less than 20 percent of amount of each type installed.

4. Extinguishing Agent: Not less than 100 percent of amount installed in largest hazard area. Include pressure-rated containers with valves.

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Provide equipment listed in UL's "Fire Protection Equipment Directory."

PART 2 - PRODUCTS

2.01 CLEAN-AGENT SYSTEMS

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. Fike Corporation.

B. Description: Clean-agent fire-extinguishing system shall be an engineered system for total flooding of the hazard area including the room cavity above the ceiling, below the ceiling. System includes separate zones above and below the ceiling. If smoke is detected below the ceiling, extinguishing agent shall be discharged in zones above and below the ceiling. If smoke is detected above the ceiling, extinguishing agent shall be discharged in the zone above the ceiling only.

C. Performance Requirements: Discharge HFC 125 within 10 seconds and maintain 8 percent concentration by volume at 70 deg F (21 deg C) for 10-minute holding time in hazard areas.

1. HFC 125 concentration in hazard areas greater than 11.5 percent immediately after discharge or less than 8 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.

2. System Capabilities: Minimum 360-psig (2484-kPa) operating pressure.

D. Cross-Zoned Detection: Devices located in two separate zones. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating single-detection device in other zone.

E. System Operating Sequence:

1. Actuating First Detector: Visual indication on annunciator panel. Energize audible and visual alarms (slow pulse), shut down air-conditioning and ventilating systems serving protected area, close

doors in protected area, and send signal to fire-alarm system.

2. Actuating Second Detector: Visual indication on annunciator panel. Energize audible and visual alarms (fast pulse), shut down power to protected equipment, start time delay for extinguishing-agent discharge for 30 seconds, and discharge extinguishing agent.

3. Extinguishing-agent discharge will operate audible alarms and strobe lights inside and outside the protected area.

F. Manual stations shall immediately discharge extinguishing agent when activated.

G. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of hand pressure on the switch will cause agent discharge if the time delay has expired.

H. EPO: Will terminate power to protected equipment immediately on actuation.

I. Low-Agent Pressure Switch: Initiate trouble alarm if sensing less than set pressure.

J. Power Transfer Switch: Transfer from normal to stand-by power source.

2.02 PIPING MATERIALS

A. See **"HFC 125 Agent Piping Applications"** Article for applications of pipe, tube, fitting, and joining materials.

B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," for charging pressure of system.

2.03 PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, Type S, Grade B or ASTM A 106/A 106M, **Grade A**; Schedule 40, Schedule 80, and Schedule 160, seamless steel pipe.

1. Threaded Fittings:

a. Malleable-Iron Fittings: ASME B16.3, Class 300.

b. Flanges and Flanged Fittings: ASME B16.5, Class 300 unless Class 600 is indicated.

c. Fittings Working Pressure: 620 psig (4278 kPa) minimum.

d. Flanged Joints: Class 300 minimum.

2. Forged-Steel Welding Fittings: ASME B16.11, Class 3000, socket pattern.

3. Steel, Grooved-End Fittings: FM Approved and NRTL listed, ASTM A 47/A 47M malleable iron or ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

E. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.04 VALVES

A. General Valve Requirements:

1. UL listed or FM Approved for use in fire-protection systems.

2. Compatible with type of clean agent used.

B. Container Valves: With rupture disc or solenoid and manual-release lever, capable of immediate and total agent discharge and suitable for intended flow capacity.

C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure relief device.

D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.05 EXTINGUISHING-AGENT CONTAINERS

A. Description: Steel tanks complying with ASME Boiler and Pressure

Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.

1. Finish: Manufacturer's standard color, enamel or epoxy paint.

2. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main- and reserve-supply banks of multiple storage containers.

3. Storage-Tank Brackets: Factory- or field-fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.06 FIRE-EXTINGUISHING CLEAN AGENT

A. HFC 125 Clean Agent: Pentafluoroethane.

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. DuPont.

2.07 DISCHARGE NOZZLES

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, size, discharge pattern, and capacity required for application.

2.08 MANIFOLD AND ORIFICE UNIONS

A. Description: NRTL-listed device with minimum 2175-psig (15-MPa) pressure rating, to control flow and reduce pressure of IG-541 gas in piping.

1. NPS 2 (DN 50) and Smaller: Piping assembly with orifice, sized for system design requirements.

2. NPS 2-1/2 (DN 65) and Larger: Piping assembly with nipple, sized for system design requirements.

2.09 CONTROL PANELS

A. Description: FM Approved or NRTL listed, including equipment and features required for testing, supervising, and operating fire-extinguishing system.

B. Power Requirements: 120/240-V ac; with electrical contacts for connection to system components and fire-alarm system, and transformer

or rectifier as needed to produce power at voltage required for accessories and alarm devices.

C. Enclosure: NEMA ICS 6, Type 1, enameled-steel cabinet.

1. Mounting: Surface.

D. Supervised Circuits: Separate circuits for each independent hazard area.

1. Detection circuits equal to the required number of zones, or addressable devices assigned to the required number of zones.

2. Manual pull-station circuit.

3. Alarm circuit.

4. Release circuit.

5. Abort circuit.

6. EPO circuit.

E. Control-Panel Features:

1. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices.

2. Automatic switchover to standby power at loss of primary power.

3. Storage container, low-pressure indicator.

4. Service disconnect to interrupt system operation for maintenance with visual status indication on the annunciator panel.

F. Annunciator Panel: Graphic type showing protected, hazard-area plans, as well as locations of detectors and abort, EPO, and manual stations. Include lamps to indicate device-initiating alarm, electrical contacts for connection to control panel, and stainless-steel or aluminum enclosure.

G. Standby Power: Nickel cadmium batteries with capacity to operate system for 24 hours and alarm for minimum of 15 minutes. Include automatic battery charger that has a varying charging rate between trickle and high depending on battery voltage, and that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, automatic transfer switch, and suitable enclosure.

2.10 DETECTION DEVICES

A. General Requirements for Detection Devices:

1. Comply with NFPA 2001, NFPA 72, and UL 268.

2. 24-V dc, nominal.

B. Ionization Detectors: Dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

C. Photoelectric Detectors: LED light source and silicon photodiode receiving element.

D. Remote Air-Sampling Detector System: Includes air-sampling pipe network, a laser-based photoelectric detector, a sample transport fan, and a control unit.

1. Pipe Network: CPVC tubing connects control unit with calibrated sampling holes.

2. Smoke Detector: Particle-counting type with continuous laser beam. Sensitivity adjustable to a minimum of four preset values.

3. Sample Transport Fan: Centrifugal type, creating a minimum static pressure of 0.05-inch wg (12.5 Pa) at all sampling ports.

4. Control Unit: Multizone unit as indicated on Drawings. Provides same system power supply, supervision, and alarm features as specified for the control panel plus separate trouble indication for airflow and detector problems.

E. Signals to the Central Fire Alarm Control Panel: Any type of local system trouble is reported to the central fire alarm control panel as a composite "trouble" signal. Alarms on each system zone are individually reported to the central fire alarm control panel as separately identified zones.

2.11 MANUAL STATIONS

A. General Description: Semirecessed FM Approved or NRTL listed, with clear plastic hinged cover, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

B. Manual Release: "MANUAL RELEASE" caption, and red finish. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked.

C. Abort Switch: "ABORT" caption, momentary contact, with green finish.

D. EPO Switch: "EPO" caption, with yellow finish.

2.12 SWITCHES

A. Description: FM Approved or NRTL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

1. Low-Agent Pressure Switches: Pneumatic operation.

2. Power Transfer Switches: Key-operation selector, for transfer of release circuit signal from main supply to reserve supply.

3. Door Closers: Magnetic retaining and release device or electrical interlock to cause the door operator to drive the door closed.

2.13 ALARM DEVICES

A. Description: Listed and labeled by an NRTL or FM Approved, low voltage, and surface mounting. Comply with requirements in Section 13852 "Digital, Addressable Fire-Alarm System.

B. Bells: Minimum 6-inch (150-mm) diameter.

C. Horns: 90 to 94 dBA.

D. Strobe Lights: Translucent lens, with "FIRE" or similar caption.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 HFC 125 agent PIPING APPLICATIONS

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.

B. NPS 2 (DN 50) and Smaller: Schedule 40, steel pipe; malleable-iron threaded fittings; and threaded joints.

C. NPS 2-1/2 (DN 65) and Larger: Schedule 40, steel pipe; forged-steel welding fittings; and welded joints.

3.03 CLEAN-AGENT PIPING INSTALLATION

A. Install clean-agent extinguishing piping and other components level and plumb, according to manufacturers' written instructions.

B. Install extinguishing-agent containers anchored to substrate.

C. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution."

1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.

2. Support piping using supports and methods according to NFPA 13.

3. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.04 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Connect electrical devices to control panel and to building's fire-alarm system. Electrical power, wiring, and devices are specified in Section 13852 "Digital, Addressable Fire-Alarm System".

3.05 IDENTIFICATION

A. Identify system components and equipment. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

B. Identify piping, extinguishing-agent containers, other equipment, and panels according to NFPA 2001.

C. Install signs at entry doors for protected areas to warn occupants that they are entering a room protected with a clean-agent fire-extinguishing system.

D. Install signs at entry doors to advise persons outside the room the meaning of the horn(s), bell(s), and strobe light(s) outside the protected space.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and

inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing clean-agent extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.

3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.07 CLEANING

A. Each pipe section shall be cleaned internally after preparation and before assembly by means of swabbing, using a suitable nonflammable cleaner. Pipe network shall be free of particulate matter and oil residue before installing nozzles or discharge devices.

3.08 SYSTEM FILLING

A. Preparation:

1. Verify that piping system installation is completed and cleaned.

2. Check for complete enclosure integrity.

3. Check operation of ventilation and exhaust systems.

B. Filling Procedures:

1. Fill extinguishing-agent containers with extinguishing agent, and pressurize to indicated charging pressure.

2. Install filled extinguishing-agent containers.

3. Energize circuits.

4. Adjust operating controls.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain clean-agent fire-extinguishing systems.

PART 4: MEASUREMENT AND PAYMENT

4.01 CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS:

A. Clean-agent fire-extinguishing systems will not be measured for payment.

B. Wet-Pipe Fire Suppression Sprinklers will not be paid directly, but will be included in the lump sum bid prices for maintenance building

END OF SECTION

SECTION 13974

FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.01 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. Section 15072 “Vibration and Seismic Controls for Fire Suppression Piping and Equipment” for seismic control.

2. Section 15091 “Sleeves and Sleeve Seals for Fire-Suppression Piping” for sleeve installations.

3. Section 15096 “Escutcheons for Fire-Suppression Piping” for escutcheon installations.

1.02 SUMMARY:

A. Section Includes:

1. Pipes, fittings, and specialties.

2. Fire-protection valves.

3. Hose connections.

4. Hose stations.

5. Monitors.

6. Alarm devices.

7. Pressure gages.

B. Related Sections:

1. Section 13852 "Digital, Addressable Fire-Alarm System" for alarm devices not specified in this Section.

2. Section 13930 "Wet-Pipe Fire-Suppression Sprinklers" for wet-pipe sprinkler piping.

1.03 DEFINITIONS:

A. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping

designed to operate at working pressure 175 psig (1200 kPa) maximum.

1.04 SYSTEM DESCRIPTIONS:

A. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

1.05 PERFORMANCE REQUIREMENTS:

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:

2. Date and Time: March 31st, 2010 10:30 a.m.

3. Performed by: City of Baltimore, test number 10-03-036.

4. Location of Residual Fire Hydrant R: 2257 Kirk Avenue.

5. Location of Flow Fire Hydrant F: Curtain and Kirk Avenues, South West Corner.

6. Static Pressure at Residual Fire Hydrant R: 102 psig.

7. Measured Flow at Flow Fire Hydrant F: 3260 gpm .

8. Residual Pressure at Residual Fire Hydrant R: 84 psig.

C. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is as follows:

a. NPS 1-1/2 (DN 40) Hose Connections: 65 psig (450 kPa).

2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:

a. NPS 1-1/2 (DN 40) Hose Connections: 100 psig (690 kPa).

D. Seismic Performance: Fire-suppression standpipes shall withstand the

effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.06 ACTION 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 standpipes. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.07 INFORMATIONAL SUBMITTALS:

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the building components including mechanical electrical and plumbing systems are shown and coordinated with each other, using input from installers of the items involved.

B. Qualification Data: For qualified Installer and professional engineer.

C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

E. Field quality-control reports.

F. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.08 QUALITY ASSURANCE:

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and

installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

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

2.02 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized- and Black-Steel Pipe: ASTM A 53/A 53M, Type E , Grade B. Pipe ends may be factory or field formed to match joining method.

B. Galvanized- and Black-Steel Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized- and Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Galvanized- and Black-Steel, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Grooved-Joint, Steel-Pipe Appurtenances:

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. Anvil International, Inc.

b. Victaulic Company.

2. Pressure Rating: 175 psig (1200 kPa) minimum.

3. Galvanized and Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.

4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.04 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.

2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig (1200 kPa).

B. Ball Valves:

1. 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. Anvil International, Inc.

b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.

3. Valves NPS 1-1/2 (DN 40) and Smaller: Bronze body with threaded ends.

4. Valves NPS 2 and NPS 2-1/2 (DN 50 and DN 65): Bronze body with threaded ends or ductile-iron body with grooved ends.

5. Valves NPS 3 (DN 80): Ductile-iron body with grooved ends.

C. Bronze Butterfly Valves:

1. 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. Global Safety Products, Inc.

b. Milwaukee Valve Company.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Bronze.

5. End Connections: Threaded.

D. Iron Butterfly Valves:

1. 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. Anvil International, Inc.

b. Global Safety Products, Inc.

c. Kennedy Valve; a division of McWane, Inc.

d. Milwaukee Valve Company.

e. NIBCO INC.

f. Victaulic Company.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Cast or ductile iron.

5. End Connections: Grooved.

E. Check Valves:

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. AFAC Inc.

b. Crane Co.; Crane Valve Group; Crane Valves.

c. Crane Co.; Crane Valve Group; Jenkins Valves.

d. Crane Co.; Crane Valve Group; Stockham Division.

e. Kennedy Valve; a division of McWane, Inc.

f. Milwaukee Valve Company.

g. Mueller Co.; Water Products Division.

h. NIBCO INC.

i. Reliable Automatic Sprinkler Co., Inc.

j. Victaulic Company.

k. Viking Corporation.

2. Standard: UL 312.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

4. Type: Swing check.

5. Body Material: Cast iron.

6. End Connections: Flanged or grooved.

F. Bronze OS&Y Gate Valves:

1. 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. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Stockham Division.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. United Brass Works, Inc.

2. Standard: UL 262.

3. Pressure Rating: 175 psig (1200 kPa).

4. Body Material: Bronze.

5. End Connections: Threaded.

G. Iron OS&Y Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.

b. Crane Co.; Crane Valve Group; Jenkins Valves.

c. Crane Co.; Crane Valve Group; Stockham Division.

d. Hammond Valve.

e. Milwaukee Valve Company.

f. Mueller Co.; Water Products Division.

g. NIBCO INC.

h. United Brass Works, Inc.

2. Standard: UL 262.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

4. Body Material: Cast or ductile iron.

5. End Connections: Flanged or grooved.

H. Indicating-Type Butterfly Valves:

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. Anvil International, Inc.

b. Kennedy Valve; a division of McWane, Inc.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Victaulic Company.

2. Standard: UL 1091.

3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Valves NPS 2 (DN 50) and Smaller:

a. Valve Type: Ball or butterfly.

b. Body Material: Bronze.

c. End Connections: Threaded.

5. Valves NPS 2-1/2 (DN 65) and Larger:

a. Valve Type: Butterfly.

b. Body Material: Cast or ductile iron.

c. End Connections: Flanged, grooved, or wafer.

6. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.

I. NRS Gate Valves:

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. American Cast Iron Pipe Company; Waterous Company Subsidiary.

b. American Valve, Inc.

c. Clow Valve Company; a division of McWane, Inc.

d. Crane Co.; Crane Valve Group; Stockham Division.

e. Kennedy Valve; a division of McWane, Inc.

f. Mueller Co.; Water Products Division.

g. NIBCO INC.

2. Standard: UL 262.

3. Pressure Rating: 250 psig (1725 kPa) minimum.

4. Body Material: Cast iron with indicator post flange.

5. Stem: Nonrising.

6. End Connections: Flanged or grooved.

2.05 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 (1200 kPa) minimum.

B. Angle Valves:

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. Fire Protection Products, Inc.

b. United Brass Works, Inc.

C. Ball Valves:

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. Conbraco Industries, Inc.; Apollo Valves.

b. Kennedy Valve; a division of McWane, Inc.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Potter Roemer.

f. Victaulic Company.

D. Globe Valves:

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. United Brass Works, Inc.

E. Plug Valves:

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. Southern Manufacturing Group.

2.06 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Pressure Rating:

a. Standard-Pressure Piping Specialty Valves: 175 psig (1200 kPa) minimum.

3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.

5. End Connections: Flanged or grooved.

B. Alarm Valves:

1. 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. AFAC Inc.

b. Reliable Automatic Sprinkler Co., Inc.

c. Victaulic Company.

d. Viking Corporation.

2. Standard: UL 193.

3. Design: For horizontal or vertical installation.

4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber**,** and fill-line attachment with strainer.

5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

C. Automatic (Ball Drip) Drain Valves:

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. AFAC Inc.

b. Reliable Automatic Sprinkler Co., Inc.

2. Standard: UL 1726.

3. Pressure Rating: 175 psig (1200 kPa) minimum.

4. Type: Automatic draining, ball check.

5. Size: NPS 3/4 (DN 20).

6. End Connections: Threaded.

2.07 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

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. AFAC Inc.

b. Elkhart Brass Mfg. Company, Inc.

c. Fire-End & Croker Corporation.

d. Kennedy Valve; a division of McWane, Inc.

e. Mueller Co.; Water Products Division.

f. NIBCO INC.

g. Standard: UL 668 hose valve for connecting fire hose.

2. Pressure Rating: 300 psig (2070 kPa) minimum.

3. Material: Brass or bronze.

4. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as required, include transition if required also.

5. Inlet: Female pipe threads.

6. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.

7. Pattern: Angle or gate.

8. Finish: Polished chrome plated.

2.08 NPS 1-1/2 (DN 40) RACK-TYPE HOSE STATIONS

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. AFAC Inc.

2. American Fire Hose & Cabinet.

3. Elkhart Brass Mfg. Company, Inc.

4. Hose Rack:

5. Standard: UL 47.

6. Material: Brass or bronze with polished chrome-plated finish.

7. Type: Hose-rack assembly. Include hose valve, hose rack, water-retention device, hose pins, and hose.

8. Operation: Semiautomatic.

9. Sized to hold fire hose.

B. Hose Valve:

1. Standard: UL 668 NPS 1-1/2 (DN 40), for connecting fire hose.

2. Type: Nonadjustable.

3. Pressure-Control Device: Not required.

4. Hose Valve and Trim Finish: Polished chrome plated.

5. Pressure Rating: 300 psig (2070 kPa) minimum.

6. Pattern: Angle.

7. Material: Brass or bronze.

8. Pressure-Control Device: UL 1468 integral or for field installation if indicated.

9. Size: NPS 1-1/2 (DN 40).

10. Inlet: Female pipe threads.

11. Outlet: Male hose threads according to NFPA 1963 and matching local fire-department threads.

2.09 MONITORS

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. AFAC Inc.

2. Elkhart Brass Mfg. Company, Inc.

3. Potter Roemer.

B. Type: Stationary.

C. Nozzle: UL 401, NPS 2-1/2 (DN 65), brass, adjustable from fog spray to straight stream to shutoff.

D. Horizontal Rotation: 360 degrees with locking device.

E. Vertical Rotation: 80-degree elevation and 60-degree depression with locking device.

F. Waterway: Double brass or stainless-steel tube.

G. Waterway Size: NPS 2-1/2 (DN 65) minimum.

H. Water Stream Flow: 500 gpm (31.5 L/s).

I. Operation: Lever.

J. Base Inlet Size: NPS 2-1/2 (DN 65).

K. Finish: Red-painted body with brass trim.

2.10 ALARM DEVICES

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

B. Electrically Operated Alarm Bell:

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. Fire-Lite Alarms, Inc.; a Honeywell company.

b. Notifier; a Honeywell company.

c. Potter Electric Signal Company.

2. Standard: UL 464.

3. Type: Vibrating, metal alarm bell.

4. Size: 10-inch (250-mm) diameter.

5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Water-Flow Indicators:

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. McDonnell & Miller; ITT Industries.

b. System Sensor; a Honeywell company.

c. Viking Corporation.

2. Standard: UL 346.

3. Water-Flow Detector: Electrically supervised.

4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element

to prevent false signals and tamperproof cover that sends signal if removed.

5. Type: Paddle operated.

6. Pressure Rating: 250 psig (1725 kPa).

7. Design Installation: Horizontal or vertical.

D. 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. AFAC Inc.

b. System Sensor; a Honeywell company.

c. 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.

E. 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. Fire-Lite Alarms, Inc.; a Honeywell company.

b. Kennedy Valve; a division of McWane, Inc.

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 controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

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. WIKA Instrument Corporation.

B. Standard: UL 393.

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

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

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

F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PIPING INSTALLATION

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

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written

approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

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

E. Install drain valves on standpipes. Extend drain piping to outside of building.

F. Install alarm devices in piping systems.

G. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

H. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

I. Fill wet-type standpipe system piping with water.

J. Install electric heating cables and pipe insulation on wet-type, fire-suppression standpipe piping in areas subject to freezing.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15091 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15096 "Escutcheons for Fire-Suppression Piping."

3.03 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

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

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

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

2. Alarm Valves: Install bypass check valve and retarding chamber drain-line connection.

3.05 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 1-1/2 (DN 40) hose-connection valves with flow-restricting device.

D. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device.

E. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 10522 "Fire Extinguisher Cabinets."

3.06 HOSE-STATION INSTALLATION

A. Install freestanding hose stations for access and minimum passage restriction.

B. Install NPS 1-1/2 (DN 40) hose-station valves with flow-restricting device unless otherwise indicated.

C. Install NPS 2-1/2 (DN 65) hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 (DN 65 by DN 40) reducer adapter and flow-restricting device unless otherwise indicated.

D. Install freestanding hose stations with support or bracket attached to standpipe.

E. Install wall-mounted, rack hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-

supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Section 10522 "Fire Extinguisher Cabinets."

3.07 MONITOR INSTALLATION

A. Install monitors on standpipe piping.

3.08 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

3.09 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.

4. Energize circuits to electrical equipment and devices.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings;

grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe fire-suppression standpipe system, NPS 2 (DN 50) and smaller, shall be one of the following:

1. Exposed or within the maintenance areas:

a. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

b. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Concealed:

a. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

b. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. Standard-pressure, wet-pipe fire-suppression standpipe system, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:

1. Exposed or within the maintenance areas:

a. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

b. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Concealed:

a. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

b. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping;

grooved-end-pipe couplings for steel piping; and grooved joints.

E. Standard-pressure, wet-pipe fire-suppression standpipe system, NPS 5 (DN 125) and larger, shall be one of the following:

1. Exposed piping:

a. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

b. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

2. Concealed:

a. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

b. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

PART 4: MEASUREMENT AND PAYMENT

4.01 FIRE-SUPPRESSION STANDPIPES:

A. Fire-Suppression Standpipes will not be measured for payment.

B. Fire-Suppression Standpipes will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 14240

HYDRAULIC ELEVATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Hydraulic passenger elevators.

2. Elevator car enclosures, hoistway entrances and signal equipment.

3. Jacks.

4. Operation and control systems.

5. Accessibility provisions for physically disabled persons.

6. Equipment, machines, controls, systems and devices as required for safely operating the specified elevators at their rated speed and capacity.

7. Materials and accessories as required to complete the elevator installation.

B. Related Sections:

1. Division 3 Sections: Installing inserts, sleeves and anchors in concrete.

2. Division 4 Sections: Installing inserts, sleeves and anchors in masonry.

3. Division 5 Sections:

   a. Providing hoist beams, pit ladders, steel framing, and auxiliary support steel.

   b. Providing steel angle sill supports and grouting hoistway entrance sills and frames.

4. Division 9 Sections: Providing elevator car finish flooring and field painting unfinished and shop primed ferrous materials.

5. Division 16 Sections:

   a. Providing electrical service to elevators, including fused

disconnect switches.

b. Emergency power supply, transfer switch and auxiliary contacts.

c. Heat and smoke sensing devices.

d. Convenience outlets and illumination in machine room, hoistway and pit.

C. Design Requirements: Manufacturer is responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.

1. Contract Documents broadly outline performance features and equipment required, but do not cover details of design and construction of elevator equipment. Compliance with Contract Documents and requirements of local authorities is responsibility of manufacturer and installer.

2. Do not permit name plates or logos identifying manufacturer to be visible to general public.

1.02 SUBMITTALS

A. Product data: When requested, submit product data for the following:

1. Elevator car enclosures and hoistway entrances.

2. Operation, control, and signal systems.

B. Shop Drawings:

1. Show equipment arrangement in the machine room, pit and hoistway. Provide plans, elevations, sections and details of assembly, erection, anchorage, and equipment location.

2. Indicate elevator system capacities, sizes, performances, safety features, finishes and other pertinent information.

3. Show floors served, travel distances, maximum loads imposed on the building structure at points of support and all similar considerations of the elevator work.

4. Indicate electrical power requirements and branch circuit protection device recommendations.

C. Color Selection: Submit color charts of exposed finishes and materials for

color selection.

1. Submit manufacturer's standard samples of exposed finishes and materials selected for the elevator system materials and components.

D. Certificates: Inspection and acceptance certificates of elevator system installation.

E. Operation and Maintenance Data. Include the following:

1. Operation and maintenance instructions.

2. Parts list, with recommended parts inventory.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: An approved manufacturer regularly engaged in manufacturing, installing, and servicing elevators of the type required for the project.

1. The manufacturer of the machine, controller, signal fixtures, door operators cab, entrances, and all other major parts of the elevator operating equipment.

a. The major parts of the elevator equipment shall be manufactured in the United States, and not be an assembled system.

2. The manufacturer shall have a documented, on-going quality assurance program.

B. Installer Qualifications: The manufacturer or an authorized agent of the manufacturer with not less than five years of satisfactory experience installing elevators equal in character and performance to the project elevators.

C. Regulatory Requirements:

1. ASME A17.1 Safety Code for Elevators and Escalators, latest edition or as required by the local building code.

2. National Building Code.

3. NFPA 70 National Electrical Code.

4. NFPA 80 Fire Doors and Windows.

5. Americans with Disabilities Act - Accessibility Guidelines

(ADAAG).

D. Fire-rated entrance assemblies: Opening protective assemblies including frames, hardware, and operation shall comply with ASTM E2074, CAN4-S104 (ULC-S104), UL10(b), and NFPA Standard 80. Provide entrance assembly units bearing Class B or 1 1/2 hour label by a Nationally Recognized Testing Laboratory.

E. Inspection and Testing: Obtain and pay for required inspections, tests, permits and fees for elevator installation.

1. Arrange for inspections and make required tests.

2. Deliver to the Owner upon completion and acceptance of elevator work.

F. Certifications: Submit following:

1. Manufacturer's certification that products furnished for Project meet or exceed specified requirements. Include certification that elevator hoistway dimensions and penthouse dimensions are acceptable to manufacturer.

2. Certificate of compliance from authority having jurisdiction indicating approval of elevator system.

1.04 DELIVERY, STORAGE AND HANDLING

A. Deliver elevator materials, components and equipment in manufacturer's protective packaging.

B. Store materials in a dry protected area provided by others. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage, soiling, or deterioration.

1.05 PROJECT CONDITIONS

A. Verify dimensions of supporting structure at site by accurate field measurements so that elevator Work will be accurately fabricated and fitted to structure and that clearances and alignments are proper for installation of Work.

B. Painting:

1. Except as otherwise specified, paint all metal work provided by the elevator manufacturer and installer.

2. Provide all ferrous metals installed in the hoistway shop primed with

a rust inhibitive primer.

1.06 WARRANTY

A. Warranty: Submit elevator manufacturer's standard written warranty agreeing to repair, restore or replace defects in elevator work materials and workmanship not due to ordinary wear and tear or improper use or care for 24 months from date of Substantial Completion.

1.07 MAINTENANCE

A. Provide Owner with a proposal for maintenance and call back service for a period of 24 months months for elevator from date Final Acceptance. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the elevators in proper operation.

1. Maintenance work, including 24 hour-per-day, 7 day-per-week emergency call back repair service, shall be performed by trained employees of the elevator contractor.

2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.

3. Manufacturer shall have a service office and full time service personnel within a 50 mile radius of the project site.

PART 2 PRODUCTS

2.01 PRODUCTS AND MANUFACTURERS

A. Basis of Design

1. Manufacturer: ThyssenKrupp Elevator, Memphis, TN.

2. Products:

a. Endura Below Ground Conventional

B. Acceptable Manufacturers:

1. Kone Elevator Company, Moline, IL.

2. Otis Elevator, A United Technologies Company, Farmington, CT.

3. Schindler Elevator Corp., Morristown, NJ.

4. US Elevator Corp., Spring Valley, CA.

2.02 MATERIALS

A. Colors, patterns, and finishes: As selected by the Architect from manufacturer's full range of standard colors, patterns, and finishes.

B. Steel:

1. Shapes and bars: ASTM A 36.

2. Sheet: ASTM A 366, cold-rolled steel sheet, commercial quality, Class 1, matte finish, stretcher leveled.

3. Finish: Factory-applied baked enamel.

C. Stainless steel:

1. Shapes and bars: ASTM A 276, Type 300 (18-8).

2. Tubing: ASTM A 269, Type 300 (18-8).

D. Aluminum:

1. Sheet and plate: ASTM B 209, alloy 6063-T52.

2. Extrusions: ASTM B 221, alloy 6063-T52.

E. Glass: Clear laminated safety glass, complying with ANSI Z97.1, nominal 9/16" thickness.

F. Carpet: Refer to Finish Schedule.

2.03 ELEVATOR CRITREA

B. Elevator No. 1:

1. Capacity and Speed: 4500 pounds, 150 FPM.

2. Floors Served: Ground, second, and third.

3. Stops and Openings: 3 stops, 3 openings: 2 Front, 1 Rear.

4. Power Supply: 460/480 volt, 3 phase, 60 hertz.

5. Machine Type and Location: Hydraulic with machine room located on second floor.

6. Operation: Simplex selective collective.

7. Platform Size: Refer to Drawings.

8. Cab Size (Inside Dimensions): Refer to Drawings.

9. Cab Height: 7’-11” to canopy with 7'-4" clear at ceiling.

10. Door Opening: 4'-0" by 7’-0”, two speed right hand opening.

11. Home Landing: Ground floor.

2.04 HOISTWAY EQUIPMENT

A. Platform: Fabricated frame of formed or structural steel shapes, gusseted and rigidly welded with a wood subfloor. Underside of the platform shall be fireproofed.

B. Sling: Steel stiles affixed to a steel crosshead and bolstered with bracing members to remove strain from the car enclosure.

C. Guide Rails: Steel, omega shaped, fastened to the building with steel brackets.

D. Guide Shoes: Slide guides shall be mounted on top and bottom of the car.

E. Guide Rail Lubricators: Provide a leakproof reservoir on top of upper guide shoes. Wool felt wiper shall apply an even, uniform flow of lubricant which shall thoroughly cover face of guide rail.

F. Buffers: Provide substantial buffers in the elevator pit. Mount buffers on continuous channels fastened to the elevator guide rail or securely anchored to the pit floor. Provide extensions if required by project conditions.

G. Jack: Jack unit shall be of sufficient size to lift the gross load the height specified. Factory test jack to insure adequate strength and freedom from leakage. Jack unit shall consist of the following components:

1. Heavy seamless steel tubing plunger accurately turned and polished.

2. Stop ring shall be electrically welded to the plunger to prevent plunger leaving the cylinder.

3. Internal guide bearing.

4. Packing or seal of suitable design and quality.

5. Drip ring around cylinder top.

6. Cylinder made of steel pipe and provided with a pipe connection and air bleeder.

7. Weld brackets to the jack cylinder for supporting the elevator on pit

channels.

8. An auxiliary safety bulkhead shall be provided in the lower end of the cylinder.

9. Provide sealed PVC casing corrosion protection for the jack cylinder by encasing the entire length of the cylinder below ground.

H. Automatic Terminal Limits: Place electric limit switches in the hoistway near the terminal landings. Limit switches shall be designed to cut off the electric current and stop the car if it runs beyond either terminal landing.

I. Automatic Self-Leveling: Provide each elevator car with a self-leveling feature to automatically bring the car to the floor landings and correct for overtravel or undertravel. Self-leveling shall, within its zone, be automatic and independent of the operating device. The car shall be maintained approximately level with the landing irrespective of its load.

J. Failure Protection: Design electrical control circuit so if a malfunction occurs, due to motor starter failure, oil becoming low in the system, or the car failing to reach a landing in the up direction within a pre-determined time, the elevator car will automatically descend to the lowest terminal landing. If power operated doors are used, the doors will automatically open when the car reaches that landing to allow passengers to depart. The doors will then automatically close and all control buttons, except the "door open" button in the car station, shall be made inoperative.

K. Wiring, Piping, and Oil:

1. Provide hoistway wiring in accordance with the National Electrical Code

2. Provide pipe and fittings to connect the power unit to the jack unit. Provide proper grade oil.

L. Emergency Terminal Stopping Device: Provide emergency terminal stopping devices for speeds over 100 FPM. The emergency terminal stopping device shall operate independently of the normal terminal stopping device if it fails to slow down the car at the terminal as intended. Stopping devices shall not be prevented from functioning by a single short circuit caused by a combination of grounds or by other conditions.

1. Normal and emergency terminal stopping devices shall not control the same controller switches unless two or more separate and independent switches are furnished, two or which shall be closed in either direction of travel to complete the circuit to the control valve solenoids in the down direction and to complete the circuit to the

pump motor for the up direction of travel.

2.05 POWER UNIT

A. Power Unit (Oil Pumping and Control Mechanism): A self-contained unit consisting of the following items:

1. Oil reservoir with tank cover and controller compartment with cover.

2. An oil hydraulic pump.

3. An electric motor.

4. Oil control unit with the following components built into single housing; high pressure relief valve, check valve, automatic unloading up start valve, lowering and leveling valve, and magnetic controller.

B. Pump: Positive displacement type pump specifically manufactured for oil-hydraulic elevator service. Pump shall be designed for steady discharge with minimum pulsation to give smooth and quiet operation. Output of pump shall not vary more than 10 percent between no load and full load on the elevator car.

C. Drive: Drive shall be by direct coupling with the pump and motor submerged in the oil reservoir or by multiple V-belts and sheaves of number and size to insure maximum factor of safety. Drive type shall be determined based primarily on the load on the car, travel, and speed.

D. Motor: Standard manufacture motor specifically designed for oil-hydraulic elevator service. Duty rating shall comply with specified speeds and loads.

E. Oil Control Unit: The following components shall be built into a single housing. Welded manifolds with separate valves to accomplish each function are not acceptable. Adjustments shall be accessible and be made without removing the assembly from the oil line.

1. Relief valve shall be externally adjustable and be capable of bypassing the total oil flow without increasing back pressure more than 10 percent above that required to barely open the valve.

2. Up start and stop valve shall be externally adjustable and designed to bypass oil flow during start and stop of motor pump assembly. Valve shall close slowly, gradually diverting oil to or from the jack unit, ensuring smooth up starts and up stops.

3. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.

4. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to ensure smooth "down" starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is traveling when slowdown is initiated.

F. Power controller shall contain electrical contactors, electro-mechanical switches and thermal overload relays. Mount components in a NEMA 1 enclosure. Logic control system shall be microprocessor based and protected from environmental extremes and excessive vibrations.

G. Starting: Provide solid state.

2.06 HOISTWAY ENTRANCES

A. Doors and Frames: Provide complete hollow metal type hoistway entrances at each hoistway opening.

1. Manufacturer's standard entrance design consisting of 14 gauge frames with 2 inch (50 mm) profile, 16 gauge doors, hangers, hanger supports, hanger covers, fascia plates, sight guards, and necessary hardware.

2. Elevator wall interface with hoistway entrance assembly shall comply with elevator manufacturer's requirements.

3. Doors: Flush construction

a. Stainless steel panels, no. 4 brushed finish.

4. Frames: Formed construction.

a. Stainless steel panels, no. 4 brushed finish.

B. Interlocks: Equip each hoistway entrance with an approved type interlock tested as required by code. Interlock shall be designed to prevent operation of the car away from the landing until the doors are locked in the closed position as defined by code and shall prevent opening the doors at any landing from the corridor side unless the car is at rest at that landing or is in the leveling zone and stopping at that landing.

C. Door Hanger and Tracks: Provide sheave type two point suspension hangers and tracks for each hoistway sliding door.

1. Sheaves: Polyurethane tires with ball bearings properly sealed to retain grease.

2. Hangers: Provide an adjustable slide to accommodate the up-thrust

of the doors.

3. Tracks: Drawn steel shapes, smooth surface and shaped to conform to the hanger sheaves.

D. Hoistway Sills: Extruded, with grooved surface, 1/4 inch (6.4 mm) thickness

1. Aluminum: ASTM B 221 aluminum, mill finish.

2.07 CAR ENCLOSURE

A. Car Enclosure:

1. Walls:

a. Reinforced 16 gauge cold-rolled steel.

b. Finish: Stainless steel, no. 4 brushed finish

2. Canopy:

a. Reinforced 14 gauge cold-rolled steel with hinged exit.

b. Finish: Two coats factory applied reflective baked enamel.

3. Ceiling:

a. Suspended type, fluorescent lighting with translucent diffuser mounted in a metal baked enamel frame.

b. Metal finish: Factory applied baked enamel finish.

4. Cab Columns, Front, and Transom: Stainless steel: ASTM A 167, Type 300 stainless steel panels, No. 4 satin finish.

5. Doors: Horizontal sliding car doors reinforced with steel for panel rigidity. Hang doors on sheave type hangers with polyurethane tires that roll on a polished steel track and are guided at the bottom by non-metallic shoes sliding in a smooth threshold groove.

a. Door Finish: Stainless steel panels: No. 4 brushed finish.

b. Cab Sills: Extruded aluminum, with grooved surface, 1/4 inch thickness.

6. Handrail: 2” Flat metal bar, stainless steel no. 4 brushed finish. Provide at side walls only.

7. Ventilation: Two speed exhaust fan mounted on the car top.

8. Pad Buttons: Provide pad buttons on cab front(s) and walls.

   a. Provide one set of vinyl protection pads for the project.

9. Finished Floor: Refer to Finish Schedule.

B. Car Top Inspection: Provide a car top inspection station with an "emergency stop" switch and constant pressure "up-down" direction buttons to make the normal operating devices inoperative and give the inspector complete control of the elevator. Mount the car top inspection station in the door operator assembly.

2.08 DOOR OPERATION

A. Door Operation: Provide a direct current motor driven heavy duty operator designed to operate the car and hoistway doors simultaneously. Door movements shall be electrically cushioned at both limits of travel and the door operating mechanism shall be arranged for manual operation in event of power failure. Doors shall automatically open when the car arrives at the landing and automatically close after an adjustable time interval or when the car is dispatched to another landing. Direct drive geared operators, AC controlled units with oil checks, or other deviations are not acceptable.

1. No Un-Necessary Door Operation: Car door shall open only if the car is stopping for a car or hall call, answering a car or hall call at the present position or selected as the next car up.

2. Door Open Time Saver: If a car is stopping in response to a car call assignment only (no coincident hall call), the current door hold open time is changed to a shorter field programmable time when the electronic door protection device is activated.

3. Double Door Operation: When a car stops at a landing with concurrent up and down hall calls, no car calls, and no other hall call assignments, the car door opens to answer the hall call in the direction of the car's current travel. If an onward car call is not registered before the door closes to within 6 inches of fully closed, the travel will reverse and the door will reopen to answer the other call.

4. Nudging Operation: The doors shall remain open as long as the electronic detector senses the presence of a passenger or object in the door opening. If door movement is obstructed for a field programmable time, a buzzer will sound and the doors will close at reduced speed. If the infra-red door protection system detects a

person or object while closing, the doors will stop and resume closing after the obstruction has been removed.

5. Limited Door Reversal: If the doors are closing and an infra-red beam is interrupted, the doors will reverse and reopen partially. After the obstruction is cleared, the doors will begin to close.

6. Door Open Sentinel: If the doors are opening, but do not fully open after a field adjustable time, the doors will recycle closed then open six times to try and correct the fault.

7. Door Close Sentinel: If the doors are closing, but do not fully close after a field adjustable time, the doors will recycle open then close six times to try and correct the fault.

8. Door Close Assist: When the doors have failed to fully close and are in the recycle mode, the door drive motor shall have increased torque applied to possibly overcome mechanical resistance or differential air pressure and allow the door to close.

B. Door Protection Devices: Provide a door protection system using 40 microprocessor controlled infra-red light beams. The beams shall project across the car opening detecting the presence of a passenger or object. If door movement is obstructed, the doors shall immediately reopen. A mechanical reopening device is not acceptable.

2.09 CAR OPERATING STATION

A. Car Operating Station, General: The main car control in each car shall contain the devices required for specific operation mounted in stainless steel no. 4 integral swing return panel requiring no applied faceplate. The panel shall consist of a series of modules, inclined 20 degrees from vertical for optimum viewing and accessibility.

1. The lowest module shall contain the "door open," "door close," "alarm" buttons and a keyed "emergency stop" switch.

2. Intermediate modules shall contain floor buttons which illuminate when a call is registered and remain illuminated until the call is answered. Raised floor indications and handicap symbols shall be located immediately adjacent to the floor buttons and be fully integrated in the module design. No applied symbols or floor indications or symbols on the buttons shall be permitted.

3. The next module shall contain required switches.

4. The top module shall contain fire service features in accordance with ASME A17.1, Rule 211.3, including operating instructions.

B. Position Indicator: An electronic dot matrix position indicator inclined 20 degrees from vertical and mounted in a module matching the control panel for optimum viewing. As the car travels, its position in the hoistway shall be indicated by the illumination of the alpha/numeric character corresponding to the landing which the elevator is stopped or passing.

C. Emergency Light: An emergency light and capacity plate shall be integrated into a module inclined 20 degrees from vertical. Emergency light shall illuminate automatically upon loss of the building's normal power supply.

D. Emergency Communications System: Provide an emergency communications device mounted in the swing return. Emergency communications device shall comply with Americans with Disabilities Act (ADA) requirements.

E. Auxillary Operating Panel: not applicable in this application.

F. Column Mounted Car Riding Lantern: A car riding lantern shall be installed in the elevator cab and located in the entrance. The lantern, when illuminated, will indicate the intended direction of travel. The lantern will illuminate and a signal will sound when the car arrives at a floor where it will stop. The lantern shall remain illuminated until the door(s) begin to close.

G. Special Accessories:

1. Independent service switch.

2. Inspection switch.

3. Two speed fan/light switch.

4. Telephone jack.

5. Certificate frame.

2.10 CONTROL SYSTEMS

A. Controller: The elevator control system shall be microprocessor based and software oriented and be linked together for purposes of communication by a serial communications link. Control of the elevator shall be automatic in operation by means of push buttons in the car numbered to correspond to floors served, for registering car stops, and by "up-down" push buttons at each intermediate landing and "call" push buttons at terminal landings.

1. Momentary pressing of one or more buttons shall dispatch the car to the designated landings in the order in which the landings are reached by the car, irrespective of the sequence in which the buttons

are pressed. Each landing call shall be canceled when answered.

2. When the car is traveling in the up direction, it shall stop at all floors for which car buttons or "up" hall buttons have been pressed. The car shall not stop at floors where "down" buttons have been pressed, unless the stop for that floor has been registered by a car button or unless the down call is at the highest floor for which any buttons have been pressed. Pressing the "up" button when the car is traveling in the down direction shall not intercept the travel unless the stop for that floor has been registered by a car button or unless the up call is the lowest for which any button has been pressed.

3. When the car has responded to its highest or lowest stop, and stops are registered for the opposite direction, its direction of travel shall reverse automatically and it shall then answer the calls registered for that direction. If both up and down calls are registered at an intermediate floor, only the call corresponding to the direction of car travel shall be canceled upon the stopping of the car at the landing.

B. Microprocessor: Locate the main microprocessor and car controller in the elevator machine room.

1. Microprocessor door operator shall reside in the door operator and control all functions of the elevator door(s).

2. Electronic selector shall reside on the car top and contain hall effect transducers that detect magnetic fields. Magnets, corresponding to floor positions and top/bottom of hoistway are mounted on a perforated metal tape that runs the length of the hoistway.

C. Group Operation: The system shall operate on a real time response, demand basis, constantly scanning and calculating the most efficient car assignment. Hall call assignments shall be based on the availability of each car in the group and shall be based primarily on the principle of the nearest car selection and priority call assignment. Car available status is determined based on the following input:

1. Car position.

2. Direction of car travel.

3. Car calls registered.

4. Direction and unanticipated delay.

5. Perform new calculation and reassignment for each occurrence.

D. Provide a key operated switch in the elevator for the purpose of removing

the car from normal operation. When the switch is in the "independent service" position, the elevator will bypass all landing calls and answer only car calls. The operator will have complete control over the operation of the car.

E. Emergency Power 10D-OC: In the event of a normal power supply failure, the elevator system shall be arranged to lower from an emergency power supply. The emergency power supply shall consist of a battery furnished by the elevator contractor. The elevator contractor shall provide circuitry so after normal power failure and establishment of emergency power, each elevator shall lower to a field adjustable return landing and park with the doors closed. If the designated return landing is above the current position, the elevator shall run down to the next lower landing and park with the doors closed.

2.11 HALL STATIONS

A. Hall Stations, General: Provide buttons with red-illuminating LED halos to indicate call has been registered at that floor for the indicated direction. Faceplates shall be stainless steel no. 4. Provide one set of risers.

1. Each terminal station shall contain one illuminating push button.

2. Each intermediate station shall consist of two illuminating pushbuttons, one for the up direction and one for the down position.

3. Phase 1 firefighters service key switch, with instructions, shall be incorporated into the hall station at the designated level.

B. Floor Identification Pads: Provide door jamb pads at each floor. Jamb pads shall comply with Americans with Disabilities Act (ADA) requirements.

C. Hall Position Indicator: A dot matrix position indicator shall be provided and inclined 20 degrees from vertical and mounted in a module for optimum viewing. As the car travels, its' position in the hoistway shall be indicated by the illumination of the alpha/numeric character corresponding to the landing which the elevator is stopped or passing. When hall lanterns are provided, the position indicator shall be combined with the hall lanterns in the same faceplate.

1. Hall Position Indicator: Main floor only.

2. Faceplates shall match hall stations.

2.12 MISCELLANEOUS ELEVATOR COMPONENTS

A. Oil Hydraulic Silencer: Install an oil hydraulic silencer (muffler device) at the power unit location. Silencer shall contain pulsation absorbing material

inserted in a blowout proof housing arranged for inspecting interior parts without removing unit from oil line. Rubber hose without blowout proof features will not be acceptable.

B. Vibration Pads: Mount vibration pads under the power unit assembly to isolate the unit from the building structure.

C. Sound Insulating Panels: When pump and motor are not submerged, provide panels manufactured of reinforced 14 gauge steel with 1 inch (25 mm) thick 1-1/2 pound fiberglass core attached to interior and mounted on all four open sides of the power unit frame.

D. Sound Isolating Couplings: When pump and motor are not submerged, install a minimum of two couplings in the oil line in the machine room between pump and jack.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before starting elevator installation, inspect hoistway, hoistway openings, pits and machine rooms, as constructed, verify all critical dimensions, and examine supporting structures and all other conditions under which elevator work is to be installed. Do not proceed with elevator installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 INSTALLATION

A. Install elevator systems components and coordinate installation of hoistway wall construction.

1. Work shall be performed by competent elevator installation personnel in accordance with ASME A17.1, manufacturer's installation instructions and approved shop drawings.

2. Comply with the National Electrical Code for electrical work required during installation.

B. Perform work with competent, skilled workmen under the direct control and supervision of the elevator manufacturer's experienced foreman.

C. Supply in ample time for installation by other trades, inserts, anchors, bearing plates, brackets, supports, and bracing including all setting templates and diagrams for placement.

D. Jack Unit Installation: Drill excavation to accommodate installation of plunger-cylinder unit and maintain shaft free of water.

1. Install casings with waterproof seals at pit floor and with waterproof, high-pressure seal at bottom of casings.

2. Place casing full depth of shaft. Align to within 1/4 inch from plumb. Terminate top of casing flush with hoistway pit slab.

3. Install hydraulic piping without routing underground, wherever possible; where not possible, cover underground piping with permanent protective wrapping before backfilling. Backfill around hydraulic lines between plunger and remote machine room casing.

4. Set jack unit-cylinder assembly plumb, centered accurately and shimmed to proper elevation, using centering lugs to prevent dislocation during filling. Fill space between casing and cylinder with clean, dry, compacted sand.

F. Welded construction: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn Parts. Comply with AWS standards for workmanship and for qualification of welding operators.

G. Coordination: Coordinate elevator work with the work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines, and levels designated by the Contractor, to ensure dimensional coordination of the work.

H. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration.

I. Sound isolation: Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent the transmission of vibrations to the structure, and eliminate sources of structure-borne noise from the elevator system.

J. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum safe, workable dimensions at each landing.

K. Erect hoistway sills, headers, and frames before erection of rough walls and doors; erect fascias and toe guards after rough walls finished. Set sill units

accurately aligned and slightly above finish floor at landings.

L. Lubricate operating parts of system, including ropes, as recommended by manufacturer.

3.03 FIELD QUALITY CONTROL

A. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required and recommended by Code and governing regulations or agencies. Perform other tests, if any, as required by governing regulations or agencies.

B. Advise Owner, Contractor, Architect, and governing authorities in advance of dates and times tests are to be performed on the elevator.

3.04 ADJUSTING

A. Make necessary adjustments of operating devices and equipment to ensure elevator operates smoothly and accurately.

3.05 CLEANING

A. Before final acceptance, remove protection from finished surfaces and clean and polish surfaces in accordance with manufacturer's recommendations for type of material and finish provided.

B. At completion of elevator work, remove tools, equipment, and surplus materials from site. Clean equipment rooms and hoistway. Remove trash and debris.

3.06 PROTECTION

A. At time of Substantial Completion of elevator work, or portion thereof, provide suitable protective coverings, barriers, devices, signs, or other such methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period.

DEMONSTRATION

A. Instruct Owner's personnel in proper use, operations, and daily maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation and other building emergencies. Train Owner's personnel in normal procedures to be followed in checking for sources of operational failures or malfunctions.

B. Make a final check of each elevator operation, with Owner's personnel present, immediately before date of substantial completion. Determine that

control systems and operating devices are functioning properly.

PART 4: MEASUREMENT AND PAYMENT

4.01 HYDRAULIC ELEVATORS:

A. Hydraulic Elevators will not be measured for payment.

B. Hydraulic Elevators will not be paid directly, but will be included in the lump sum bid price for maintenance building.

END OF SECTION

SECTION 14420

WHEELCHAIR LIFTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Vertical platform lifts.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each lift.

1. Include plans, elevations, sections, details, attachments to other work, and required clearances.

2. Indicate dimensions, weights, loads, and points of load to building structure.

3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.04 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Sample warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Inspection and acceptance certificates and operating permits.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and

approved by manufacturer.

1.07 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of lifts that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

1.08 MAINTENANCE

A. Provide Owner with a proposal for maintenance and call back service for a period of 24 months for the lift from date of Final Acceptance. Service shall consist of periodic examination of the equipment, adjustment, lubrication, cleaning, supplies and parts to keep the lift in proper operation.

1. Maintenance work, including 24 hour-per-day, 7 day-per-week emergency call back repair service, shall be performed by trained employees of the lift contractor.

2. Submit parts catalog and show evidence of local parts inventory with complete list of recommended spare parts. Parts shall be produced by manufacturer of original equipment.

3. Manufacturer shall have a service office and full time service personnel within a 50 mile radius of the project site.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

B. Regulatory Requirements: Comply with ASME A18.1, "Safety Standard for Platform Lifts and Stairway Chairlifts."

2.02 VERTICAL PLATFORM

A. Vertical Platform Lift, General: Preengineered lift system.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Multilift VPL by Savaria or comparable product by one of the following:

a. Bruno Independent Living Aids, Inc.

b. Butler Mobility Products.

c. Florlift of New Jersey, Inc.

d. Garaventa Accessibility.

e. Giant Lift Equipment Mfg. Co. Inc.

f. Inclinator Company of America.

g. Liftavator, Inc.

h. National Wheel-O-Vator Co., Inc. (The).

B. Platform Size: 34 by 48 inches.

C. Rated Speed: 9 to 12 fpm.

D. Power Supply: 120 V, 60 Hz, one phase.

E. Emergency Operation: Provide manual operation to raise or lower unit in case of malfunction or power loss.

F. Self-Supporting Unit: Support vertical loads of unit only at base, with lateral support only at landing levels.

G. Platform: Steel sheet or galvanized-steel sheet with manufacturer's standard black rubber flooring.

H. Ramp: Retractable ramp matching platform to provide transition from lower floor to lift platform. Ramp lowers to floor automatically when lifts reach lower landing and door opens. Ramp rises automatically when lift control is activated for lift to leave lower landing.

1. Ramp Size: End ramps a minimum of 32 inches wide; length as required for slope.

2. Ramp Slope: Maximum 1:12.

3. Ramp Finish: Finish ramps to match lift platform.

2.03 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500/A 500M.

C. Steel Pipe: ASTM A 53/A 53M; standard weight (Schedule 40) unless otherwise indicated or required by loads.

D. Steel Sheet: ASTM A 1008/A 1008M, cold-rolled commercial steel (CS) or

ASTM A 1011/A 1011M hot-rolled, commercial steel (CS); as required for each use.

E. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use, corrosion resistance, and finish indicated; manufacturer's standard strengths and thicknesses for type of use.

1. Extruded Aluminum: ASTM B 221.

2. Aluminum Sheet and Plate: ASTM B 209.

F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing structural members, guide rails, machines, and other lift components where installation of devices is specified in another Section.

G. Expansion Anchors: Anchor-bolt-and-sleeve assembly of material indicated below with capability to sustain a load equal to 10 times the load imposed as determined by testing according to ASTM E 488 conducted by a qualified independent testing agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.04 FINISHES

A. Steel Factory Finish: Manufacturer's standard baked-enamel or powder-coat finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

B. Aluminum Finishes:

1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

a. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Comply with ASME A18.1 and manufacturer's written instructions for installation of lifts unless otherwise indicated.

B. Minimum Headroom Clearance: Verify that installed lift will have a minimum headroom of 80 inches above any point on platform floor at any point of travel.

C. Wiring Method: Conceal conductors and cables within housings of units or building construction. Do not install conduit exposed to view in finished spaces.

D. Coordinate runway doors with platform travel and positioning, for accurate alignment and minimum clearance between platforms, runway doors, sills, and door frames.

E. Position sills accurately and fill space under sills solidly with nonshrink, nonmetallic grout.

F. Adjust stops for accurate stopping at each landing.

G. Adjust retractable ramps to meet maximum allowable slope and change-in-elevation requirements, and to lie fully against landing surfaces.

H. Lubricate operating parts of lift, including drive mechanism, guide rails, hinges, safety devices, and hardware.

3.02 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of lift installation and before permitting use of lifts, perform acceptance tests as required and recommended by ASME A18.1 and authorities having jurisdiction.

B. Operating Test: In addition to acceptance testing, load lifts to rated capacity and operate continuously for 30 minutes between lowest and highest landings served. Readjust stops, signal equipment, and other devices for accurate stopping and operation of system.

3.03 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lifts. Include a review of emergency systems and emergency procedures to be followed at time of operational failure and other building emergencies.

B. Check operation of lifts with Owner's personnel present and before date of Substantial Completion. Determine that operating systems and devices are functioning properly.

C. Check operation of lifts with Owner's personnel present not more than one month before end of warranty period. Determine that operating systems and devices are functioning properly.

PART 4: MEASUREMENT AND PAYMENT

4.01 WHEELCHAIR LIFTS:

A. Wheelchair Lifts will not be measured for payment.

B. Wheelchair Lifts will not be paid directly, but will be included in the lump sum bid prices for maintenance building

END OF SECTION

SECTION 14450

VEHICLE LIFTS

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. This Section specifies furnishing, installing and testing portable lifts. Provide necessary labor, services, and incidental required for complete equipment installations.

2. In-ground lift shall be capable of lifting all of the vehicles in the Owner's fleet including cars, trucks, vans, and buses with a maximum dimensions of 730 inches long by 102 inches wide and up to 66,790 pounds.

B. Related Documents:

1. Drawings, MTA General Provisions for Construction Contracts, Supplementary General Provisions and Division 1 specification sections apply to the work of this section.

C. Related Sections:

1. Section 01780 –Close Out.

2. Section 01600 – Products.

3. Section 11005 – Basic Equipment Materials and Methods.

4. Division 15 - Mechanical.

5. Division 16 - Electrical.

1.02 QUALITY ASSURANCE/QUALITY CONTROL:

A. The manufacturer shall guarantee the lifts' compliance with all applicable provisions set forth by ALI ALCTV "Standard for Automotive Lifts – Safety Requirements for Construction, Testing and Validation".

B. The manufacturer shall certify that the vehicle lift installer has satisfactory past experience in the installation of equipment of the type specified herein. Manufacturer's certification shall include the following items:

1. A letter certifying that the proposed vehicle lift installer has

submitted satisfactory evidence that the installing firm has had successful past experience in the installation of similar equipment in the past 2 years.

2. Provide a list of a minimum of three locations where similar equipment installed by the proposed vehicle lift installer is in service, including the duration of service.

3. Provide the name of a person contacted by the manufacturer at each installation location referred to above, who is familiar with the operation and maintenance of the vehicle lift equipment. Include a brief synopsis of conversation regarding lift operation and maintenance.

C. Construction Conditions and Coordination:

1. Before submitting bid, review the Contract Documents and become thoroughly familiar with the conditions affecting the work. No additional compensation will be granted due to extra work made necessary by his failure to investigate such conditions.

2. Prior to initiating work specified in this Section examine all work prepared by other trades to receive the work of this Section and report any defect affecting installation to the Engineer for correction. Commencement of work will be construed as complete acceptance of preparatory work by other trades.

3. Plan installation of new work and connections to any existing work if applicable to insure minimum interference with other Work of the Contract.

4. The Work shall be carried out in accordance with actual field requirements and shall not depend on the extent of details shown on plans.

5. Verify the critical building dimensions associated with the equipment prior to final fabrication and installation of the equipment.

6. Coordinate the fabrication and installation of the equipment with the other Work of the Contract and schedule so that there will be no delay in the proper installation and completion of any part or part of each respective work task wherein it may be interrelated with that of this Contract so that generally all construction work can proceed in its natural sequence without unnecessary delay.

7. Examine all Contract Drawings relating to this Project, and verify

all governing conditions at the site and become fully informed as to the extent and character of the work required and its relation to other work in this Project. No consideration will be granted for any alleged misunderstanding of the materials to be furnished for work to be done.

D. References:

1. Automotive Lift Institute [ALI].

   a. ALI ALCTV, Standard for Automotive Lifts - Safety Requirements for Construction, Testing and Validation.

2. National Electrical Manufacturers Association (NEMA).

3. Underwriter Laboratories, Inc. (UL).

4. National Electrical Code (NEC).

5. Institute for Electrical and Electronics Engineers, Inc. (IEEE).

6. American National Standards Institute (ANSI).

7. American Bearing Manufacturers Association (ABMA).

1.03 SUBMITTALS:

A. Submit shop drawings, catalog cuts and all manufacturer's data covering all equipment covered in this section. If submitting catalog cuts, assure that the models specified or submitted are highlighted or underlined. No generic information will be accepted. Submit the following for review and approval:

1. Shop drawings.

2. Product data.

3. Installation Instructions.

4. Operations and maintenance manuals.

B. Shop Drawings: Shop drawings shall consist of the following as applicable:

1. Layout drawings showing equipment layout, elevations, conduit runs, utility layout and hook-ups, and all required dimensions.

2. Detail drawings.

3. Foundation and structural support drawings including anchor bolt plan and elevation.

4. Utility connection plan.

5. Electrical control diagram.

6. Electrical equipment layout, with all motors, limit switches, solenoid valves, disconnects, control panels, etc. located and labeled.

7. Piping systems including pipe routing, sizing, valving, etc. fully noted and scheduled.

C. Product Data: Manufacturer's literature including catalog cuts, pamphlets, descriptive literature, equipment specifications, performance and test data, and brochures which adequately describe the piece of equipment or product. Provide sufficient product and preventive maintenance information to properly address each equipment item and all major components installed to the maximum extent possible during the equipment submittal and approval phase of the project.

D. Installation Instructions: Manufacturer's recommended installation instructions and manufacturer's installation drawings.

E. Operations and Maintenance Data:

1. In accordance with Section 01780 and 11005.

1.04 TRAINING PROGRAM:

A. In accordance with Section 01780 and 11005.

1.05 GENERAL DESIGN AND FABRICATION REQUIREMENTS:

A. Equipment shall be designed, fabricated, installed and adjusted to secure the best commercially available results with respect to smooth, quiet, convenient and efficient operation, durability, economy of maintenance and operation, and the highest standards of safety.

B. It is not the intent of these Specifications to detail the design and fabrication of the various parts of the equipment, but is expected that the type, material, design, workmanship and fabrication of each part shall be fully adequate for the service required, durable, properly coordinated with all other parts, in accordance with the best commercial standards and of the highest commercial efficiency. The components of electric circuits shall be of ample and proper size, design and material to avoid injurious

heating and arcing, and all other objectionable effects which may reduce the efficiency of operation and economy of maintenance and upkeep below the best commercially available results. Minimum requirements are given herein for the certain parts of equipment. Equivalent requirements approved by the Engineer shall apply to such parts as are of special design, construction or material and to which the specified requirements are not directly applicable. These minimum requirements as a whole shall also be considered as establishing proportionate general minimum standards for all parts of the equipment.

C. The Engineer may permit variations from the requirements of these Specifications to permit the use of the manufacturer' standard equipment, provided that in his opinion such standard equipment is in every way adequate for the intended use and meets the full intent of these Specifications. All proposed variations shall be called to the attention of the Engineer in writing and shall be made only if approved in writing.

D. Certain design limitations and tests are herein specified as a partial check on the adequacy of design, fabrication, and materials. These requirements do not cover all features necessary to insure satisfactory and approved operation of the equipment. Conformity with these requirements shall, in no way, supersede the general requirements as to satisfactory and efficient operation of the equipment.

1.06 SHOP PAINTING:

A. Equipment shall be given one shop prime coat of approved rust-inhibitive paint containing at least 50 percent rust-inhibitive pigments and manufacturer's standard finish coat system. Shop drawings shall indicate brand and type of paints.

1.07 ELECTRICAL REQUIREMENTS:

A. Power supply for equipment shall be 480 volts, 3-phase, 60 hertz unless otherwise specified.

B. Provide transformers for equipment as required to step down the specified supply voltage to provide lower voltage for controls and accessories and to provide voltage compatible with equipment as required.

C. Wiring shall be provided for complete installation of all equipment and accessories and shall be adequate for proper operation of equipment. Provide a disconnect switch for each equipment item requiring electric power; disconnect switch shall meet requirements of the respective equipment item manufacturer. Permanently label each disconnect switch to identify corresponding equipment item; labeling method shall be subject to

approval of the Engineer. Power wiring to line side of disconnect switch will be provided through work outside this contract. Contractor/supplier shall make connection to secondary side of disconnect switch and provide all wiring and conduit from this point, including wiring to controllers and starters. Provide 480 volt equipment with electric fusible disconnecting means, sized and fused as required for each equipment item. All disconnect switches shall be fused with 100,000 amp limiter fuses. Provide 120 volt equipment with electric thermal overload disconnect means sized as required for each equipment item. Wire and cable for light, power and signal circuits shall conform to those specified in the NEC. In no case shall maximum current carried exceed that specified by National Electrical Code for type of conductor used. Provide conduit where required; all wiring and conduit shall be in accordance with the requirements of NEC. Wiring and conduit for power shall be provided to all equipment from power connection sources within the building. See building drawings for power connection sources provided.

D. Motors:

1. Motors shall be high efficiency motors each bearing the UL label and constructed to standard of NEMA, IEEE, ANSI, and ABMA.

2. Motors shall be suitable for operation on the electrical service indicated.

3. There shall be no open motors provided. Motors shall be totally enclosed or drip-proof.

4. Provide motors with epoxy encapsulated insulation for severe usage in a corrosive atmosphere.

5. Motors rated one horsepower or greater shall have a full-load power factor of 85 percent or higher. Motors rated 25 horsepower and over shall be designed for reduced voltage starting. All motors shall be of the highest energy efficiency design available for the application.

6. 60 hertz unless otherwise specified.

E. Provide transformers for equipment as required to step down the specified supply voltage to provide lower voltage for controls and accessories and to provide voltage compatible with equipment as required.

1. Electrical enclosures to be NEMA 12 for indoor units and NEMA 4 for outdoor units unless otherwise noted on the Contract Drawings.

2. Starters shall be complete with two sets of auxiliary contacts; one set normally open; one set normally closed.

3. For motors 25 HP or greater, provide solid state type reduced voltage starters.

F. Control devices necessary for proper operation shall be provided and shall be located to permit efficient operation of the equipment, and where possible shall be grouped in a factory-fabricated approved control panel.

G. Switches, lights and control functions shall be identified with legend decals.

1.08 GASKETS AND FASTENERS:

A. Provide new gaskets wherever gasketed mating equipment items or pipe connections have been dismantled. Gaskets shall be in accordance with manufacturer's recommendations.

B. Replace all assembly bolts, studs, nuts and fasteners of any kind which are bent, flattened, corroded, or have their threads, heads or slots damaged.

C. Furnish all bolts, studs, nuts and other fasteners for make-up of all connections to equipment and replace any of these items damaged in storage, shipment or moving.

1.09 EQUIPMENT:

A. Equipment, machinery and materials shall be as specified in this section.

B. Equipment shall be factory-finished with manufacturer's standard primer and finish coats of paint.

C. All piping, valves, fittings, conduits and wiring required for the equipment installation shall be in accordance with the applicable portions of the overall construction contract, except where specified by the Equipment Specification.

1.10 HOLES, OPENINGS AND INSERTS:

A. Provide holes and openings in floors, walls, ceilings and roofs as required.

B. Core drill holes in existing concrete and masonry work using dustless method. Install concrete inserts and flashings as required. Grout in holes in walls, floor and roof slabs after installation of equipment, and leave them in a completely neat and sealed condition.

C. Repair holes in non-masonry surfaces to match existing materials. Seal

with appropriate matching materials.

D. Paint or coat repaired match existing adjacent surfaces.

1.11 SETTING AND ALIGNING EQUIPMENT:

A. Equipment shall be set and aligned in accordance with manufacturer's recommendations, approved shop drawings and applicable standards of trade practice.

B. Equipment shall be set true and level. Demonstrate adequate leveling of installed equipment.

C. Re-tighten bolted connections after installation.

1.12 CLEANING AND PROTECTION

A. Clean fabricated assemblies and equipment items thoroughly before and after operating and testing.

B. Protect equipment from damage, deterioration, paint or coating spills or spots, corrosion, or harm from any source.

1.13 CONCRETE FOUNDATIONS:

A. Provide concrete foundations for equipment as indicated on the Contract Drawings or as specified herein.

B. Concrete and reinforcement shall conform to manufacturer’s suggested installation or all required governing codes.

C. Provide anchor bolts as required for equipment to be mounted.

D. Provide grouting as necessary to stabilize equipment bases to concrete foundations.

1.14 MOTORS AND DRIVES:

A. Motors and drives shall be checked carefully for correct rotation and alignment before placing equipment into operation.

B. Couplings shall be disconnected and realigned before placing into service or testing.

C. Belt drives shall be adjusted and worn belts replaced in sets. Speed adjustment shall be subject to approval of the Engineer.

1.15 INSPECTION:

A. Work will be inspected by the Engineer periodically during the course of construction.

B. Provide for inspections by all other trades having jurisdiction over the work performed during the progress of the work.

C. At time of final inspection, furnish certificates of final approval by all those having jurisdiction as applicable.

1.16 FIELD PAINTING:

A. Field painting equipment, including touch-up painting, if any, is included under this Section of Specifications. Normally, equipment shall be factory-finished as previously specified.

B. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish matching the factory finish.

1.17 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. Deliver, store, and handle products without damaging them.

1. Receive, unload, check, protect, and store equipment in facilities suitable to keep it clean, dry, and free from damage, vandalism, and pilferage.

2. Pay demurrage charges and claims for damage resulting from unloading operations.

3. Examine equipment for visible and concealed damage. Report any damage to carrier, supplier, and the Engineer as soon as possible.

B. Protect equipment from loss, deterioration, and damage until work is complete.

1. Protect installed equipment prior to start-up and Final Acceptance.

2. Protect exposed finished surfaces with removable coating or film, cover openings to exclude dirt and fouling materials, and protect unfinished surfaces against rust, corrosion, and other damage.

3. Protect equipment from paint or coating spills and spots.

1.18 WARRANTY:

A. Manufacturer shall warrant all equipment including parts and labor for a period of two (2) years from date of acceptance.

B. Contractor shall provide written documentation from the manufacturer that warranty service will be available at the delivery location(s) by a dealership franchised by the manufacturer. Service shall be provided within 24 hours after notification from the Owner.

C. Parts shall be available from a dealership franchised by the manufacturer. The dealership shall normally stock all consumables and parts that could reasonably be expected to fail during normal use of the lift.

PART 2 PRODUCTS

2.01 PORTABLE BUS LIFTS (SET OF 4 OR 6):

A. Equipment Item Number:

1. MB-2 Portable Bus Lifts 4 Post: 36 Plug In Units required.

2. CW-3 Portable Bus Lifts 6 Post: 12 Plug In Units required.

B. Acceptable manufacturers:

1. Products of the following manufacturer are the standard of quality for the portable bus lifts:

a. Stertil-Koni USA, Inc.

200 Log Canoe Circle

Stevensville, MD 21666

Telephone: (800) 336-6637 or (410) 643-9001

Email: request info (lifts@stertil-koni.com)

2. Products of equal quality and utility of other approved manufacturers will be accepted.

C. Requests for substitutions

1. Will be considered in accordance with provisions of Section 01600.

2. Requests for changes on products, materials, equipment and

methods of construction required by the contract documents by the Contractor after the award shall be considered requests for "substitutions", and shall follow the procedures outlined within the bid documents for Substitutions.

3. Any substitution of specified lift requiring modifications of foundation system detailed will be the responsibility of the Contractor.

4. The Contractor shall provide for any and all engineering and redesign of foundation system as a result of substitution.

5. Under no circumstances will extra payment be permitted as a result of additional work to accommodate any equipment substitution.

D. General Description

1. The lift system shall consist of four (4) or six (6) portable wheel engaging type lift stations with tire contact adapters, and operating controls.

2. Lift shall be capable of handling all vehicles in Owner’s fleet.

3. The base frame of the lifting column shall be of a rectangular design with mitered rear corners to permit a narrow turning radius. The contact pattern to the foundation under the column shall be triangular in design to ensure uniform contact with the lifting foundation.

E. Lifting Capacity:

1. Each column shall have a nominal rated capacity of 18,000 lbs. per jack.

2. Lifting and Column Height:

a. The achieved lifting height of the column shall be no less than 69 inches when measured from the foundation on which the column rests to the bottom of the lifting fork.

b. Column height shall not be greater than 102 inches when fully collapsed and 143.5 inches when the carriage has achieved maximum height.

3. Tire Size:

a. Wheel contact forks shall freely accept tires with rim

diameters between R 17 and R 22.5 without modification. Optional reduction sleeves shall be available to narrow the contact forks to allow the lifting of tires with smaller rim diameters. With the installation of one reduction sleeve the operator shall have the ability to lift vehicles with rim diameters between R15 and R17.

4. Pallet Jack Mechanism:

   a. The pallet jack mechanism shall have a gas shock incorporated into its design which will dampen the impact of floor deviations experienced while the column is relocated as well as to prevent damage to the pallet jack mechanism from overloading.

   b. The gas shock will ensure that the column settles to the lifting foundation if the operator neglects to release the pallet jack before rising.

   c. Pallet jack mechanisms that do not incorporate a gas shock to protect the operator and column shall be unacceptable.

5. Wheels:

   a. The column shall be fitted with fixed front roller wheels fabricated from oil impregnated nylon so as to be non-destructive to the foundation on which the column rests. Columns that utilize steel roller wheels shall not be acceptable.

   b. Floor pressure at the front roller wheel location shall be no greater than 7000 psi.

6. Controls:

   a. The various functions of the mobile lifting system shall be initiated from the control panels on the columns.

   b. Each control box (primary and secondary) shall at a minimum:

      i. An "up" button.

      ii. A "down" button.

      iii. PCB-printed circuit board.

iv. Motor relays.

v. Transformer for all voltages with 24 VDC output for the control circuit.

vi. Reserve fuses.

vii. Connectors for communication cables with hinged sealing caps fitted with gaskets.

viii. Lock to prevent unauthorized entry into box.

ix. A "select" button to initial start up and column selection.

x. LEDs to illustrate single, all or pair operation as well as fault condition.

xi. A "lock release" button.

xii. A "slow (turtle)" initiate button for slowed lowering.

c. Each control panel designated as the primary shall contain the following as a minimum:

i. Input power supply cable.

ii. Main power switch.

d. The control panel of each column shall be fitted with a button that displays a turtle. The function of the turtle button shall be so that the operator can initialize the system to lower at a reduced speed to aid in the placement of support stands and the installation of under vehicle components.

e. Each column shall be fitted with an individual analog height measuring device. This height measuring device shall ensure that the height of each column in the set remains synchronized at the height initiated by the operator. The height measuring device shall also allow, through single operation, that the operator can raise any column to its individual maximum height.

f. The electrical connection of the communication cables of the lifting system shall be a closed loop. The control system

shall immediately disconnect the high voltage that is transmitted through the communication cables at the instant that the communication loop is opened.

g. Interconnecting communication cables shall be of a heavy-duty type with a minimum diameter of 0.75 inch. The construction of the cable shall incorporate an outer oil resistant jack covering a layer of interlocking steel braids over another layer of insulation, all of which encase the individually insulated conductors. The cable shall be design to withstand being drive over occasionally with pneumatic tires. Any communication cable that will not withstand pneumatic tire traffic without suffering damage is not unacceptable.

h. Control panel shall be rated IP 65. . Control panels that do not meet IP 65 standards are unacceptable.

7. Drive Mechanism:

a. The drive system shall be hydraulic and shall permit lifting without any pulsation, jerks, or unsteady lifting. Lifting shall be smooth. The hydraulic power unit shall be an electrically-powered pump, flow control valves, and a fluid reservoir.

b. Lifting carriage shall ride on durable oil filled nylon guide rollers. Guide rollers shall require no lubrication and no maintenance. Guide rollers made of hard steel or any other steel type shall not be accepted. Also carriages that operate with a sliding blocks system shall be unacceptable.

c. Each hydraulic cylinder shall be equipped with a hose burst check valve to prevent decent in the event of a major fluid leak.

8. Safety Devices:

a. An independent and fail-safe mechanical locking system shall be present on each column. This safety device shall be totally independent from the lifting drive system. Systems that utilize non-load bearing "safety nuts" shall not be acceptable since they are integrated with the lifting drive itself.

b. Increments on lifting carriage locking profile shall not be greater than 1.375 inches and the first locking position shall

engage after no more than five inches of lifting. Columns with locks that engage above five inches are not acceptable.

F. Power Requirements

1. Motor - 440 volt, 3-phase, 60 hertz. (Wired for 480 volts.)

2. Operating Amps: 4 posts @ 208 volts: 15 amps

3. Control Voltage - 110 volts

4. Provide NEMA L16-30P plugs.

G. Accessories

1. Furnish 2 complete sets of power/control cables, to serve as spare cables.

2. Provide optional reduction sleeves to narrow the contact forks to allow the lifting of tires with smaller rim diameters. With the installation of one reduction sleeve the operator shall have the ability to lift vehicles with rim diameters between R15 and R17. With the installation of two reduction sleeves, the operator shall have the ability to lift vehicles with rim diameters as small as R12.

3. Provide retractable wheel design to ensure no loaded wheel contact with concrete with the columns are loaded.

4. Mobile Support Stand: The support stand shall have a capacity of 15,000 pounds with a cradle support pad. The stand shall be adjustable from 52 inches to 78 inches, in increments of three inches (3 inches). Further, the stand shall be designed and engineered to sustain three-time its rated load carrying capacity and finished in OSHA safety green. Two (2) wheels and a handle shall be provided for easy maneuvering of stand(s). Quantity: Six (6) each.

5. Screw Fine Adjustment (Model SP-75): For Model AB-6-20 Mobile Support Stand. Shall be made of a quarter inch (1/4) steel plating with a machined turret-head allowing the mounting pad to make direct contact with the vehicle frame. One each stand.

H. Portable Bus Lifts shall be Mobile Lifting Columns Model ST 1082 as manufactured by Stertil-Koni USA, Inc.

PART 3 EXECUTION

3.01 EXAMINATION:

A. Verify existing conditions before starting work.

B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.

C. Test soil to determine corrosive characteristics. Take necessary measures to protect in-ground equipment with a cathodic protection system if needed.

3.02 INSTALLATION:

A. Install lift in strict accordance with the approved shop drawings and manufacturer's installation instructions.

B. Electrical Interface:

1. Electric services for equipment are specified as work of Division 16 – Electrical, and are terminated near the piece of equipment in a shut-off means. As part of the work of this Contract, extend these services to the equipment and make the associated connections as recommended by the equipment manufacturer.

C. Proceed with start-up, testing and instructions.

D. The following utilities will be provided as work of other sections:

1. 480 VAC / 208 VAC, 3 phase, 60 Hz.

2. Compressed Air, 100 psig maximum, 2 CFM maximum oil-free, with filter and regulator.

3. Contractor shall be responsible for any other utilities required.

E. Contractor shall be responsible for coordinating with the manufacturer regarding the scheduling, delivery and preparations necessary to install the specified equipment.

F. Contractor shall coordinate with the manufacturer to ensure floor slabs and recesses are adequate to mount and support equipment.

3.03 FIELD QUALITY CONTROL:

A. Provide the services of a qualified manufacturer's representative to perform the following:

1. Supervise preparatory work performed by other trades.

2. Supervise installation.

3. Prior to substantial completion of the facility, supervise testing, by the Contractor in the presence of the Owner to ensure proper operation of the equipment.

3.04 TRAINING:

A. The contractor shall provide training in accordance with the requirements of Division 1 and Section 11005 and this section.

B. Operations and Maintenance Manuals shall be approved and accepted prior to the training and will be provided as required for reference materials during class presentations.

PART 4 : MEASUREMENT AND PAYMENT

4.01 PORTABLE BUS LIFTS (SET OF 4 OR 6):

A. Portable Bus Lifts (MB-2 and CW-3) will not be measured for payment.

B. Portable Bus Lifts (MB-2 and CW-3) will not be paid directly, but will be included in the lump sum bid prices for the Maintenance Building.

END OF SECTION

SECTION 14513

FORKLIFTS

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. The work specified in this section includes furnishing, installing, and testing at locations shown on the Drawings. All wiring, conduit and controls required to connect chargers for this equipment to building utilities are also a part of the work of this section.

B. Related Documents:

1. Drawings, MTA General Provisions for Construction Contracts, Supplementary General Provisions and Division 1 specification sections apply to the work of this section.

C. Related Sections:

1. Section 01110 - Summary.

2. Section 01300 - Submittals.

3. Section 01450 - Quality Assurance and Quality Control.

4. Section 01780 - Contract Close Out.

5. Section 11005 - Basic Equipment Materials and Methods.

6. Division 15 - Mechanical

7. Division 16 - Electrical

1.02 QUALITY ASSURANCE;

A. The manufacturer shall certify that the forklifts and lift trucks comply with applicable OSHA standards.

B. References

1. American National Standards Institute (ANSI):

a. B56.1, Safety Standard for Powered Industrial Trucks.

b. B10A Safety Standard for Explosion Proof Class I, Division 2.

2. UL Listing for Class "E" fire and electric shock hazard.

3. Occupational Safety and Health Administration (OSHA)

a. 29 CFR 1910 Occupational Safety and Health Standards.

1.03 SUBMITTALS:

A. Pursuant to the provisions of Section 01300, Submittals and Section 11005, Basic Equipment General Materials and Methods the Contractor shall submit:

1. Material and Equipment List.

2. Product Data (e.g., catalog cuts, manufacturer's data, manufacturer's certificate of conformance or compliance, certified test reports, samples).

3. Shop Drawings.

4. Schedule of Work.

5. Training Program and Operations and Maintenance Manuals.

6. Spares/Maintenance Materials.

7. Results of tests specified in Article 3.03.

PART 2 PRODUCTS

2.01 FORKLIFT AND CHARGING STATION, 6000 POUND:

A. Equipment Item No. PS-10, one required.

B. Acceptable Manufacturers:

1. The products of the following manufacturer are specified as the standard of quality for the Forklift and Charging Station, 6000 Pound.

a. Clark Material Handling Co.

2317 Alumni Park Plaza

Lexington, KY 40507

Telephone: (859) 288-1200

2. Products of equal quality and utility of the following manufacturers will be accepted.

a. Crown Equipment Corporation

40 S. Washington Street

New Bremen, OH 45869

Telephone: (419) 629-2311

b. Yale Materials Handling Corp.

15 Junction Road

Flemington, NJ 08822

Telephone: (800) 233-9253

C. Provide 6,000 pound capacity, cushion tire lift truck with the following construction features:

1. 48 volt electrical system.

2. Drum and shoe service brake. Petal actuated parking brake, hand release parking brake.

3. Outriggers and forks must be adjustable.

4. Triple stage uprights with C-channel outer rails and I-section inner and intermediate rails with 48 inch load backrest.

5. Hydrostatic power steering.

6. Hydraulic system.

7. Electrical controls:

a. AC traction and pump control.

b. Drive system stall warning

c. Three forms of regenerative braking,

d. Ramp start and control roll back features

e. Accurate speed control.

8. 100% AC system

9. Motors are totally enclosed

10. Wall mounted automatic battery charger designed to recharge above specified battery in one 8 hour shift. Charger to operate on 480 volts, 3 phase, 60 hertz power supply. Locate charger as shown on the Drawings.

D. Dimensions and Capacities:

1. Capacity: 6,000 pounds at 24 inch load center.

2. Maximum fork height with rated load: 144 inches minimum.

3. Upright tilt: 5 degrees forward, 6 degrees back.

4. Fork size: 42 x 5 x 1.75 inches

5. Approximate overall dimensions:

a. Width: 43.9 inches maximum.

b. Length to fork face: 87.7 inches.

c. Height: 88 inches with upright lowered, 189 inches with upright extended.

6. Approximate turning radius: 73.9 inches.

7. Speeds (approximate):

a. Travel: 9.8 mph with load; 10.8 mph without load.

b. Lift: 82 fpm with load; 104 fpm without load.

c. Lowering: 92 fpm with load; 80 fpm without load.

E. Forklift with Charging Station shall be Model No. ECX 30 with Deka Industrial Battery Model 18-D85-25-1020AHC and Ametek Model 1050H3-18C Charger as manufactured by Clark Material Handling Co.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install equipment specified herein in strict accordance with the approved shop drawings and manufacturer's installation instructions.

B. Mount battery charger at location indicated on the Drawings at heights recommended by the manufacturer. Provide mounting hardware as required.

C. Proceed with equipment start-up, testing, and instructions in accordance with Section 11005

3.02 FIELD QUALITY CONTROL:

A. Provide the services of a qualified manufacturer's representative to perform the following:

1. Supervise installation.

2. Supervise testing, in the presence of the Engineer to ensure proper operation of the equipment.

3.03 FIELD TESTING:

A. Perform testing of the equipment and system in accordance with the requirements specified in Section 01450 Perform and document all testing procedures recommended by the manufacturer. Include the following tests:

1. Load testing.

2. Accessibility

3. Operation testing.

3.04 TRAINING PROGRAM AND OPERATION AND MAINTENANCE MANUALS:

A. Provide a training program and operation and maintenance manual in accordance with the requirements specified in Section 01780 and 11005.

PART 4 : MEASUREMENT AND PAYMENT

4.01 FORKLIFT AND CHARGING STATION:

A. Forklift and Charging Station (PS-10) will be measured for at the contract unit price bid per each.

B. Forklift And Charging Station (PS-10) will be paid per each, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 14630

BRIDGE CRANE

PART 1 GENERAL

1.01 DESCRIPTION:

A. This Section specifies furnishing, installing and testing overhead bridge crane, complete with hoist, crane, track, electrifications and controls at locations indicated on the Contract Drawings.

B. The provisions of Section 11005 apply to the work of this Section.

C. Related Documents:

1. Drawings, MTA General Provisions for Construction Contracts, Supplementary General Provisions and Division 1 specification sections apply to the work of this section.

D. Referenced Sections

1. Section 01300 – Submittals
2. Section 01450 – Quality Assurance and Quality Control.
3. Section 01780 – Close Out.
4. Section 05500 – Metal Fabrications
5. Section 11005 – Basic Equipment Materials and Methods.
6. Electrical: Division 16.

1.02 QUALITY ASSURANCE:

A. Reference Standards: Requirements of regulatory agencies: Comply with all applicable Federal, State and with local codes having jurisdiction including:

B. NFPA-70 National Electric Code (NEC)

1. For Underhung Bridge Cranes and Monorail Systems:

a. ANSI B30.11 Safety Standard for Monorails and Under hung Cranes

b. ANSI MH27.1 Specifications for Under hung Cranes and Monorail Systems

2. For Hoists:

   a. ANSI B30.16 Safety Standard for Overhead Hoists, HMI Standard - Underhung

   b. ANSI/ASME HST-4M Performance Standards for Overhead Electric Wire Rope Hoists

3. General Standards:

   a. ASTM International

      i. ASTM A36 – Standard Specification for Carbon Structural Steel.

   b. American Welding Society (AWS) D14.1 Specifications for Welding Industrial and Mill Cranes and D1.1 Code for Welding in Building Construction.

   c. Specifications for Design, Fabrication and Erection of Steel Buildings of the American Institute of Steel Construction (AISC)

   d. Underwriters Laboratory (UL)

   e. Crane Manufacturer's Association of America. (CMAA)

      i. CMAA 70 – Specifications for electric overhead traveling cranes

   f. Occupational Safety and Health Administration (OSHA)

   g. National Electric Code (NEC)

   h. National Electrical Manufacturers Association (NEMA)

C. Furnish all materials and labor necessary to meet these requirements and to obtain approvals of inspections and tests.

D. Materials - All materials shall be new, and the completed Overhead Handling System shall be essentially the product of one crane manufacturer regularly engaged in the production of such equipment.

E. Service Class - All equipment shall be designed for minimum "Class C" - Moderate Service, as specified in the ANSI MH27.1 Specifications, and operation in normal ambient temperatures (0° to 40° C) and normal indoor conditions, free from excessive dust, moisture and corrosive

F. Vertical Impact - Where powered hoists are used, an impact allowance shall be included in design calculations for carriers (trolleys), cranes and

runway monorail tracks. The impact allowance shall be 1/2% of the rated load for each “foot per minute” of the hoisting speed with a minimum allowance of 15% and a maximum of 50%. For bucket and magnet applications, the impact allowance shall be a minimum of 50% of the rated load.

G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall take effect.

H. Design of the overhead bridge cranes shall be in general conformance to CMAA 70 and the Hoist Manufacturer’s Institute Specification # HMI 100, except as otherwise specified herein. All structural steel members of the handling system shall be designed in accordance with the specifications of the AISC, current edition. And all welded construction shall be in accordance of the American Welding Society. Casting, forgings, and other similar items shall have a factor of safety of 5.

I. Provide a permanent stainless steel embossed plaque to be located conspicuously on the ground floor level which indicates the hoist, trolley and crane equipment numbers; working load capacity of the hoists, trolley and crane, and a statement that all records of inspection and testing are located in the maintenance office.

1.03 SUBMITTALS:

A. Pursuant to the provisions of the General Provisions, Section 01300, Submittals, and Section 11005, Basic Equipment Materials and Methods, the contractor shall submit:

1. Material and Equipment List.

2. Product Data including catalog cuts.

3. Shop Drawings.

4. Training Program and Operations and Maintenance Manuals.

5. Spares/Maintenance Materials.

6. Certificates specified in Article 1.06.

7. Results of tests specified in Article 3.02.

B. Submit manufacturer's structural calculations for equipment anchoring requirements in accordance with the International Building Code, Seismic Zone 1 for the State of Maryland. These calculations shall be stamped and signed by a registered Professional Engineer (Civil or Structural).

1.04 DELIVERABLES:

A. Record Drawings:

1. Provide Record Drawings in accordance with the requirements of the Contract.

B. Training Program:

1. General Requirements: In accordance with Section 11005 and Section 01780, the Overhead Crane System Manufacturer shall provide training on owner-furnished equipment; the training program shall consist of both classroom and hands on instruction.

a. Contractor shall provide labor and materials as required to assist Overhead Crane system's Manufacturer's training staff during hands on instruction program.

1.05 VERIFICATION OF DIMENSIONS:

A. Contractor is responsible for coordination and proper relation of all work to the building structure and to the work of all trades. The Contractor shall verify all dimensions of the building that relate to fabrication of the monorail and notify the Engineer of any discrepancy.

1.06 CERTIFICATIONS:

A. Submit load test certificate for each electric wire rope hoist, which indicates actual breaking strength of the wire rope or the manufacturer's minimum wire rope breaking strength.

B. Crane Hook Certification: Provide a certification in writing of satisfactory nondestructive test hook (including hook, hook shank, and retaining nut), and certifications that hook has satisfactorily completed proof test in accordance with ANSI B30.10.

1.07 DELIVERY, STORAGE AND HANDLING:

A. Ship all equipment and components securely wrapped, crated or packaged and labeled for safe handling to avoid damage.

B. Receive, store and handle products in compliance with the requirements specified in Section 11005.

1.08 WARRANTY:

A. Following completion, the Contractor shall provide the owner with a one (1) year warranty starting at project acceptance, covering all parts,

materials, and labor. All warranty work shall be performed by a local manufacturer's representative at the Project Site location, who has capabilities of responding to all problems within 24 hours. Any shipping and delivery costs associated with the warranty of this equipment shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.01 1/2 TON UNDERHUNG BRIDGE CRANE WITH HOIST:

A. Equipment Item No.: TS-8; one required.

B. Acceptable Manufacturer:

1. Products of the following manufacturer are specified herein as the standard of quality for the 1/2 Ton Bridge Crane with Hoist.

a. Acco Material Handling Solution (Crane)

Available from Cordell & Associates, Inc.

95 West Butler Ave, Chalfont, PA.

Telephone: (215) 822-9345.

2. Products of equal quality and utility of the following manufacturer shall be accepted.

a. Philadelphia Tramrail Overhead Crane Division

2207 E. Ontario Street

Philadelphia, PA 19134

Telephone: (800) 523-3651

b. Shaw-Box Hoists

Dresser Industries

Crane and Hoist Division

Muskegon, MI 49443

C. Design Criteria

1. Track and Fittings

a. The track shall be a specially fabricated section with a

special rolled bottom section having a flat tread with a minimum bottom flange width of 3.25 inch. Bottom flange shall have a minimum ultimate tensile strength of 125,000psi with a minimum Brinell hardness of 255. Track shall be straight, with factory prepared ends. No rough-cut ends will be permitted. Holes shall be factory punched or drilled.

b. The track size shall be computed based on the load positioned on the track system to produce the most severe conditions of stress and deflection.

c. The total track deflection shall not exceed 1/450 of the span or 1 1/4 inch, whichever is the least.

d. Track end stops shall be of the bolted type and shall be capable of withstanding the impact of a fully loaded crane or carrier traveling at 50% of the full load speed.

e. Standard structural steel shapes or modifications of structural shapes will not be accepted.

f. Track sections shall be installed with bolted or welded splice plates to provide flush and level connections at the operating tread of the track. The maximum gap between adjacent ends at load carrying flange shall not exceed 1/16 inch.

2. Track Suspensions

a. All necessary clamps, hanger rods, bolts and other fittings from which the track system is suspended, shall be provided as part of the Overhead Track System. Track hanger supports shall be spaced as per the drawings attached or as specified.

b. Means shall be provided on flexible type rod suspensions to allow for minimum 1” vertical adjustment of the track both before and after the system has been put in operation so that the track can be erected and maintained level.

c. Where flexible type rod suspensions are used, the hanger rod shall be made from high strength steel with rolled or cut threads and furnished with a Gimbal washer and adjusting nut at each end. The lower nut shall be factory assembled and secured in place by a roll pin. The upper adjusting nut shall be equipped with a nylok socket set

screw. In addition, a roll pin shall be provided at the end of the rod to prevent the nut from backing off the rod.

d. Where flexible type rod suspensions are used, the top and bottom hanger fittings shall be provided with a hardened bearing washer to match the Gimbal washer on the hanger rod.

e. Where track system is suspended by rod suspensions, the system shall be braced laterally and longitudinally. It is necessary to brace only one track laterally on flexible type rod suspensions. Both tracks shall be braced longitudinally. All bracing is to be provided by the crane erector.

f. Rigid suspension can be accomplished by flush clamping or bolting the runway track direct to the support steel.

g. All suspension fittings shall be furnished with SAE Grade 5 or ASTM A-325 mounting bolts.

3. Track Electrification

a. Conductor bar shall be rolled-formed electrogalvanized steel sections, rated at a minimum of 90 amps continuous. Insulation cover shall be rigid PVC, self-extinguishing, with an operating temperature of 150° F.

b. Conductors are to be complete with mounting clips, end caps, splices with covers and power feeds.

c. Current collectors shall be the sliding shoe type, spring loaded and so designed that sparking and loss of contact will be minimized.

d. Separate conductors shall be provided for each phase. More than one conductor in a single enclosure will not be permitted.

4. End Truck Trolleys

a. Crane end truck trolley assemblies shall be rigid type. Load bars shall be cradled in the yokes in such a manner to assure that all wheels are in contact with the operating flange at all times.

b. Yokes shall be ductile castings, forging, or steel fabrications and shall be fixture machined.

c. Trolley wheels shall be made from high strength forged or machined steel, 4 1/2 inch minimum tread diameter. The wheel tread shall be accurately machined to assure concentricity of axle and tread, and hardened to 425 Brinell.

d. Wheel bearings shall be double row precision ball or taper roller bearings, lubricated and permanently sealed at assembly. Bearings must have a minimum B-10 life of 5,000 hours.

e. Flangeless wheels with side guide rollers may be provided in lieu of flanged wheels.

5. Crane End Trucks

a. End trucks shall consist of steel weldments bolted direct to the crane bridge member, providing a rigid and square connection. Trolleys shall be as specified in Section 2.01, Paragraph C. The ratio of crane span to wheelbase shall be a minimum of 10 to 1.

b. Restraining lugs shall be provided to limit drop of end truck to not more than 1” in the event of wheel, yoke, axle or load bar failures. Restraining lugs shall be placed on both sides of the rail so that if failure occurs, the rail is centrally loaded about the vertical axis.

6. Single Girder Crane

a. Crane girders shall comply with Section 2.01, Paragraph C and shall be equipped with suitable track end stops as outlined in Section 2.01, Paragraph C.

b. End truck assemblies shall comply with Section 2.01, Paragraph C.

c. Travel speeds, electrical characteristics and specific options, such as type electrification, brakes, etc., are to be as noted in the “Specific Job Requirements”.

7. Crane Drives

a. Cranes shall be driven by individual motorized trolley drives mounted on two or more end trucks, which provide traction dependent upon wheel loads. Both motorized trolley wheels shall be driven simultaneously thorough a specially machined drive pinion. Drive wheels shall have

hardened treads and employ side guide rollers.

b. Cranes shall be driven by a squaring shaft drive that provides traction by pressure of the drive tires on the underside of the track. Bearing pressure of the drive tires on the underside of the runway track shall be adjustable and maintained by spring loaded bearing assemblies. The squaring shaft shall be supported by vertically adjustable anti-friction, self-aligning bearing assemblies.

c. All single and two speed motors shall be squirrel cage type, totally enclosed. Motor shall be provided with lifetime lubricated anti-friction bearings unless otherwise specified.

8. Crane Controls: Controls for the cranes are to include the following features:

a. Controls shall be housed in a NEMA 3R enclosure for protection against dust and moisture.

b. A fused manual disconnect switch, housed in a NEMA 12 enclosure, with a lockable handle shall be provided and wired into the incoming circuit from the runway power collectors.

c. A magnetic mainline contactor is to be provided and operated from the push-button station.

d. All motor starters shall be adequately sized for crane duty consistent with horsepower requirements and shall be of the reversing type, fully magnetic, with mechanical and electrical interlocks.

e. Each motor shall be provided with thermal overload protection.

f. Fusing shall be provided on the secondary side of the control circuit transformer.

g. A means for controlling acceleration must be provided. Across the line starting is not acceptable.

h. The complete control panel is to be factory mounted and wired. All wires within the panel are to be marked and terminated on numbered terminal strips.

i. All wiring shall be “EMT” (Electrical Metallic Tubing) conduit wherever possible. Flexible cable may be used on

short runs where “EMT” is not practical.

9. Hoists

a. Crane supplier shall furnish as part of their contract a hoist of the type most suitable for the particular application under consideration. Such hoist shall comply with ANSI B30.16 “Safety Standard for Overhead Hoists”, ANSI/ASME HST-1M “Performance Standards for Electric Chain Hoists”, and ANSI/ASME HST-4 “Performance Standards for Electric Overhead Wire Rope Hoists”.

b. Hoists shall be equipped with an automatic Weston-Type multiple disc mechanical load brake. This brake shall be capable of holding a full capacity load independent of the motor brake. The load brake shall additionally assure that the load does not accelerate while being lowered to the floor level. Brake shall not require adjustment.

c. Hoists shall be equipped with a motor brake rated a minimum of 150% of full load motor torque. If the motor brake is a DC rectified brake, it shall include a brake-sensing microswitch that prevents the motor from operating against an engaged brake when the brake requires adjustment.

d. Hoists and appurtenances shall be designed to withstand all stresses imposed under safe operating conditions while handling loads within the rated capacity. Load bearing parts shall be designed such that the static stress, calculated for rated load, shall not exceed 20% of the ultimate strength of the material.

e. The braking system shall be capable under normal operating conditions with rated load to stop and hold the load when controls are released. Controlled lowering shall be limited to 120% of the rated lowering speed. In the event of complete power failure, the load shall be stopped and held in place.

f. All bearings shall be heavy duty, anti-friction type with a minimum B-10 life of 5,000 hours. Motor bearings shall be lifetime lubricated, sealed ball bearings.

g. All gearing shall be forged heat-treated alloy steel machined for smooth quiet operation. All gearing must meet AGMA quality standards.

h. Bottom block shall be completely shrouded for safety and fabricated from steel. Sheaves shall be forged or rolled steel, running on anti-friction bearings. Hooks are to be forged steel supported by anti-friction thrust bearings and permit 360° rotation. Hooks shall be equipped with latches and web slings necessary for material handling of Tires and wheels.

i. Motors shall be totally enclosed, specifically designed for hoist service, capable of starting and operating under the conditions within the designed capacity and provided with thermal overload protection.

j. Each hoist shall incorporate an upper plugging type limit switch automatically stopping the hoist motion when the block reaches its highest position. Excessive hook drift shall cause the block to be momentarily reversed.

k. Electric hoist controls shall comply with N.E.C. requirements for the application being considered and shall include control circuit fusing and contactors mechanically and electrically interlocked.

l. Regardless of Hoist Duty Class chosen for application, the hoist must meet the Duty Class per Table 1 of ASME HST-4-1999. Exceptions to this table will not be considered.

10. Push-button Control Station

a. Pendant festoon system shall consist of a support rail ("C-Track"), cables, junction boxes, cable cars and accessories. Cable loops shall not drop below the high hook position. Pendant control car shall be provided with a NEMA 12 junction box. Pendant festoon system shall be independent of trolley motion.

b. Pendant control station enclosure shall be NEMA 12. Physical size of pendant shall be held to a minimum. A separate cable of corrosion-resistant cable or chain shall be provided as a strain relief. Pendant station shall attach to an independent festoon assembly and shall hand vertically, with the bottom of the pendant at 40" above the floor. Weight of the pendant shall not be support from the control cable.

c. Operating push-buttons shall be heavy-duty, dust and oil tight. Pendant control buttons shall be momentary push-

buttons. Push-buttons (except the Power-Off) button shall be recessed type to avoid accidental operation. In multi-speed applications, dual-position push-buttons shall have a definite click-detent position for each speed. Pendant shall include separate buttons for each motion and for Power-ON and Power-OFF. Power-OFF button shall be a red, mushroom head button.

D. Hoist Characteristics

1. Hoist Characteristics for the Electric Wire Rope Hoist:

a. Capacity: 1,000 pounds.

b. Hoist Control: single speed.

c. Motor: 1 horsepower TENV.

d. Lift and Speed: 32 feet at 15 fpm.

e. Cable and Reeving: 3/16 inch diameter cable, 2 part double reeving.

f. Trolley: 1/2 HP, 50 fpm travel.

g. Hook Height: 20 ft. minimum

h. Hoist/Trolley Weight: 500 lbs

E. Crane Characteristics:

1. 1/2-ton rated load, single girder, dual drive crane, span per Contract Drawing.

2. Design Requirements and Construction Features:

a. End Trucks: End trucks each having four 6-inch diameter flanged wheels running on double row tapered roller bearings.

b. Single speed trolley with travel rate of 50 fpm.

c. Trolley motor: 1/2 HP

d. Crane Span: 34 feet with one (1) foot overhang at each end

e. Crane Travel: 35 feet minimal w/overhang

f. Include the following:

i. NEMA Type 3R gasketed enclosure.

ii. Manual disconnect switch with fuse protection for hoist circuit. Switch operable by handle on enclosure cover; handle capable of being padlocked in "OFF" position.

iii. Mainline contactor operated by momentary contact push buttons in the crane control station.

iv. 150 VA transformer with fused secondary.

v. Dual element fusetrons to provide short circuit protection and motor running protection.

vi. Thermal overload relays in 3 phases.

g. Crane Equivalent Center Load: 2,075 lbs.

h. Push Button Enclosure: Pendant type, push button station with momentary contact type pushbuttons in a molded rubber or high impact plastic enclosure suspended from carrier. Provide an 8-button station to control hoist and crane.

F. System Track/Runway Characteristics

1. Provide crane beams (per Contract Drawing). Provide required splice plates and end stops. Provide crane runway end stops, as recommended by manufacturer, at each end of runway, at location designated by the Engineer. Crane runaway beams shall be 325 Series Rail by TDC/American or approved equal with the above minimum requirements.

2. Provide electrification on rail of runway consisting of a single conductor bottom entry electrification bar, figure 8 conductor including but not limited to required hangers/brackets, power feeds, expansion assembly, connector tool and end covers.

G. 1/2 Ton Underhung Bridge Crane With Hoist shall include Wire Rope Hoist with Motorized Trolley Model No. C1W01S032-15-2D0;_ Series 585 Single Girder Motor Propelled Crane catalog number 41-0301 with 604.1435 bridge girder; monorail beam shall be 325 Series Rail by TDC/American Girder Track as manufactured by Acco Material Handling Solutions or approved equal with the above minimum requirements.

PART 3 EXECUTION

3.01 INSTALLATION:

A. Install equipment in accordance with the approved shop drawings and manufacturer's installation instructions.

B. Electrical Interface:

1. Power supply for equipment is designed as 460 volts, 3-phase, 60 hertz.

2. Provide transformers for equipment as required to step down the specified supply voltage to provide lower voltage for controls and accessories and to provide voltage compatible with equipment as required.

3. Provide wiring and conduit for a complete installation and proper operation of all equipment and accessories. Provide electrical service devices (disconnect switches) complying with the requirements of Division 16 - Electrical. Install these electrical service devices, perform wiring (including conduit installation) and make connections between these electrical service devices and equipment specified. Size wiring and conduits for the loads and voltages indicated. Wiring and conduits types shall be in accordance with the requirements of the National Electrical Code of the individual equipment location except where more stringent requirements are specified in Division 16. In no case shall maximum current carried exceed that specified by the National Electrical Code for type of conductor used.

4. Provide disconnect switches (fused and nonfused as required), motor starters and start-stop control stations for all equipment subject to the following conditions:

   a. Provide above stated electrical devices consistent with both N. E. C. and equipment design requirements, as well as the electrical power circuit design for each piece of equipment.

   b. Provide the type of electrical device based on the requirements of the preceding paragraph and the electrical characteristics of the project electrical design.

   c. Sizing of the above stated electrical devices is the responsibility of the Contractor based on the information supplied by equipment manufacturer.

5. Provide control devices necessary for proper operation and locate

to permit efficient operation of the equipment, and where possible group in a factory-fabricated control panel meeting NEMA requirements.

6. Identify switches, lights and control functions with legend plates. Construct the plates of polyvinyl-chloride material of laminated multiple construction, and rout engraved with appropriate legends. Submit the size of letters, colors and legend for review. Mount legend plates on the equipment. No decals shall be accepted.

C. Proceed with start-up, testing and instructions in accordance with Section 11000.

D. Paint

1. The bridge cranes before shipment shall be painted with one coat of mustard yellow lead-free chromate paint.

2. All marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

3.02 FIELD TESTING:

A. Testing shall be performed by a Certified Inspector in the State of Maryland and must perform all required tests including as follows:

1. No-Load Test:

a. Hoist: Raise each load hook into the hoist limit switch at operating speed. Lower and raise each hook through all controller points.

b. Trolley: Move trolley the full distance of the bridge rails and observe proper brake operations.

c. Bridge: Move the bridge the full distance of the bridge rails and observe crane movement and check electrification.

2. Full Rated Load Test:

a. Hoist:

i. Static Test: Raise test load approximately one foot and hold for ten minutes. Observe lowering that may occur which shall indicate malfunction of hoisting components or brakes.

ii. Dynamic Test: Hoist and lower test load through all controller points. Lower the test load to the ground until hoist lines are slack. Wait five minutes, hoist and lower test load again through controller points.

iii. Hoist Load Brake: Raise test load approximately five feet. With the hoist controller in the neutral position, release (by hand) the holding brake. The load brake should hold the test load. Again with the holding brake in the released position start the test load down (first point) and return the controller to off position as the test load lowers. The load brake should prevent the test load from accelerating.

iv. During either the static or dynamic test, visually observe hoist brakes to ensure correct operation including the proper time delay.

v. Loss of Power Test: This test is designed to test the reaction of the hoisting unit in the event of power of power failure during a lift. Hoist the test load to convenient distance above the surface. Lower test load and with the controller in the lowering position disconnect the main power source and return the controller to the neutral position. The test load should stop lowering when the controller is placed in the neutral position.

b. Trolley Motion: Move trolley with test load (if space is available) the full distance of the bridge rails using extreme caution and observe any binding of bridge trucks and for proper operation.

c. Bridge Motion: Move bridge with test load the full distance of the runway using extreme caution and observe for any binding of bridge trucks and for proper operations.

3.03 FIELD QUALITY CONTROL:

A. Upon completion of installation, the crane system shall be tested in accordance with ANSI B30.11 and the tests listed in Article 3.1C.

B. Provide the services of a qualified manufacturer's representative to perform the following:

1. Inspect preparatory work performed by other disciplines.

2. Inspect installation.

3. Observe testing, by the Contractor in the presence of the Engineer, to ensure proper operation of the equipment.

4. Instruct the operating personnel in the proper safe operation and maintenance of the equipment.

3.04 TRAINING PROGRAM AND OPERATION AND MAINTENANCE MANUALS:

A. Provide a training program and operation and maintenance manual in accordance with the requirements specified in Section 01780 and 11005

PART 4 : MEASUREMENT AND PAYMENT

4.01 1/2 TON UNDERHUNG BRIDGE CRANE WITH HOIST:

A. 1/2 Ton Underhung Bridge Crane with Hoist (TS-8) will not be measured for payment.

B. 1/2 Ton Underhung Bridge Crane with Hoist (TS-8) will not be paid directly, but will be included in the lump sum bid prices for the Maintenance Building.

END OF SECTION

SECTION 14635

FALL ARREST SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. Furnishing, installing and testing rigid rail fall protection system, complete with rail track, SRL, trolley, harness and tag line on every bus bay supported from the roof structure at locations indicated on the Contract Drawings. The system will be designed and installed to use when employees are working on top of buses in the designated bays.

B. The provisions of Section 11005 apply to the work of this Section.

C. Related Documents:

1. Drawings, MTA General Provisions for Construction Contracts, Supplementary General Provisions and Division 1 specification sections apply to the work of this section.

D. Related Sections:

1. Section 01300 - Submittals.

2. Section 01450 - Quality Assurance and Quality Control.

3. Section 01780 – Close Out.

4. Section 05500 - Metal Fabrications.

5. Section 11005 - Basic Equipment Materials and Methods.

1.02 QUALITY CONTROL:

A. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall take effect.

B. Design of the Fall Arrest System rail shall follow all of the federal, state and local safety codes and standards. All structural steel members of the fall arrest system shall be designed in accordance with the specifications of the AISC, current edition. And all welded construction shall be in accordance of the American Welding Society.

C. All components shall be approved by the American national Standards

Institute.

D. Reference Standards: Requirements of regulatory agencies: Comply with all applicable Federal, State and with local codes having jurisdiction including:

1. America National Standards Institute (ANSI)

a. ASI Z359.1-2007, A10.32. Requirements for harness: Self Retracting Lifeline (SRL) and drop lines for construction and industrial use.

2. American Society of Testing Materials (ASTM)

3. American Welding Society

4. American Institute of Steel Construction (AISC)

5. Occupational Safety and Health Administration (OSHA)

a. 29 CFR 1910 Occupational Health and Safety Standards.

E. 29 CFR 1926 Safety and Health Regulations for Construction. Furnish all materials and labor necessary to meet these requirements and to obtain approvals of inspections and tests.

1.03 SUBMITTALS:

A. Submit shop drawings showing all dimensions, elevations, connections and materials, catalog cuts, preliminary copies of Product Maintenance Forms, and manufacturer's installation instructions and operation and maintenance manuals within sixty (60) days of the first job meeting.

B. Submit manufacturer's structural calculations for equipment anchoring requirements in accordance with the Uniform Building Code, Seismic Zone 1 for the State of Maryland. These calculations shall be stamped and signed by a registered Professional Engineer (Civil or Structural) in the State of Maryland.

1.04 DELIVERABLES:

A. Record Drawings:

1. Provide Record Drawings in accordance with the requirements of the Contract.

B. Training Program:

1. General Requirements: The Fall Arrest System Manufacturer shall

provide training on owner-furnished equipment; the training program shall consist of hands on instruction.

a. Contractor shall provide labor and materials as required to assist fall arrest system's Manufacturer's training staff during hands on instruction program.

1.05 DELIVERY, STORAGE AND HANDLING:

A. Ship all equipment and components securely wrapped, crated or packaged and labeled for safe handling to avoid damage.

B. Receive, store and handle products in compliance with the requirements specified in Section 11005.

1.06 WARRANTY:

A. Following completion, the Contractor shall provide the owner with a one (1) year warranty starting at project acceptance, covering all parts, materials, and labor. All warranty work shall be performed by a local manufacturer's representative at the Project Site location, who has capabilities of responding to all problems within 24 hours. Any shipping and delivery costs associated with the warranty of this equipment shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.01 FALL ARREST SYSTEM:

A. Equipment Item Nos. MB-4; fifteen required.

B. Acceptable Manufacturers:

1. Products of the following manufacturer are specified as the standard of quality for the Fall Arrest System:

a. Rigid Lifelines

604 Hemlock Road

Morgantown, PA 19543

Telephone: (610) 286-7200

2. Products of equal quality and utility of the following manufacturer shall be accepted.

a. CAI Safety Systems

2161 Railroad Street

Corona, CA 92880

Contact: Peter Kavia

Telephone: (951) 272-6999

b. Approved equal

C. Design Criteria

1. System shall consist of the following primary components of rigid rail horizontal lifeline, Self Retracting Lifeline (SRL), SRL trolley unit, full body harness and tagline and structural steel supports required for support of lifelines and connection to the structural steel frame. All other hardware (snap hooks, D-rings, etc.) necessary to make a safe and complete system shall be provided.

2. The system shall be designed to allow one user to walk interrupted the entire length of the top of the bus without having to unhitch from the fall protection system to pass through intermediate support points.

3. The system shall be designed to support one user in case of a fall. The system shall be designed to allow hands-free operation once the user is properly attached to the system.

4. Lanyards, D-rings, snap hooks and all other necessary hardware shall be capable of sustaining a minimum tensile load of 5,000 pounds.

5. In order to assure uniform quality, ease of maintenance and minimal parts storage, all equipment for the system shall be supplied by a single source.

6. The manufacturer of the system shall be regularly engaged in manufacturing and production of fall arrest systems for a minimum of five years with at least a dozen systems installed within the last two years.

7. All materials shall be new and shall be properly stored during construction to prevent physical damage and damage from the weather.

8. Where required a nylon tagline shall be provided on each system for the purpose of pulling each vertical lifeline down to floor level for hook-up to the harness.

9. All components and hardware shall meet the requirements of ANSI Z359.1

10. Horizontal Lifeline: Will be a rigid rail track without paint finish. Track must meet the following criteria:

    a. Maximum height of 12 inches

    b. Track profile design to ensure wheel protection, accurate alignment with minimum friction, and minimum maintenance “self” cleaning profile.

    c. All fall protection tracks shall have full contact flange loading surfaces [flat] to decrease flange and wheel loads during a fall event.

    d. End stop bumpers through bolted to the track.

11. SRL: Shall be a self-retracting lifeline suitable for the provided horizontal lifeline and the minimum clearance required from nearest obstruction level to the working level. DBI SALA Ultra-Lok or approved equal and equivalent.

12. Body Harness: Lightweight nylon full body Class III harness with back D-ring and tongue buckle sub pelvic straps. DBI SALA or approved equal and equivalent.

13. I Beam trolley rated for fall arrest and DBI SALA or approved equal and equivalent.

    a. Trolleys shall have pivoting wheel axles to decrease flange loadings during an off-plumb fall event and that allow more freedom of movement for operator preventing lanyard twisting.

    b. Trolley wheels to be equipped with sealed bearings.

14. Tagline: Nylon filament rope rated for specified operations.

15. Structural steel supports required to attach the lifelines to the main steel frame.

16. Each horizontal lifeline will include a warning label measuring 12 inches X 8 inches that will outline the limitations and proper use of the fall protection system. Each warning label will be permanently stamped with a unique manufacturers serial number

D. Design

1. A registered professional engineer shall design the entire fall protection system to include all requirements for the State of Maryland including National, State and Local codes having jurisdiction.

2. Calculations shall be submitted to the Owner's Representative for his review.

3. The system shall be designed for one (1) worker at a time, with full body harness and SRL with a maximum arresting force of 900 pounds per worker.

4. System should arrest fall when user is working on top of bus that is maximum of 12 feet high.

5. Design the system to be supported at the locations described on plans. The end anchors shall be fixed type and shall resist vertical and horizontal (in-line) loads. The anchors and the system shall be designed to maintain a safety factor of at least 2 when a fall takes place.

E. Dimensions and Capacities:

1. Forty-Five Foot (45) Bus Systems: Total of Nine (9)

   a. Support spacing is 12 feet-0 inches.

2. Sixty-Five Foot (65) Bus Systems: Total of Six (6)

   a. Support spacing is 12 feet-8 inches.

3. Lanyards, D-rings, snap hooks and all other hardware: Minimum tensile load of 5,000 pounds.

4. Arresting Force: 900 pounds per worker.

PART 3 EXECUTION

3.01 INSTALLATION:

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

B. Contractor to coordinate with building design to assure that the fall arrest system shop drawings have utilized the design intent for support of the rigid rail beam for the use of the fall arrest devices.

C. Provide a training session on use and maintenance of system. Training shall consist of a single session, held at completion of installation. Furnish six (6) copies of an operation and maintenance manual.

D. Paint

1. All marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

3.02 FIELD QUALITY CONTROL:

A. Upon completion of installation, the fall arrest system shall be tested to meet the America National Standards Institute, Z359.1-2007, A10.32. Requirements for harness: Self Retracting Lifeline (SRL) and drop lines for construction and industrial use.

B. Provide the services of a qualified manufacturer's representative to perform the following:

1. Inspect preparatory work performed by other disciplines.

2. Inspect installation.

3. Observe testing, by the Contractor in the presence of the Engineer, to ensure proper operation of the equipment.

4. Instruct the operating personnel in the proper safe operation and maintenance of the equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 FALL ARREST SYSTEM:

A. Fall Arrest System (MB-4) will be measured at the contract unit price per each.

B. Fall Arrest System (MB-4) will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 14920

MONORAIL CRANES

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. Furnishing, monorail systems complete with electrification, monorail track, hoist, trolley, at the location shown on the Drawings. Include all wiring, conduit, piping, switching and controls required to connect the equipment to the building utilities, and to interconnect the various system components as part of the work of this section.

B. Related Documents:

1. Drawings, MTA General Provisions for Construction Contracts, Supplementary General Provisions and Division 1 specification sections apply to the work of this section.

C. Related Sections:

1. Section 01300 - Submittals.

2. Section 01450 - Quality Assurance and Quality Control.

3. Section 01780 – Contract Close Out.

4. Section 05500 - Metal Fabrications.

5. Section 11005 - Basic Equipment Materials and Methods.

6. Division 16 - Electrical.

1.02 QUALITY ASSURANCE:

A. Qualifications:

1. Submit load test certificate for each electric wire rope hoist, which indicates actual breaking strength of the wire rope on the manufacturer's minimum wire rope breaking strength.

B. References

1. American National Standards Institute (ANSI).

a. ANS1 MH 27.1 Specifications for Underhung Cranes and Monorail Systems.

b. ANSI B30.10, Hooks

c. ANSI B30.11, Monorail Systems and Underhung Cranes.

d. ANSI B30.16, Overhead Hoists.

e. ANSI B30.16, Overhead Hoists.

2. American Welding Society (AWS).

a. AWS D14.1, Specifications for Welding Industrial and Mill Cranes.

3. Hoist Manufacturer's Institute (HMI).

a. HMI 100, Standard Specifications for Electric Wire Rope Hoists.

4. Occupational Safety and Health Administration (OSHA):

a. 29 CFR 1910 Subpart 179 Overhead and Gantry Cranes.

1.03 SUBMITTALS:

A. Pursuant to the provisions of the General Provisions, Section 01300, Submittals, and Section 11005, Basic Equipment Materials and Methods, the contractor shall submit:

1. Material and Equipment List.

2. Product Data including catalog cuts.

3. Shop Drawings.

4. Training Program and Operations and Maintenance Manuals.

5. Spares/Maintenance Materials.

6. Certificates specified in Article 1.06.

7. Results of tests specified in Article 3.03.

B. Submit manufacturer's structural calculations for equipment anchoring requirements in accordance with the International Building Code, Seismic Zone 1 for the State of Maryland. These calculations shall be stamped and signed by a registered Professional Engineer (Civil or Structural).

1.04 DELIVERABLES:

A. Record Drawings:

1. Provide Record Drawings in accordance with the requirements of the Contract.

B. Training Program:

1. General Requirements: In accordance with Section 11005 and Section 01780, the Overhead Crane System Manufacturer shall provide training on owner-furnished equipment; the training program shall consist of both classroom and hands on instruction.

a. Contractor shall provide labor and materials as required to assist Overhead Crane system's Manufacturer's training staff during hands on instruction program.

1.05 VERIFICATION OF DIMENSIONS:

A. Contractor is responsible for coordination and proper relation of all work to the building structure and to the work of all trades. The Contractor shall verify all dimensions of the building that relate to fabrication of the monorail and notify the Engineer of any discrepancy.

1.06 CERTIFICATIONS:

A. Submit load test certificate for each electric wire rope hoist, which indicates actual breaking strength of the wire rope or the manufacturer's minimum wire rope breaking strength.

B. Crane Hook Certification: Provide a certification in writing of satisfactory nondestructive test hook (including hook, hook shank, and retaining nut), and certifications that hook has satisfactorily completed proof test in accordance with ANSI B30.10.

1.07 WARRANTY:

A. Following completion, the Contractor shall provide the owner with a one (1) year warranty starting at project acceptance, covering all parts, materials, and labor. All warranty work shall be performed by a local manufacturer's representative at the Project Site location, who has capabilities of responding to all problems within 24 hours. Any shipping and delivery costs associated with the warranty of this equipment shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.01 MONORAIL AND HOIST –2 TON:

A. Equipment Item No. MB-11; one required.

B. Acceptable Manufacturers:

1. Products of the following manufacturers are specified herein as the standard of quality for the 2 Ton Monorail and Hoist.

   a. Acco Chain and Lifting Products Division

      Available from Cordell & Associates, Inc.

      95 West Butler Ave, Chalfont, PA.

      Telephone: (215) 822-9345.

2. Products of equal quality and utility of the following manufacturers will be accepted:

   a. Yale Hoists

      240 Pennsylvania Ave.

      Salem, MI 44460

      Telephone: 800-742-9269

   b. Shaw-Box

      Lift-Tech, division of Columbus McKinnon Corp.

      414 West Broadway Avenue

      Muskegon, MI 49443-0769

      Telephone: (800) 742-9269

C. Monorail System Design Criteria:

1. Design and provide all material in accordance with ANSI MH 27.1.

2. Design all material with a minimum safety factor of 5 based on the ultimate strength of the material.

3. Include an impact factor of at least 15 percent of the full live load

rated capacity of hoist in design calculations for track, trolleys and loading imposed on structure.

4. Design system for service classification, Class C (moderate service) in accordance with ANSI MH 27.1.

5. Monorail system shall be furnished complete with standard end stops, electrification and controls. Coordinate the baffle system with the contacts to be provided under Division 16. Contacts are to be provided as an electrical stop.

D. Monorail Track:

1. Construct monorail track of hard alloy steel designated and produced specifically for underhung crane and monorail application. Track configuration shall be as shown on the Drawings.

2. Design track to accommodate a 2 ton hoist when supported as indicated on the Contract Drawings. Monorail length is approximately 80 feet.

3. Track shall be the TC/American 325 Series Rail having a 3.25 inch raised operating tread or equal.

4. Provide end stops.

E. Hoist Design Criteria:

1. HMI - H4 service classification.

2. Wire Rope: Lubricated with swaged fittings at both ends.

3. Load Blocks: Shrouded type to protect wire rope and sheaves. Sheaves shall be supported on prelubricated, sealed, anti-friction ball bearings.

4. Hook: Drop forged, heat treated, ductile alloy steel with spring latch.

5. Geared limit switch shall be provided to interrupt the raising circuit to stop the hoist and set both mechanical load brake and motor brake when the hook reaches the upper limit. A gravity type upper hook travel limit switch is provided as back-up to the Geared Limit Switch and will be equipped with a reversing circuit to prevent overtravel in up direction. The Gravity Limit Switch shall not be used as a final stop.

6. Gear Train: Combination of helical and spur gears, in accordance with AGMA standards. Gears shall operate in a sealed oil bath.

7. Mechanical Load Brake: Weston type multiple disc.

8. Motor Brake: Rectified DC magnet actuated disc type with a minimum torque rating of 150% of the full load motor torque.

9. Overload Cutoff Device: Load sensing unit completely independent of the hoist gearing. The overload unit interrupts the raising circuit, stops hoist motor, sets the motor and mechanical brake, and resets when overload is lowered and removed.

10. Motor: Single speed 2 Hp Standard NEMA C face Class F insulation TENV. Automatic reset thermostats for overcurrent protection. Rated at 30 minute duty with + 10% voltage variation.

11. Controls: Three pole magnetic reversing type, mechanically interlocked with 115 volt control circuit and rated at 600 volts, includes control transformer. Enclosure NEMA type 3R with lightweight impact resistant LEXAN resin cover, deep molded. All hoist and trolley controls shall be located in one enclosure. Mount this enclosure near Column Line “E.5”.

12. Pushbutton Station: Pendant type. Provide an 8 button station to control hoist, trolley and mainline disconnect. Clearly mark the function of each pushbutton. Hoist suspended momentary contact type pushbuttons in NEMA Type 4 enclosure. The bottom of pendant control shall be located approximately 4 feet above finished floor. .

F. Capacities:

1. Hoist:

a. Lift: 18 feet, 6 inches.

b. Single Speed: 15 FPM.

c. Lift Capacity: 2 ton.

d. Hoist cable and reeving: 1/4 inch diameter, 2 part double reeving.

e. Bottom of beam to saddle of hook: 24 inches (approximate).

f. Load: 2 hp.

2. Trolley:

   a. Single Speed: 50 FPM.

   b. Motor: 1/2 HP.

   c. Trolley brake.

3. Runway

   a. 76 feet, 6 inches long.

4. End Stops:

   a. Stop Hoist from impacted the offset lower beam at column lines C and E.

   b. Position approximately 21 inches from column lines C and E.

G. Power Supply for Hoist and Trolley: 460 volts, 3 phase, 60 hertz.

H. Electrification: Monorail web supported conductor including but not limited to insulator, clamps joint covers, connector pins, joint clamps, end caps, isolation section and collectors. Locate monorail electrification at ceiling at Column Line “E”.

I. Paint: Monorail and hoist shall be painted safety yellow with rated load painted clearly in black.

J. Monorail track with End Stops shall be 325 Series Rail by TC/American with 3.25 Inch operating flange. Hoist shall be model C1W02D025-15*2D0 with single speed motorized trolley as manufactured by Acco Chain and Lifting Products Division.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install monorail system in strict accordance with the approved shop drawings and manufacturer's installation instructions.

B. Monorail Track to be installed straight and level. Operating flanges of monorail track and track switches shall be installed at the same elevation above finished floor. Coordinate monorail installation with work of Division 16 - Electrical.

C. Proceed with start-up, testing and instructions in accordance with Section 01780 and 11005.

3.02 FIELD QUALITY CONTROL:

A. Provide the services of a qualified, certified manufacturer's representative to perform the following:

1. Supervise preparatory work performed by other trades.

2. Supervise installation.

3. Supervise testing, by the Contractor in the presence of the Engineer, to ensure proper operation of the equipment.

3.03 FIELD TESTING:

A. Perform testing of the equipment and system in accordance with the requirements specified in Section 01450. Perform and document all testing procedures recommended by the manufacturer and OSHA standards, ANSI B30.10 and ANSI B30.11. Testing to be performed by a qualified Independent Inspection and Testing Agency per Section 01450.

1. Test each monorail for operation and load test not less than 100 percent and not more than 125 percent of the rated load.

3.03 TRAINING PROGRAM AND OPERATION AND MAINTENANCE MANUALS:

A. Provide a training program and operation and maintenance manual in accordance with the requirements specified in Section 01780 and 11005.

PART 4 : MEASUREMENT AND PAYMENT

4.01 MONORAIL AND HOIST –2 TON:

A. Monorail and Hoist –2 Ton (MB-11) will not be measured for payment.

B. Monorail and Hoist –2 Ton (MB-11) will not be paid directly, but will be included in the lump sum bid prices for the Maintenance Building.

END OF SECTION

SECTION 15058

COMMON MOTOR REQUIREMENTS FOR HVAC AND PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.

2. Torque, speed, and horsepower requirements of the load.

3. Ratings and characteristics of supply circuit and required control sequence.

4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT:

A. Common Motor Requirements for HVAC and Plumbing Equipment will not be measured for payment.

B. Common Motor Requirements for HVAC and Plumbing Equipment will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15062

HANGERS AND SUPPORTS FOR HVAC AND PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. Related Sections:

1. Section 05500 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 15074 "Vibration and Seismic Controls for HVAC and Plumbing Piping and Equipment" for vibration isolation devices.
3. Section 15124 "Expansion Fittings and Loops for HVAC and Plumbing Piping" for pipe guides and anchors.
4. Section 15815 "Metal Ducts for duct hangers and supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment.

1.05 ACTION SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.

2. Metal framing systems.

3. Pipe stands.

4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data.

1. Detail fabrication and assembly of trapeze hangers.

2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.02 TRAPEZE PIPE HANGERS

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

2.03 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing 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. Cooper B-Line, Inc.

b. Flex-Strut Inc.

c. GS Metals Corp.

d. Unistrut Corporation; Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.

3. Standard: MFMA-4.

4. Channels: Continuous slotted steel channel with inturned lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

7. Paint Coating: Epoxy.

2.04 THERMAL-HANGER SHIELD INSERTS

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. ERICO International Corporation.

2. National Pipe Hanger Corporation.

3. PHS Industries, Inc.

4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.

5. Piping Technology & Products, Inc.

6. Rilco Manufacturing Co., Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated,

ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.05 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.06 EQUIPMENT SUPPORTS

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

2.07 MISCELLANEOUS MATERIALS

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

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to

properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

I. Install lateral bracing with pipe hangers and supports to prevent swaying.

J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including

valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

M. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.

b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.

c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.

d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.

e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 ADJUSTING

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

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9"Interior Painting"."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.06 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal-hanger shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 and larger.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 and larger, requiring up to 4 inches (100 mm) of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 and larger, requiring clamp flexibility and up to 4 inches (100 mm) of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 and larger if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).

11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).

12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 and larger.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 and larger, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 and larger, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 and larger if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.

18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 and larger, from single rod if horizontal movement caused by expansion and contraction might occur.

19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 and large if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.

20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 and large if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.

21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 and large if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 and larger.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 and larger if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches (150 mm) for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb (340 kg).

    b. Medium (MSS Type 32): 1500 lb (680 kg).

    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).

2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

3. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

4. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow

expansion and contraction of piping system from base support.

6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

   a. Horizontal (MSS Type 54): Mounted horizontally.

   b. Vertical (MSS Type 55): Mounted vertically.

   c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

PART 4: MEASUREMENT AND PAYMENT

4.01 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT:

A. Hangers And Supports For HVAC and Plumbing Piping And Equipment will not be measured for payment.

B. Hangers And Supports For HVAC and Plumbing Piping And Equipment will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15072

VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Isolation pads.

2. Isolation mounts.

3. Restrained elastomeric isolation mounts.

4. Restraining braces.

1.03 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: A.

2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.

a. Component Importance Factor: 1.0.

b. Component Response Modification Factor: 1.5.

c. Component Amplification Factor: 1.0.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second).

4. Design Spectral Response Acceleration at 1-Second Period: 5 percent.

1.05 ACTION 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.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.

b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.

2. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum

ratings of restraint items and the basis for approval (tests or calculations).

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

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

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. Kinetics Noise Control.

3. Mason Industries.

4. Vibration Eliminator Co., Inc.

5. Vibration Mountings & Controls, Inc.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

2.02 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. Cooper B-Line, Inc.; a division of Cooper Industries.

3. Hilti, Inc.

4. Kinetics Noise Control.

5. Mason Industries.

6. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least **four** times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to 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.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.

G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

I. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.03 FACTORY FINISHES

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

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 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.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. 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.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

2. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127 and NFPA 13.

2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.

3. Brace a change of direction longer than 12 feet (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

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

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to 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 sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to 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 introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 13974 "Fire-Suppression Standpipes," Section 13930 "Wet-Pipe Fire-Suppression Sprinklers," for piping flexible connections.

PART 4: MEASUREMENT AND PAYMENT

4.01 VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT:

A. Vibration and Seismic Controls for Fire-Suppression Piping and Equipment will not be measured for payment.

B. Vibration and Seismic Controls for Fire-Suppression Piping and Equipment will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15074

VIBRATION AND SEISMIC CONTROLS FOR HVAC AND PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Seismic snubbers.
12. Restraining braces and cables.
13. Steel and inertia, vibration isolation equipment bases.

1.03 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: A.

2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.

a. Component Importance Factor: 1.0.

b. Component Response Modification Factor: 1.5.

c. Component Amplification Factor: 1.0.

3. Design Spectral Response Acceleration at Short Periods (0.2 Second):

4. Design Spectral Response Acceleration at 1-Second Period: 5 percent.

1.05 ACTION 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.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES.

b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details 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. Design Calculations: Calculate static and dynamic loading due to

equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. Isolation Technology, Inc.

3. Kinetics Noise Control.

4. Mason Industries.

5. Vibration Eliminator Co., Inc.

6. Vibration Mountings & Controls, Inc.

B. Pads : Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.

3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger

with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.02 VIBRATION ISOLATION EQUIPMENT BASES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. Isolation Technology, Inc.

3. Kinetics Noise Control.

4. Mason Industries.

5. Vibration Eliminator Co., Inc.

6. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate

supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.03 SEISMIC-RESTRAINT DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amber/Booth Company, Inc.

2. Cooper B-Line, Inc.; a division of Cooper Industries.

3. Hilti, Inc.

4. Kinetics Noise Control.

5. Mason Industries.

6. TOLCO Incorporated; a brand of NIBCO INC.

7. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least **four** times the maximum seismic forces to which they will be subjected.

C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.

2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.

3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to 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.

E. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.04 FACTORY FINISHES

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

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 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.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. 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.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Section 07720 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).

3. Install seismic-restraint devices using methods approved by [an evaluation service member of ICC-ES providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of [80 feet (24 m) o.c.

3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

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

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to 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 sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to 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 introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 15181 "Hydronic Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.

3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.

6. Measure isolator restraint clearance.

7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-mounting systems. Refer to Section 01820 "Demonstration and Training."

3.08 HVAC VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Isolator, pad, spring or other mounting equipment shall meet requirements of equipment or component.

B. Motor driven equipment shall include internal isolation or provide with spring isolation mounts to meet ICC-ES.

C. Piping and duct connected to isolated equipment shall be provided with isolation mounts with travel equal to the connected equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT:

A. Vibration And Seismic Controls For HVAC and Plumbing Piping and Equipment will not be measured for payment.

B. Vibration And Seismic Controls For HVAC and Plumbing Piping and Equipment will not be paid directly, but be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15077

IDENTIFICATION FOR HVAC AND PLUMBING

PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Duct labels.
4. Valve tags.

1.03 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.04 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

2.01 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

2. Letter Color: Dark Blue.

3. Background Color: White.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

6. Minimum Letter Size: ½ inch for name of units Include secondary lettering three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

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

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

2.02 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or

adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches (38 mm)high.

2.03 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black for supply and grey for exhaust.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

F. Minimum Letter Size: ½ inch for name of units. Include secondary lettering three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches (38 mm)high.

2.04 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material Aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.01 PREPARATION

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

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Pipe Label: Install pipe labels with, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

B. Locate pipe labels where piping is exposed or accessible as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 25 feet (7.6 m).

3.04 DUCT LABEL INSTALLATION

A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts:

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application: Tag valves according to size, shape, and color scheme ASME A13.1 Colors and Designs and with captions.

PART 4: MEASUREMENT AND PAYMENT

4.01 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT:

A. Identification for HVAC and Plumbing Piping and Equipment will not be measured for payment.

B. Identification for HVAC and Plumbing Piping and Equipment will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15086

DUCT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.

2. Indoor, exposed supply and outdoor air.

3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Related Sections:

1. Section 15087 "HVAC Equipment Insulation."

2. Section 15088 "HVAC Piping Insulation."

3. Section 15815 "Metal Ducts" for duct liners.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.

3. Detail application of field-applied jackets.

4. Detail application at linkages of control devices.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches (300 mm) square.

2. Sheet Jacket Materials: 12 inches (300 mm) square.

3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," "articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aerocel.

b. Armacell LLC; AP Armaflex.

c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.

b. Johns Manville; Microlite.

c. Knauf Insulation; Friendly Feel Duct Wrap.

d. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.

b. Fibrex Insulations Inc.; FBX.

c. Johns Manville; 800 Series Spin-Glas.

d. Knauf Insulation; Insulation Board.

e. Owens Corning; Fiberglas 700 Series.

2.02 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II,

Class I.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Aeroflex USA, Inc.; Aeroseal.

   b. Armacell LLC; Armaflex 520 Adhesive.

   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.

   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

   b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.

b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.

b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.

b. Eagle Bridges - Marathon Industries; 501.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.

d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.

3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).

4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.

5. Color: White.

D. Breather Mastic: Water based; suitable for indoor use on above ambient services.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.

b. Eagle Bridges - Marathon Industries; 550.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

d. Mon-Eco Industries, Inc.; 55-50.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

4. Solids Content: 60 percent by volume and 66 percent by weight.

5. Color: White.

2.04 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.

b. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.

4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

5. Color: White.

2.05 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements as stipulated in Division 1 available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.

b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 FACTORY-APPLIED JACKETS

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with

kraft-paper backing; complying with ASTM C 1136, Type II.

4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.07 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

c. Compac Corporation; 104 and 105.

d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).

3. Thickness: 11.5 mils (0.29 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.

c. Compac Corporation; 110 and 111.

d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).

3. Thickness: 6.5 mils (0.16 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.

b. Compac Corporation; 130.

c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).

3. Thickness: 6 mils (0.15 mm).

4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.

5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.

c. Compac Corporation; 120.

d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).

4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.08 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements as stipulated in Division 1, available products that may be incorporated into the Work include, but are not limited to, the following:

a. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal or Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; CWP-1.

ii. GEMCO; CD.

iii. Midwest Fasteners, Inc.; CD.

iv. Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; CHP-1.

ii. GEMCO; Cupped Head Weld Pin.

iii. Midwest Fasteners, Inc.; Cupped Head.

iv. Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.

ii. GEMCO; Perforated Base.

iii. Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Copper- or zinc-coated, low-carbon steel , Aluminum or Stainless steel, fully annealed, 0.106-inch-(2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging

insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      i. GEMCO; Nylon Hangers.

      ii. Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

   c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).

   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      i. AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.

      ii. GEMCO; Peel & Press.

      iii. Midwest Fasteners, Inc.; Self Stick.

   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Copper- or zinc-coated, low-carbon steel , Aluminum or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; RC-150.

ii. GEMCO; R-150.

iii. Midwest Fasteners, Inc.; WA-150.

iv. Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

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:

i. GEMCO.

ii. Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6-mm) soft-annealed, stainless steel.

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. C & F Wire.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

   1. Verify that systems to be insulated have been tested and are free of defects.

   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

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

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.04 PENETRATIONS

A. Insulation Installation at Roof Curbs: Install insulation continuously through roof penetrations within curb.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously upto wall mounted fans.

1. Seal penetrations with flashing sealant.

2. Terminate insulation inside wall surface and seal with joint sealant.

3. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).

1. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

3.05 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.06 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

   b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

   d. Do not overcompress insulation during installation.

   e. Impale insulation over pins and attach speed washers.

   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment.

Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct.

Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.

b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not overcompress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of

stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.07 FINISHES

A. Insulation with Paintable Jacket (excluding PVC) Material: Paint jacket with paint system identified below and as specified in Section 09911 "Exterior Painting" and Section 09915 "Interior Painting."

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.08 FIELD QUALITY CONTROL

A. Testing Agency Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to **two** location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed and exposed outdoor air.

2. Indoor, concealed and exposed supply air in conditioned spaces.

3. Indoor, concealed return located in unconditioned space.

4. Indoor, exposed return located in unconditioned space.

5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.

6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Fibrous-glass ducts.

2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.

3. Factory-insulated flexible ducts.

4. Factory-insulated plenums and casings.

5. Flexible connectors.

6. Vibration-control devices.

7. Factory-insulated access panels and doors.

8. Indoor exposed ductwork within heated only spaces.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, , supply-air and outdoor-air duct insulation shall be **one of** the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.

2. Mineral-Fiber Blanket: 2 inches (50 mm thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

B. Return and exhaust-air passing thru unconditioned spaces duct insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.

2. Mineral-Fiber Blanket: 2 inches (50 mm thick and 1.5-lb/cu. ft. (24-kg/cu. m) nominal density.

3. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

C. Exposed supply-air and outdoor-air duct insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.

2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

D. Exposed return and exhaust-air passing thru unconditioned spaces duct insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch (25 mm) thick.

2. Mineral-Fiber Board: 1-1/2 inches (38 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. None.

PART 4: MEASUREMENT AND PAYMENT

4.01 DUCT INSULATION:

A. Duct Insulation will not be measured for payment.

B. Duct Insulation will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15087

HVAC AND PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulating the following equipment that is not factory insulated:

1. Heat exchangers.
2. Converters.
3. Heating, hot-water pumps.
4. Expansion/compression tanks.
5. Air separators.
6. Tanks.
7. Piping system filtration unit housings.

B. Related Sections:

1. Section 15086 "Duct Insulation."
2. Section 15088 "HVAC and Plumbing Piping Insulation."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail removable insulation at equipment connections.

3. Detail application of field-applied jackets.

4. Detail application at linkages of control devices.

5. Detail field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).

2. Sheet Form Insulation Materials: 12 inches (300 mm) square.

3. Sheet Jacket Materials: 12 inches (300 mm) square.

4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and

smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in

the manufacturing process.

F. Calcium Silicate:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Industrial Insulation Group (IIG); Thermo-12 Gold.

2. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

G. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.

3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.

5. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aerocel.

b. Armacell LLC; AP Armaflex.

c. K-Flex USA; Insul-Sheet and K-FLEX LS.

I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and

ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; SoftTouch Duct Wrap.

   b. Johns Manville; Microlite.

   c. Knauf Insulation; Friendly Feel Duct Wrap.

   d. Manson Insulation Inc.; Alley Wrap.

   e. Owens Corning; SOFTR All-Service Duct Wrap.

J. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Products: Subject to compliance with requirements, [provide one of the following:

   a. Industrial Insulation Group (IIG); MinWool-1200 Flexible Batt.

   b. Johns Manville; HTB 26 Spin-Glas.

K. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. Provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; CertaPro Commercial Board.

   b. Fibrex Insulations Inc.; FBX.

   c. Johns Manville; 800 Series Spin-Glas.

   d. Knauf Insulation; Insulation Board.

   e. Manson Insulation Inc.; AK Board.

   f. Owens Corning; Fiberglas 700 Series.

L. Mineral-Fiber, Tank Insulation: Mineral or glass fibers bonded with a

thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corp.; CrimpWrap.

   b. Johns Manville; MicroFlex.

   c. Knauf Insulation; Pipe and Tank Insulation.

   d. Manson Insulation Inc.; AK Flex.

   e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F (10 to 427 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.

b. Eagle Bridges - Marathon Industries; 290.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.

d. Mon-Eco Industries, Inc.; 22-30.

e. Vimasco Corporation; 760.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available

products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.

b. Armacell LLC; Armaflex 520 Adhesive.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.

d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.

d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.

b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

c. P.I.C. Plastics, Inc.; Welding Adhesive.

d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H .B. Fuller Company; 30-80/30-90.

b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.

b. Eagle Bridges - Marathon Industries; 501.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.

d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.

3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).

4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.

5. Color: White.

D. Breather Mastic: Water based; suitable for indoor use on above ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.

b. Eagle Bridges - Marathon Industries; 550.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.

d. Mon-Eco Industries, Inc.; 55-50.

e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

4. Solids Content: 60 percent by volume and 66 percent by weight.

5. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 40 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.

b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.

c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.

4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

5. Color: White.

2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

   b. Eagle Bridges - Marathon Industries; 405.

   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.

   d. Mon-Eco Industries, Inc.; 44-05.

   e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).

5. Color: White or gray.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

   b. Eagle Bridges - Marathon Industries; 405.

   c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.

   d. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirementsavailable products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering equipment.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for equipment.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.

b. Vimasco Corporation; Elastafab 894.

2.09 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.

b. P.I.C. Plastics, Inc.; FG Series.

c. Proto Corporation; LoSmoke.

d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

4. Factory-fabricated tank heads and tank side panels.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.

b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.

c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

   a. Sheet and roll stock ready for shop or field sizing.

   b. Finish and thickness are indicated in field-applied jacket schedules.

   c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.

   d. Factory-Fabricated Fitting Covers:

      i. Same material, finish, and thickness as jacket.

      ii. Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.

      iii. Tee covers.

      iv. Flange and union covers.

      v. End caps.

      vi. Beveled collars.

      vii. Valve covers.

      viii. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

   a. Sheet and roll stock ready for shop or field sizing.

   b. Material, finish, and thickness are indicated in field-applied jacket schedules.

   c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

c. Compac Corporation; 104 and 105.

d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).

3. Thickness: 11.5 mils (0.29 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.

c. Compac Corporation; 110 and 111.

d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).

3. Thickness: 6.5 mils (0.16 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. FSK Tape Disks and Squares: Precut disks or squares of FSK

tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.

c. Compac Corporation; 120.

d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).

4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements as stipulated in Division 1, available products that may be incorporated into the Work include, but are not limited to, the following:

a. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 3/4 inch (19 mm) wide with wing seal.

3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 3/4 inch (19 mm) wide with wing seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin,

fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; CWP-1.

ii. GEMCO; CD.

iii. Midwest Fasteners, Inc.; CD.

iv. Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; CHP-1.

ii. GEMCO; Cupped Head Weld Pin.

iii. Midwest Fasteners, Inc.; Cupped Head.

iv. Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.

ii. GEMCO; Perforated Base.

iii. Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.

c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. GEMCO; Nylon Hangers.

ii. Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.

c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).

d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

i. AGM Industries, Inc.; RC-150.

ii. GEMCO; R-150.

iii. Midwest Fasteners, Inc.; WA-150.

iv. Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

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:

i. GEMCO.

ii. Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy or 0.062-inch (1.6-mm) soft-annealed, stainless steel.

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. C & F Wire.

2.13 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or

ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

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

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Manholes.

5. Handholes.

6. Cleanouts.

3.04 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.

3. Protect exposed corners with secured corner angles.

4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

a. Do not weld anchor pins to ASME-labeled pressure vessels.

b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.

c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.

d. Do not overcompress insulation during installation.

e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.

f. Impale insulation over anchor pins and attach speed washers.

g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches (75 mm).

8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in

insulation.

11. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

12. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.

13. Seal longitudinal seams and end joints.

B. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch (150-mm) centers, starting at corners. Install 3/8-inch-(10-mm-) diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.

2. Fabricate boxes from aluminum at least 0.060 inch (1.6 mm) thick or stainless steel at least 0.040 inch (1.0 mm) thick.

3. Fabricated boxes shall have heavy duty surface mounted draw latches so that access can be gained without the use of tools.

4. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.05 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation:

1. Secure single-layer insulation with stainless-steel bands at 12-inch (300-mm) intervals and tighten bands without deforming insulation material.

2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches (75 mm). Secure inner layer with wire spaced at 12-inch (300-mm) intervals. Secure outer layer with stainless-steel bands at 12-inch (300-mm) intervals.

3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch (25 mm). Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.06 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.

3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

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

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches (850 mm) or less. 33-1/2-inch- (850-mm-) circumference limit

allows for 2-inch- (50-mm-) overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.

2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.07 FINISHES

A. Equipment Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09911 "Exterior Painting" and Section 09915 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections: Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to two location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Heat-exchanger's insulation shall be one of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.

2. Cellular Glass: 3 inches (75 mm) thick.

3. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

4. Mineral-Fiber Pipe and Tank: 2 inches (50 mm) thick.

D. Heating-hot-water pump insulation shall be one of the following:

1. Calcium Silicate: 3 inches (75 mm) thick.

2. Cellular Glass: 3 inches (75 mm) thick.

3. Mineral-Fiber Board: 2 inches (50 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density.

E. Heating-hot-water expansion/compression, air-separator tank, storage tank and piping system filter-housing insulation shall be one of the following:

1. Calcium Silicate: 2 inches (50 mm) thick.

2. Cellular Glass: 1-1/2 inches (38 mm) thick.

3. Mineral-Fiber Board: 1 inch (25 mm) thick and 2-lb/cu. ft. (32-kg/cu. m) nominal density.

4. Mineral-Fiber Pipe and Tank: 1 inch (25 mm) thick.

3.10 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Equipment, Concealed:

1. None.

D. Equipment, Exposed, provide one of the following:

1. PVC 30 mils (0.8 mm)] thick.

2. Aluminum, Smooth0.024 inch (0.61 mm) thick.

3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish 0.016 inch (0.41 mm) thick.

PART 4: MEASUREMENT AND PAYMENT

4.01 HVAC EQUIPMENT INSULATION:

A. HVAC and Plumbing Equipment Insulation will not be measured for payment.

B. HVAC and Plumbing Equipment Insulation will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15088

HVAC AND PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes insulating the following HVAC and Plumbing piping systems:

1. Condensate drain piping, indoors.
2. Heating -water piping, indoors.
3. Refrigerant suction and hot-gas piping, indoors and outdoors.
4. Domestic hot water, hot water recirc, and cold water pipe.
5. Horizontal Strom Water Pipe.
6. Sanitary drain traps

B. Related Sections:

1. Section 15086 "Duct Insulation."
2. Section 15087 "HVAC and Plumbing Equipment Insulation."

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1. Using Small-Scale Environmental Chambers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail insulation application at pipe expansion joints for each type of insulation.

3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

4. Detail removable insulation at piping specialties.

5. Detail application of field-applied jackets.

6. Detail application at linkages of control devices.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and

grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements available

products that may be incorporated into the Work include, but are not limited to, the following:

a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.

3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.

5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.

6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.

7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aerocel.

b. Armacell LLC; AP Armaflex.

c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.

b. Johns Manville; Microlite.

c. Knauf Insulation; Friendly Feel Duct Wrap.

d. Manson Insulation Inc.; Alley Wrap.

e. Owens Corning; SOFTR All-Service Duct Wrap.

I. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Fibrex Insulations Inc.; Coreplus 1200.

b. Johns Manville; Micro-Lok.

c. Knauf Insulation; 1000-Degree Pipe Insulation.

d. Manson Insulation Inc.; Alley-K.

e. Owens Corning; Fiberglas Pipe Insulation.

2.02 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Super-Stik.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Thermokote V.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F (minus 73 to plus 93 deg C).

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

2. For indoor applications, 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. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.; Aeroseal.

b. Armacell LLC; Armaflex 520 Adhesive.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.

d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.

d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.

b. Eagle Bridges - Marathon Industries; 225.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.

d. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 739, Dow Silicone.

b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.

c. P.I.C. Plastics, Inc.; Welding Adhesive.

d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H .B. Fuller Company; 30-80/30-90.

b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).

4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.

5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.

b. Eagle Bridges - Marathon Industries; 501.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.

d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.

3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).

4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.

5. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 40 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.

b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.

c. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment insulation.

4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).

5. Color: White.

2.06 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following]:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

b. Eagle Bridges - Marathon Industries; 405.

c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.

d. Mon-Eco Industries, Inc.; 44-05.

e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F (Minus 73 to plus 149 deg C).

5. Color: White or gray.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).

5. Color: White.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; Zeston.

b. P.I.C. Plastics, Inc.; FG Series.

c. Proto Corporation; LoSmoke.

d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.

3. Color: White.

4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.

b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.

c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.

b. Finish and thickness are indicated in field-applied jacket schedules.

c. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper.

d. Factory-Fabricated Fitting Covers:

i. Same material, finish, and thickness as jacket.

ii. Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.

iii. Tee covers.

iv. Flange and union covers.

v. End caps.

vi. Beveled collars.

vii. Valve covers.

viii. Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.

c. Compac Corporation; 104 and 105.

d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).

3. Thickness: 11.5 mils (0.29 mm).

4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.

5. Elongation: 2 percent.

6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.

7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.

b. Compac Corporation; 130.

c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).

3. Thickness: 6 mils (0.15 mm).

4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.

5. Elongation: 500 percent.

6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. ABI, Ideal Tape Division; 488 AWF.

b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.

c. Compac Corporation; 120.

d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).

3. Thickness: 3.7 mils (0.093 mm).

4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.

5. Elongation: 5 percent.

6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.

3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

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

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at [2 inches (50 mm)] [4 inches (100 mm)] o.c.

   a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.

2. Testing agency labels and stamps.

3. Nameplates and data plates.

4. Manholes.

5. Handholes.

6. Cleanouts.

3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install

insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than

two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations requiring removal for maintenance. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish

cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

3.07 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.08 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.

4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.09 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

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

3.10 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09911 "Exterior Painting" and Section 09915 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, three locations of threaded strainers, three locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.

2. Underground piping.

3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

B. Heating and Process piping Water, 100 Deg F and above:

1. All pipe sizes: Insulation shall be one of the following:

a. Cellular Glass: 2 inches (50 mm) thick.

b. Mineral-Fiber, Preformed Pipe, Type I 1-1/2 inches (38 mm) thick.

C. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

D. Domestic Hot Water, Hot Water Recirculation and Cold Water Piping;

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

E. Horizontal Stormwater Drainage Pipe:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

F. Sanitary Drainage Traps in ceiling cavities above finished ceilings:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Tubing:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Cellular Glass: 1-1/2 inches (38 mm) thick.

b. Flexible Elastomeric: 1 inch (25 mm) thick.

c. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch (25 mm) thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. PVC 30 mils (0.8 mm) thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. Aluminum, Corrugated with Z-Shaped Locking Seam: 0.024 inch (0.61 mm) thick.

PART 4: MEASUREMENT AND PAYMENT

4.01 HVAC PIPING INSULATION :

A. HVAC and Plumbing Piping Insulation will not be measured for payment.

B. HVAC and Plumbing Piping Insulation will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15091

SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

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

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

2.02 STACK-SLEEVE FITTINGS

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. Smith, Jay R. Mfg. Co.

2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

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. Advance Products & Systems, Inc.

2. CALPICO, Inc.

3. Metraflex Company (The).

4. Pipeline Seal and Insulator, Inc.

5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.04 SLEEVE-SEAL FITTINGS

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. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.05 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

Comply with requirements for sealants specified in Section 07920 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07841 "Through-Penetration Firestop Systems."

3.02 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07620 "Sheet Metal Flashing and Trim."

3. Install section of pipe to extend sleeve to 2 inches (50 mm) above finished floor level.

4. Extend sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07841 "Through-Penetration Firestop Systems."

3.03 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.05 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.

   b. Piping NPS 6 (DN 150) Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6 (DN 1 50): Galvanized-steel-pipe sleeves with sleeve-seal system.

      i. Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

      i. Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.

      i. Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

      i. Select sleeve size to allow for 1-inch (25-mm) annular

clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6 (DN 150) Galvanized-steel-pipe sleeves.

   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

   a. Piping Smaller than NPS 6 (DN 150) Galvanized-steel-pipe sleeves.

   b. Piping NPS 6 (DN 150) and Larger: [Galvanized-steel-sheet sleeves.

PART 4: MEASUREMENT AND PAYMENT

4.01 SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING:

A. Sleeves And Sleeve Seals for Fire-Suppression Piping will not be measured for payment.

B. Sleeves And Sleeve Seals for Fire-Suppression Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15093

SLEEVES AND SLEEVE SEALS FOR HVAC AND PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

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

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

2.02 STACK-SLEEVE FITTINGS

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. Smith, Jay R. Mfg. Co.

2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.03 SLEEVE-SEAL SYSTEMS

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. Advance Products & Systems, Inc.

2. CALPICO, Inc.

3. Metraflex Company (The).

4. Pipeline Seal and Insulator, Inc.

5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.04 SLEEVE-SEAL FITTINGS

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. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.05 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

Comply with requirements for sealants specified in Section 07920 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07841 "Through-Penetration Firestop Systems."

3.02 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07620 "Sheet Metal Flashing and Trim."

3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.

4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07841 "Through-Penetration Firestop Systems."

3.03 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.04 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.05 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.

   b. Piping NPS 6 (DN 150) Galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6 (DN 1 50): Galvanized-steel-pipe sleeves with sleeve-seal system.

      i. Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

      i. Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system>.

      i. Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

      i. Select sleeve size to allow for 1-inch (25-mm)

annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6 (DN 150) Galvanized-steel-pipe sleeves.

   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

   a. Piping Smaller Than NPS 6 (DN 150) Galvanized-steel-pipe sleeves.

   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

PART 4: MEASUREMENT AND PAYMENT

4.01 SLEEVES AND SLEEVE SEALS FOR HVAC PIPING:

A. Sleeves And Sleeve Seals for HVAC and Plumbing Piping will not be measured for payment.

B. Sleeves And Sleeve Seals for HVAC and Plumbing Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15096

ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Escutcheons.

2. Floor plates.

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.02 FLOOR PLATES

A. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 INSTALLATION

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

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.

b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.

f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge..

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Piping: Split-casting, floor-plate type.

3.02 FIELD QUALITY CONTROL

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

PART 4 - MEASUREMENT AND PAYMENT

4.01 ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING:

A. Escutcheons for Fire-Suppression Piping will not be measured for payment.

B. Escutcheons for Fire-Suppression Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15098

ESCUTCHEONS FOR HVAC AND PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Escutcheons.

2. Floor plates.

1.03 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.01 ESCUTCHEONS

A. Split-Casting Brass Type: With polished, chrome-plated and rough-brass finish and with concealed hinge and setscrew.

B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.02 FLOOR PLATES

A. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.01 INSTALLATION

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

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for Piping:

a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.

b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge.

c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.

e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge.

f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Piping: Split-casting, floor-plate type.

3.02 FIELD QUALITY CONTROL

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

PART 4: MEASUREMENT AND PAYMENT

4.01 ESCUTCHEONS FOR HVAC PIPING :

A. Escutcheons for HVAC and Plumbing Piping will not be measured for payment.

B. Escutcheons for HVAC and Plumbing Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15110

PLUMBING VALVES

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following general-duty valves:

1. Copper-alloy ball valves.
2. Ferrous-alloy ball valves.
3. Ferrous-alloy butterfly valves.
4. Bronze check valves.
5. Gray-iron swing check valves.
6. Ferrous-alloy wafer check valves.
7. Spring-loaded, lift-disc check valves.
8. Bronze gate valves.
9. Cast-iron gate valves.
10. Bronze globe valves.
11. Cast-iron globe valves.

B. Related Sections include the following:

1. Division 2 piping Sections for general-duty and specialty valves for site construction piping.
2. Division 13 fire-suppression piping and fire pump Sections for fire-protection valves.
3. Division 15 Section "Mechanical Identification" for valve tags and charts.
4. Division 15 piping Sections for specialty valves applicable to those

Sections only.

1.03 DEFINITIONS:

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.

2. EPDM: Ethylene-propylene-diene terpolymer rubber.

3. NBR: Acrylonitrile-butadiene rubber.

4. PTFE: Polytetrafluoroethylene plastic.

5. SWP: Steam working pressure.

6. TFE: Tetrafluoroethylene plastic.

1.04 SUBMITTALS:

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.05 QUALITY ASSURANCE:

A. ASME Compliance: ASME B31.9 for building services piping valves.

1. Exceptions: Domestic hot- and cold-water piping valves unless referenced.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 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 angle, gate, and 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.

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

2.01 MANUFACTURERS:

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 VALVES, GENERAL:

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Handwheel: For valves other than quarter-turn types.

2. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.

G. Extended Valve Stems: On insulated valves.

H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

I. Valve Grooved Ends: AWWA C606.

1. Solder Joint: With sockets according to ASME B16.18.

a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check, gate, and globe valves; below 421 deg F (216 deg C) for ball valves.

2. Threaded: With threads according to ASME B1.20.1.

J. Valve Bypass and Drain Connections: MSS SP-45.

2.03 COPPER-ALLOY BALL VALVES:

A. Available Manufacturers:

1. One-Piece, Copper-Alloy Ball Valves:

a. American Valve, Inc.

b. Conbraco Industries, Inc.; Apollo Div.

c. Grinnell Corporation.

d. NIBCO INC.

e. Watts Industries, Inc.; Water Products Div.

2. Two-Piece, Copper-Alloy Ball Valves:

a. Conbraco Industries, Inc.; Apollo Div.

b. Grinnell Corporation.

c. Hammond Valve.

d. Milwaukee Valve Company.

e. NIBCO INC.

f. Watts Industries, Inc.; Water Products Div.

3. Three-Piece, Copper-Alloy Ball Valves:

a. Conbraco Industries, Inc.; Apollo Div.

b. Grinnell Corporation.

c. Hammond Valve.

d. NIBCO INC.

B. Copper-Alloy Ball Valves, General: MSS SP-110.

C. Copper-Alloy Ball Valves: Brass or bronze body with chrome-plated bronze ball, PTFE or TFE seats, and 600-psig (4140-kPa) CWP rating.

2.04 FERROUS-ALLOY BALL VALVES:

A. Available Manufacturers:

1. Conbraco Industries, Inc.; Apollo Div.

2. Hammond Valve.

3. Milwaukee Valve Company.

4. NIBCO INC.

B. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.

C. Ferrous-Alloy Ball Valves: Class 300, full or regular port.

2.05 FERROUS-ALLOY BUTTERFLY VALVES:

A. Available Manufacturers:

1. Flangeless, Ferrous-Alloy Butterfly Valves:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Industries, Inc.; Water Products Div.

2. Single-Flange, Ferrous-Alloy Butterfly Valves:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. Mueller Steam Specialty.

e. NIBCO INC.

3. Flanged, Ferrous-Alloy Butterfly Valves:

a. Bray International, Inc.

b. Cooper Cameron Corp.; Cooper Cameron Valves Div.

c. Grinnell Corporation.

d. Mueller Steam Specialty.

e. Tyco International, Ltd.; Tyco Valves & Controls.

4. Grooved-End, Ductile-Iron Butterfly Valves:

a. Central Sprinkler Co.; Central Grooved Piping Products.

b. Grinnell Corporation.

c. Hammond Valve.

d. NIBCO INC.

e. Victaulic Co. of America.

B. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.

C. Flangeless, 300-psig (2070-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer type with one- or two-piece stem.

D. Single-Flange, 300-psig (2070-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Wafer-lug type with one- or two-piece stem.

E. Flanged, 300-psig (2070-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one- or two-piece stem.

F. Grooved-End, 300-psig (2070-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Ductile-iron or steel body with grooved or shouldered ends.

2.06 BRONZE CHECK VALVES:

A. Available Manufacturers:

1. Type 1, Bronze, Horizontal Lift Check Valves with Metal Disc:

   a. Cincinnati Valve Co.

   b. Red-White Valve Corp.

   c. Walworth Co.

2. Type 2, Bronze, Horizontal Lift Check Valves with Nonmetallic Disc:

   a. Cincinnati Valve Co.

   b. Walworth Co.

3. Type 1, Bronze, Vertical Lift Check Valves with Metal Disc:

   a. Cincinnati Valve Co.

   b. Red-White Valve Corp.

4. Type 2, Bronze, Vertical Lift Check Valves with Nonmetallic Disc:

   a. Grinnell Corporation.

   b. Kitz Corporation of America.

   c. Milwaukee Valve Company.

5. Type 3, Bronze, Swing Check Valves with Metal Disc:

   a. Grinnell Corporation.

   b. Hammond Valve.

   c. Milwaukee Valve Company.

   d. NIBCO INC.

   e. Watts Industries, Inc.; Water Products Div.

6. Type 4, Bronze, Swing Check Valves with Nonmetallic Disc:

   a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Industries, Inc.; Water Products Div.

B. Bronze Check Valves, General: MSS SP-80.

C. Type 1, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with bronze disc and seat.

D. Type 1, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with bronze disc and seat.

E. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

F. Type 2, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

G. Type 2, Class 200, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

H. Type 2, Class 200, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.

I. Type 3, Class 200, Bronze, Swing Check Valves: Bronze body with bronze disc and seat.

J. Type 4, Class 200, Bronze, Swing Check Valves: Bronze body with nonmetallic disc and bronze seat.

2.07 GRAY-IRON SWING CHECK VALVES:

A. Available Manufacturers:

1. Type I, Gray-Iron Swing Check Valves with Metal Seats:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Industries, Inc.; Water Products Div.

2. Type II, Gray-Iron Swing Check Valves with Composition to Metal Seats:

   a. Mueller Co.

   b. Watts Industries, Inc.; Water Products Div.

3. Grooved-End, Ductile-Iron Swing Check Valves:

   a. Grinnell Corporation.

   b. Mueller Co.

   c. Victaulic Co. of America.

B. Gray-Iron Swing Check Valves, General: MSS SP-71.

C. Type I, Class 250, gray-iron, swing check valves with metal seats.

D. Type II, Class 250, gray-iron, swing check valves with composition to metal seats.

E. 175-psig (1207-kPa) CWP Rating, Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends.

2.08 BRONZE GATE VALVES:

A. Available Manufacturers:

1. Type 1, Bronze, Nonrising-Stem Gate Valves:

   a. Grinnell Corporation.

   b. Hammond Valve.

   c. Milwaukee Valve Company.

   d. NIBCO INC.

   e. Watts Industries, Inc.; Water Products Div.

2. Type 2, Bronze, Rising-Stem, Solid-Wedge Gate Valves:

   a. Grinnell Corporation.

   b. Hammond Valve.

   c. Milwaukee Valve Company.

   d. NIBCO INC.

3. Type 3, Bronze, Rising-Stem, Split-Wedge Gate Valves:

a. Cincinnati Valve Co.

b. Grinnell Corporation.

c. NIBCO INC.

B. Bronze Gate Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 1, Class 200, Bronze Gate Valves: Bronze body with nonrising stem and bronze solid wedge and union-ring bonnet.

D. Type 2, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze solid wedge and union-ring bonnet.

E. Type 3, Class 200, Bronze Gate Valves: Bronze body with rising stem and bronze split wedge and union-ring bonnet.

2.09 CAST-IRON GATE VALVES:

A. Available Manufacturers:

1. Type I, Cast-Iron, Nonrising-Stem Gate Valves:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Industries, Inc.; Water Products Div.

2. Type I, Cast-Iron, Rising-Stem Gate Valves:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Industries, Inc.; Water Products Div.

B. Cast-Iron Gate Valves, General: MSS SP-70, Type I.

C. Class 125, OS&Y, All-Iron, Cast-Iron Gate Valves: Cast-iron body with

cast-iron trim, rising stem, and solid-wedge disc.

D. Class 250, OS&Y, All-Iron, Cast-Iron Gate Valves: Cast-iron body with cast-iron trim, rising stem, and solid-wedge disc.

2.10 BRONZE GLOBE VALVES:

A. Available Manufacturers:

1. Type 1, Bronze Globe Valves with Metal Disc:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

2. Type 2, Bronze Globe Valves with Nonmetallic Disc:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

3. Type 3, Bronze Globe Valves with Renewable Seat and Metal Disc:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

B. Bronze Globe Valves, General: MSS SP-80, with ferrous-alloy handwheel.

C. Type 1, Class 200, Bronze Globe Valves: Bronze body with bronze disc and union-ring bonnet.

D. Type 2, Class 200, Bronze Globe Valves: Bronze body with PTFE or TFE disc and union-ring bonnet.

E. Type 3, Class 200, Bronze Globe Valves: Bronze body with bronze disc

and renewable seat. Include union-ring bonnet**.**

2.11 CAST-IRON GLOBE VALVES:

A. Available Manufacturers:

1. Type I, Cast-Iron Globe Valves with Metal Seats:

a. Grinnell Corporation.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

B. Cast-Iron Globe Valves, General: MSS SP-85.

C. Type I, Class 250, Cast-Iron Globe Valves: Gray-iron body with bronze seats.

PART 3: EXECUTION

3.01 EXAMINATION:

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE APPLICATIONS:

A. Refer to piping Sections for specific valve applications. If valve

applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.

2. Throttling Service: Angle, ball, butterfly, or globe valves.

3. Pump Discharge: Spring-loaded, lift-disc check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Low-Pressure, Compressed-Air Piping: Use the following types of valves:

1. Ball Valves, NPS 2 (DN 50) and Smaller: Three-piece, 600-psig (4140-kPa) CWP rating, copper alloy.

2. Equipment-Isolation Ball Valves, NPS 2 (DN 50) and Smaller: Safety-exhaust, bronze.

3. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 300, ferrous alloy.

4. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Flanged 300-psig (2070-kPa) CWP rating, ferrous alloy, with NBRliner.

5. Lift Check Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 200, horizontal or vertical, bronze.

6. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class 200, bronze.

7. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 250, gray iron.

8. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: 300-psig (2070-kPa) CWP rating.

9. Gate Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 250, bronze-mounted cast iron.

10. Globe Valves, NPS 2-1/2 (DN 65) and Larger: Type I, Class 250, bronze-mounted cast iron.

D. Medium-Pressure, Compressed-Air Piping: Use the following types of valves:

1. Ball Valves, NPS 2 (DN 50) and Smaller: Three-piece, 600-psig (4140-kPa) CWP rating, copper alloy.

2. Equipment-Isolation Ball Valves, NPS 2 (DN 50) and Smaller: Safety-exhaust, bronze.

3. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 300, ferrous alloy.

4. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Flanged, 300-psig (2070-kPa) CWP rating, ferrous alloy, with liner.

5. Grooved-End, Ductile-Iron Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: 300-psig (2070-kPa) CWP rating.

6. Lift Check Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 200, horizontal or vertical, bronze.

7. Swing Check Valves, NPS 2 (DN 50) and Smaller: Type 4, Class 200, bronze.

8. Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: Type II, Class 250, gray iron.

9. Grooved-End, Ductile-Iron, Swing Check Valves, NPS 2-1/2 (DN 65) and Larger: 300-psig (2070-kPa) CWP rating.

10. Spring-Loaded, Lift-Disc Check Valves, NPS 2 (DN 50) and Smaller: Type IV, Class 150.

11. Spring-Loaded, Lift-Disc Check Valves, NPS 2-1/2 (DN 65) and Larger: Types I or II, Class 250, cast iron.

E. Domestic Water Piping: Use the following types of valves:

1. Ball Valves, NPS 2 (DN 50) and Smaller: Three-piece 600-psig (4140-kPa) CWP rating, copper alloy.

2. Ball Valves, NPS 2-1/2 (DN 65) and Larger: Class 300, ferrous alloy.

3. Butterfly Valves, NPS 2-1/2 (DN 65) and Larger: Flangeless, 300-psig (2070-kPa)] CWP rating, ferrous alloy, with PDM liner.

4. Globe Valves, NPS 2 (DN 50) and Smaller: Type 2, Class 125 200, bronze for drain valves only.

3.03 VALVE INSTALLATION:

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

3.04 JOINT CONSTRUCTION:

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.05 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.

PART 4: MEASUREMENT AND PAYMENT

4.01 VALVES:

A. Valves will not be measured for payment.

B. Valves will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15112

GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Bronze ball valves.
3. Iron ball valves.
4. Iron, single-flange butterfly valves.
5. Iron, grooved-end butterfly valves.
6. High-performance butterfly valves.
7. Bronze lift check valves.
8. Bronze swing check valves.
9. Iron swing check valves.
10. Iron, grooved-end swing-check valves.
11. Iron, plate-type check valves.
12. Bronze gate valves.
13. Iron gate valves.
14. Bronze globe valves.
15. Iron globe valves.
16. Lubricated plug valves.
17. Eccentric plug valves.

18. Chainwheels.

B. Related Sections:

1. Section 15077 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.04 ACTION SUBMITTALS

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

1.05 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.

1.06 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 angle, gate, and 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.

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

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to HVAC valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.

2. Handwheel: For valves other than quarter-turn types.

3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.

4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 25 plug valves, for each size square plug-valve head.

5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:

1. Gate Valves: With rising stem.

2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

3. Butterfly Valves: With extended neck.

F. 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.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE ANGLE VALVES

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

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. Hammond Valve.

b. Milwaukee Valve Company.

2. Description:

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

d. Ends: Threaded.

e. Stem and Disc: Bronze.

f. Packing: Asbestos free.

g. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, Bronze Angle Valves with Nonmetallic Disc:

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. American Valve, Inc.

b. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 2.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

d. Ends: Threaded.

e. Stem: Bronze.

f. Disc: PTFE or TFE.

g. Packing: Asbestos free.

h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Angle Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements as stipulated in Division 1, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Kitz Corporation.

2. Description:

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 300 psig (2070 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.

d. Ends: Threaded.

e. Stem and Disc: Bronze.

f. Packing: Asbestos free.

g. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

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. Hammond Valve.

b. Milwaukee Valve Company.

c. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 2.

b. CWP Rating: 300 psig (2070 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.

d. Ends: Threaded.

e. Stem: Bronze.

f. Disc: PTFE or TFE.

g. Packing: Asbestos free.

h. Handwheel: Malleable iron, bronze, or aluminum.

2.03 BRONZE BALL VALVES

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.

b. Conbraco Industries, Inc.; Apollo Valves.

c. Hammond Valve.

d. Milwaukee Valve Company.

e. NIBCO INC.

f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.

b. SWP Rating: 150 psig (1035 kPa).

c. CWP Rating: 600 psig (4140 kPa).

d. Body Design: Two piece.

e. Body Material: Bronze.

f. Ends: Threaded.

g. Seats: PTFE or TFE.

h. Stem: Bronze.

i. Ball: Chrome-plated brass.

j. Port: Full.

B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.

b. SWP Rating: 150 psig (1035 kPa).

c. CWP Rating: 600 psig (4140 kPa).

d. Body Design: Two piece.

e. Body Material: Bronze.

f. Ends: Threaded.

g. Seats: PTFE or TFE.

h. Stem: Stainless steel.

i. Ball: Stainless steel, vented.

j. Port: Full.

2.04 IRON BALL VALVES

A. Class 125, Iron Ball Valves:

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. American Valve, Inc.

b. Conbraco Industries, Inc.; Apollo Valves.

c. Kitz Corporation.

d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-72.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Design: Split body.

d. Body Material: ASTM A 126, gray iron.

e. Ends: Flanged.

f. Seats: PTFE or TFE.

g. Stem: Stainless steel.

h. Ball: Stainless steel.

i. Port: Full.

2.05 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Stainless-Steel Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bray Controls; a division of Bray International.

b. Conbraco Industries, Inc.; Apollo Valves.

c. DeZurik Water Controls.

d. Hammond Valve.

e. Milwaukee Valve Company.

f. Mueller Steam Specialty; a division of SPX Corporation.

g. NIBCO INC.

h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-67, Type I.

b. CWP Rating: 150 psig (1035 kPa).

c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.

e. Seat: EPDM.

f. Stem: One- or two-piece stainless steel.

g. Disc: Stainless steel.

2.06 IRON, GROOVED-END BUTTERFLY VALVES

A. 175 CWP, Iron, Grooved-End Butterfly Valves:

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. Tyco Fire Products LP; Grinnell Mechanical Products.

   c. Victaulic Company.

2. Description:

   a. Standard: MSS SP-67, Type I.

   b. CWP Rating: 175 psig (1200 kPa).

   c. Body Material: Coated, ductile iron.

   d. Stem: Two-piece stainless steel.

   e. Disc: Coated, ductile iron.

   f. Seal: EPDM.

2.07 HIGH-PERFORMANCE BUTTERFLY VALVES

A. Class 150, Single-Flange, High-Performance Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bray Controls; a division of Bray International.

   b. DeZurik Water Controls.

   c. Hammond Valve.

   d. Milwaukee Valve Company.

   e. NIBCO INC.

2. Description:

   a. Standard: MSS SP-68.

b. CWP Rating: 285 psig (1965 kPa) at 100 deg F (38 deg C).

c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.

e. Seat: Reinforced PTFE or metal.

f. Stem: Stainless steel; offset from seat plane.

g. Disc: Carbon steel.

h. Service: Bidirectional.

2.08 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements as stipulated in Division 1, available manufacturers offering products that meet the requirements as described herein;

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Design: Vertical flow.

d. Body Material: ASTM B 61 or ASTM B 62, bronze.

e. Ends: Threaded.

f. Disc: Bronze.

2.09 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.

b. Hammond Valve.

c. Kitz Corporation.

d. Milwaukee Valve Company.

e. NIBCO INC.

f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Design: Horizontal flow.

d. Body Material: ASTM B 62, bronze.

e. Ends: Threaded.

f. Disc: Bronze.

B. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.

b. Kitz Corporation.

c. Milwaukee Valve Company.

d. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 3.

b. CWP Rating: 300 psig (2070 kPa).

c. Body Design: Horizontal flow.

d. Body Material: ASTM B 62, bronze.

e. Ends: Threaded.

f. Disc: Bronze.

2.10 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hammond Valve.

   b. Kitz Corporation.

   c. Milwaukee Valve Company.

   d. NIBCO INC.

   e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

   a. Standard: MSS SP-71, Type I.

   b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).

   c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).

   d. Body Design: Clear or full waterway.

   e. Body Material: ASTM A 126, gray iron with bolted bonnet.

   f. Ends: Flanged.

   g. Trim: Bronze.

   h. Gasket: Asbestos free.

2.11 IRON, GROOVED-END SWING CHECK VALVES

A. 300 CWP, Iron, Grooved-End Swing Check Valves:

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. Anvil International, Inc.

b. Tyco Fire Products LP; Grinnell Mechanical Products.

c. Victaulic Company.

2. Description:

a. CWP Rating: 300 psig (2070 kPa).

b. Body Material: ASTM A 536, ductile iron.

c. Seal: EPDM.

d. Disc: Spring operated, ductile iron or stainless steel.

2.12 IRON, PLATE-TYPE CHECK VALVES

A. Class 125, Iron, Dual-Plate Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.

b. Mueller Steam Specialty; a division of SPX Corporation.

2. Description:

a. Standard: API 594.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).

c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).

d. Body Design: Wafer, spring-loaded plates.

e. Body Material: ASTM A 126, gray iron.

f. Seat: Bronze.

B. Class 150, Iron, Dual-Plate Check Valves with Metal Seat:

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. APCO Willamette Valve and Primer Corporation.

b. Mueller Steam Specialty; a division of SPX Corporation.

2. Description:

a. Standard: API 594.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 300 psig (2070 kPa).

c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 250 psig (1725 kPa).

d. Body Design: Wafer, spring-loaded plates.

e. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.

f. Seat: Bronze.

2.13 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.

b. Hammond Valve.

c. Kitz Corporation.

d. Milwaukee Valve Company.

e. NIBCO INC.

f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

d. Ends: Threaded[or solder joint].

e. Stem: Bronze.

f. Disc: Solid wedge; bronze.

g. Packing: Asbestos free.

h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.

b. Kitz Corporation.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 300 psig (2070 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.

d. Ends: Threaded.

e. Stem: Bronze.

f. Disc: Solid wedge; bronze.

g. Packing: Asbestos free.

h. Handwheel: Malleable iron, bronze, or aluminum.

2.14 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.

b. Kitz Corporation.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).

c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).

d. Body Material: ASTM A 126, gray iron with bolted bonnet.

e. Ends: Flanged.

f. Trim: Bronze.

g. Disc: Solid wedge.

h. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.; Crane Valve Group; Stockham Division.

b. Hammond Valve.

c. Kitz Corporation.

d. Milwaukee Valve Company.

e. NIBCO INC.

f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).

c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).

d. Body Material: ASTM A 126, gray iron with bolted bonnet.

e. Ends: Flanged.

f. Trim: Bronze.

g. Disc: Solid wedge.

h. Packing and Gasket: Asbestos free.

2.15 BRONZE GLOBE VALVES

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.

b. Kitz Corporation.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

d. Ends: Threaded[or solder joint].

e. Stem and Disc: Bronze.

f. Packing: Asbestos free.

g. Handwheel: Malleable iron, bronze, or aluminum.

2.16 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.

b. Kitz Corporation.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-85, Type I.

b. CWP Rating: 200 psig (1380 kPa).

c. Body Material: ASTM A 126, gray iron with bolted bonnet.

d. Ends: Flanged.

e. Trim: Bronze.

f. Packing and Gasket: Asbestos free.

2.17 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

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. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).

c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).

d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.

e. Pattern: Regular or short Venturi.

f. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

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. Nordstrom Valves, Inc.

2. Description:

a. Standard: MSS SP-78, Type II.

b. NPS 2-1/2 to NPS 12 (DN 65 to DN 300), CWP Rating: 200 psig (1380 kPa).

c. NPS 14 to NPS 24 (DN 350 to DN 600), CWP Rating: 150 psig (1035 kPa).

d. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.

e. Pattern: Regular or short Venturi.

f. Plug: Cast iron or bronze with sealant groove.

2.18 ECCENTRIC PLUG VALVES

A. 175 CWP, Eccentric Plug Valves with Resilient Seating.

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. Clow Valve Co.; a division of McWane, Inc.

b. DeZurik Water Controls.

c. Homestead Valve; a division of Olson Technologies, Inc.

d. M&H Valve Company; a division of McWane, Inc.

2. Description:

a. Standard: MSS SP-108.

b. CWP Rating: 175 psig (1200 kPa) minimum.

c. Body and Plug: ASTM A 48/A 48M, gray iron; ASTM A 126, gray iron; or ASTM A 536, ductile iron.

d. Bearings: Oil-impregnated bronze or stainless steel.

e. Ends: Flanged.

f. Stem-Seal Packing: Asbestos free.

g. Plug, Resilient-Seating Material: Suitable for potable-water service unless otherwise indicated.

2.19 CHAINWHEELS

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. Babbitt Steam Specialty Co.

2. Roto Hammer Industries.

3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

2. Attachment: For connection to ball, butterfly and plug valve stems.

3. Sprocket Rim with Chain Guides: Ductile or cast iron, Aluminum or Bronze, of type and size required for valve.

4. Chain: Hot-dip, galvanized steel, Brass or Stainless steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 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.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for valves NPS 4 (DN 100) and larger and more than 84 inches above floor located in mechanical or equipment rooms. Extend chains to 60 inches (1520 mm above finished floor.

F. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Plate-Type Check Valves: In horizontal or vertical position, between flanges.

3. Lift Check Valves: With stem upright and plumb.

3.03 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.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, gate, or plug valves.

2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service: Globe, angle, ball, or butterfly valves.

4. Pump-Discharge Check Valves:

a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.

b. NPS 2-1/2 (DN 65) and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.

4. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.

5. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

6. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.05 HEATING-WATER AND CONDENSER-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Bronze Angle Valves: Class 150, bronze disc.

3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.

4. Bronze Swing Check Valves: Class 150, bronze disc.

5. Bronze Gate Valves: Class 150, NRS bronze.

6. Bronze Globe Valves: Class 150, bronze disc.

B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.

2. Iron Ball Valves, NPS 2-1/2 to NPS 10 (DN 65 to DN 250): Class 150.

3. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 200 CWP, EPDM seat, stainless-steel disc.

4. Iron, Single-Flange Butterfly Valves, NPS 14 to NPS 24 (DN 350 to DN 600): 150 CWP, EPDM seat, stainless-steel disc.

5. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12 (DN 65 to DN 300): 175 CWP.

6. High-Performance Butterfly Valves: Class 150, single flange.

7. Iron Swing Check Valves: Class 125 metal seats.

8. Iron, Grooved-End Check Valves, NPS 3 to NPS 12 (DN 80 to DN 300): 300 CWP.

9. Iron, Plate-Type Check Valves: Class 150; single plate; metal seat.

10. Iron Gate Valves: Class 125 NRS.

11. Iron Globe Valves: Class 125.

12. Lubricated Plug Valves: Class 125 regular gland, threaded or flanged.

13. Eccentric Plug Valves: 175 CWP, resilient seating.

PART 4: MEASUREMENT AND PAYMENT

4.01 GENERAL-DUTY VALVES FOR HVAC PIPING:

A. General-Duty Valves for HVAC Piping will not be measured for payment.

B. General-Duty Valves for HVAC Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15120

PLUMBING PIPING SPECIALTIES

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Hose bibbs.
8. Wall hydrants.
9. Drain valves.
10. Water hammer arresters.
11. Air vents.
12. Trap-seal primer valves.
13. Trap-seal primer systems.
14. Cleanouts.
15. Floor drains.
16. Miscellaneous sanitary drainage piping specialties.

B. Related Sections include the following:

1. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.

2. Division 15 Section "Domestic Water Piping" for water meters.

1.03 PERFORMANCE REQUIREMENTS:

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

1.04 SUBMITTALS:

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

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE:

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.

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

PART 2: PRODUCTS

2.01 VACUUM BREAKERS:

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Co.

b. Conbraco Industries, Inc.

c. FEBCO; SPX Valves & Controls.

d. Watts Industries, Inc.; Water Products Div.

e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.

3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.

4. Body: Bronze.

5. Inlet and Outlet Connections: Threaded.

6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.

b. MIFAB, Inc.

c. Watts Industries, Inc.; Water Products Div.

d. Woodford Manufacturing Company.

e. Zurn Plumbing Products Group; Light Commercial Operation.

f. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

5. Finish: Rough bronze.

C. Pressure Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with

requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Co.

b. Conbraco Industries, Inc.

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.

5. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS:

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.

b. Watts Industries, Inc.; Water Products Div.

c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1012.

3. Operation: Continuous-pressure applications.

4. Size: NPS 3/4 (DN 20).

5. Body: Bronze.

6. End Connections: Solder joint.

7. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Ames Co.

   b. Conbraco Industries, Inc.

   c. FEBCO; SPX Valves & Controls.

   d. Watts Industries, Inc.; Water Products Div.

   e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1013.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 12 psig (83 kPa) maximum, through middle 1/3 of flow range.

5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.

6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

7. Configuration: Designed for horizontal, straight through flow.

8. Accessories:

   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Co.

b. Conbraco Industries, Inc.

c. FEBCO; SPX Valves & Controls.

d. Watts Industries, Inc.; Water Products Div.

e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1015.

3. Operation: Continuous-pressure applications, unless otherwise indicated.

4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.

5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.

6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

7. Configuration: Designed for horizontal, straight through flow.

8. Accessories:

a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 2 (DN 50) and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.

D. Dual-Check-Valve Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.

b. Flomatic Corporation.

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1024.

3. Operation: Continuous-pressure applications.

4. Body: Bronze with union inlet.

E. Double-Check, Detector-Assembly Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Ames Co.

b. Conbraco Industries, Inc.

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1048 and FMG approved or UL listed.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.

5. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.

6. End Connections: Flanged.

7. Configuration: Designed for horizontal, straight through flow.

8. Accessories:

a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.

b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

F. Hose-Connection Backflow Preventers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.

b. Watts Industries, Inc.; Water Products Div.

c. Woodford Manufacturing Company.

2. Standard: ASSE 1052.

3. Operation: Up to 10-foot head of water (30-kPa) back pressure.

4. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).

5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.

6. Capacity: At least 3-gpm (0.19-L/s) flow.

G. Backflow-Preventer Test Kits:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.

b. Flomatic Corporation.

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.03 WATER PRESSURE-REDUCING VALVES:

A. Water Regulators:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cash Acme.

b. Conbraco Industries, Inc.

c. Watts Industries, Inc.; Water Products Div.

d. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.

3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).

4. Body: Bronze with chrome-plated finish for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

5. Valves for Booster Heater Water Supply: Include integral bypass.

6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

B. Water Control Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CLA-VAL Automatic Control Valves.

b. Flomatic Corporation.

c. OCV Control Valves.

d. Watts Industries, Inc.; Ames Fluid Control Systems.

e. Zurn Plumbing Products Group; Wilkins Div.

2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.

3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa) minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.

4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

5. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.

2.04 BALANCING VALVES:

A. Copper-Alloy Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Manufacturers: Subject to compliance with requirements, provide

a. Armstrong International, Inc.

b. ITT Industries; Bell & Gossett Div.

c. NIBCO INC.

d. Taco, Inc.

e. Watts Industries, Inc.; Water Products Div.

3. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.

4. Body: Brass

5. Size: Same as connected piping, but not larger than NPS 2 (DN 50).

6. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Cast-Iron Calibrated Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong International, Inc.

b. ITT Industries; Bell & Gossett Div.

c. NIBCO INC.

d. Watts Industries, Inc.; Water Products Div.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.

3. Size: Same as connected piping, but not smaller than NPS 2-1/2 (DN 65).

C. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Conbraco Industries, Inc.

b. Hammond Valve.

c. Milwaukee Valve Company.

d. NIBCO INC.

e. Red-White Valve Corp.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.

3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.

4. Size: NPS 2 (DN 50) or smaller.

5. Body: Copper alloy.

6. Port: Standard or full port.

7. Ball: Chrome-plated brass.

8. Seats and Seals: Replaceable.

9. End Connections: Solder joint or threaded.

10. Handle: Vinyl-covered steel with memory-setting device.

2.05 TEMPERATURE-ACTUATED WATER MIXING VALVES:

A. Water-Temperature Limiting Devices:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Leonard Valve Company.

b. Powers; a Watts Industries Co.

c. Taco, Inc.

d. Watts Industries, Inc.; Water Products Div.

e. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1017.

3. Connections: Threaded or union inlets and outlet.

4. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

B. Primary, Thermostatic, Water Mixing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Armstrong International, Inc.

b. Lawler Manufacturing Company, Inc.

c. Leonard Valve Company.

d. Powers; a Watts Industries Co.

e. Symmons Industries, Inc.

2. Standard: ASSE 1017.

3. Pressure Rating: 125 psig (860 kPa).

4. Type: Exposed-mounting, thermostatically controlled water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded union inlets and outlet.

7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Valve Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.

9. Valve Finish: Chrome plated.

10. Piping Finish: Copper.

2.06 STRAINERS FOR DOMESTIC WATER PIPING:

A. Y-Pattern Strainers:

1. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and] for NPS 2-1/2 (DN 65) and larger.

2. End Connections: Threaded for NPS 2 (DN 50) and smaller flanged for NPS 2-1/2 (DN 65) and larger.

3. Screen: Stainless steel with round perforations, unless otherwise indicated.

4. Perforation Size:

a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).

b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).

5. Drain: Factory-installed, hose-end drain valve.

2.07 HOSE BIBBS:

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.

2. Body Material: Bronze.

3. Seat: Bronze, replaceable.

4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.

5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 125 psig (860 kPa).

7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.

9. Finish for Service Areas: Rough bronze.

10. Finish for Finished Rooms: Chrome or nickel plated.

11. Operation for Equipment Rooms: Wheel handle or operating key.

12. Operation for Service Areas: Wheel handle.

13. Operation for Finished Rooms: Wheel handle.

14. Include operating key with each operating-key hose bibb.

15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.08 WALL HYDRANTS:

A. Nonfreeze Wall Hydrants:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Josam Company.

b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

c. Watts Drainage Products Inc.

d. Woodford Manufacturing Company.

e. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.

3. Pressure Rating: 125 psig (860 kPa).

4. Operation: Loose key.

5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).

7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

8. Box: Deep, flush mounting with cover.

9. Box and Cover Finish: Polished nickel bronze.

10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

11. Nozzle and Wall-Plate Finish: Polished nickel bronze.

12. Operating Keys(s): Two with each wall hydrant.

2.09 DRAIN VALVES:

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.

2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.

3. Size: NPS 3/4 (DN 20).

4. Body: Copper alloy.

5. Ball: Chrome-plated brass.

6. Seats and Seals: Replaceable.

7. Handle: Vinyl-covered steel.

8. Inlet: Threaded or solder joint.

9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS:

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be

incorporated into the Work include, but are not limited to, the following:

a. AMTROL, Inc.

b. Josam Company.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Copper tube with piston.

4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 AIR VENTS:

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.

2. Pressure Rating: 125-psig (860-kPa) minimum pressure rating at 140 deg F (60 deg C).

3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.

5. Size: [NPS 3/8 (DN 10)] [NPS 1/2 (DN 15)] minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.

2. Pressure Rating: 150-psig (1035-kPa) minimum pressure rating.

3. Float: Replaceable, corrosion-resistant metal.

4. Mechanism and Seat: Stainless steel.

5. Size: NPS 3/8 (DN 10) minimum inlet.

6. Inlet and Vent Outlet End Connections: Threaded.

2.12 TRAP-SEAL PRIMER VALVES:

A. Supply-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. MIFAB, Inc.

b. PPP Inc.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.

3. Pressure Rating: 125 psig (860 kPa) minimum.

4. Body: Bronze.

5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.

6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

2. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 (DN 10) minimum, trap makeup connection.

3. Size: NPS 1-1/4 (DN 32) minimum.

4. Material: Chrome-plated, cast brass.

2.13 TRAP-SEAL PRIMER SYSTEMS:

A. Trap-Seal Primer Systems:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. PPP Inc.

2. Standard: ASSE 1044.

3. Piping: NPS 3/4, ASTM B 88, Type L (DN 20, ASTM B 88M, Type B); copper, water tubing.

4. Cabinet: Recessed-mounting steel box with stainless-steel cover.

5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

6. Vacuum Breaker: ASSE 1001.

7. Number Outlets: Four.

8. Size Outlets: NPS 1/2 (DN 15).

2.14 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products by one of the following:

a. Josam Company; Josam Div.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage

Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.

3. Size: Same as connected drainage piping

4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.

5. Closure: Countersunk, brass plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products by one of the following:

a. Josam Company; Josam Div.

b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

c. Tyler Pipe; Wade Div.

d. Watts Drainage Products Inc.

e. Zurn Plumbing Products Group; Light Commercial Operation.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.

3. Size: Same as connected branch.

4. Body or Ferrule: Cast iron.

5. Closure: Brass plug with tapered threads.

6. Adjustable Housing Material: Cast iron with threads.

7. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.

8. Frame and Cover Shape: Preferably Round.

9. Top Loading Classification: Medium Duty.

10. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

11. Standard: ASME A112.3.1.

12. Size: Same as connected branch.

13. Housing: Stainless steel.

14. Closure: Stainless steel with seal.

15. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products by one of the following:

a. Josam Company; Josam Div.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.

4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.

5. Closure: Countersunk, brass plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Wall Access: Round, deep, chrome-plated bronze cover plate with screw.

8. Wall Access: Round, nickel-bronze or stainless-steel wall-

installation frame and cover.

2.15 FLOOR DRAINS

A. Cast-Iron Floor Drains FD-A for toilet rooms, showers:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products by one of the following:

   a. Josam Company; Josam Div.

   b. MIFAB, Inc.

   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

   d. Tyler Pipe; Wade Div.

   e. Watts Drainage Products Inc.

   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.

3. Pattern: Sanitary drain.

4. Body Material: Gray iron.

5. Seepage Flange: with weep-holes.

6. Outlet: Bottom gasketed hub.

7. Top or Strainer Material: Nickel bronze.

8. Top of Body and Strainer Finish: Nickel bronze.

9. Top Loading Classification: Medium Duty.

10. Top shape, dimensions: Round 8”

11. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer connection.

12. Trap Material: Bronze.

13. Trap Pattern: Deep-seal P-trap.

14. Trap Features: Trap-seal primer valve connection.

15. Miscellaneous features: Vandal-proof Allen screws

B. Cast-Iron Floor Drains FD-M; for mechanical rooms:

1. Manufacturers: Subject to compliance with requirements, manufacturers offering products by one of the following:

   a. Josam Company; Josam Div.

   b. MIFAB, Inc.

   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

   d. Tyler Pipe; Wade Div.

   e. Watts Drainage Products Inc.

   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.

3. Pattern: Floor drain.

4. Body Material: Gray iron.

5. Seepage Flange: with weep-holes.

6. Outlet: Bottom gasketed hub.

7. Top or Strainer Material: Nickel bronze.

8. Top of Body and Strainer Finish: Rough bronze.

9. Top Loading Classification: Heavy Duty.

10. Top shape, dimensions: Round 9”

11. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer connection.

12. Trap Material: Bronze.

13. Trap Pattern: Deep-seal P-trap.

14. Trap Features: Trap-seal primer valve connection.

15. Miscellaneous features: Vandal-proof Allen screws

2.16 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer connection.

2. Size: Same as connected waste piping.

a. NPS 2 (DN 50): 4-inch- (100-mm-) minimum water seal.

b. NPS 2-1/2 (DN 65) and Larger: 5-inch- (125-mm-) minimum water seal.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer connection.

2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.

2. Body: Bronze or cast iron.

3. Inlet: Opening in top of body.

4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

2. Size: Same as connected stack vent or vent stack.

E. Frost-Resistant Vent Terminals:

1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.

2. Design: To provide 1-inch (25-mm) enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

PART 3: EXECUTION

3.01 INSTALLATION:

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

H. Install outlet boxes recessed in wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 6 Section "Rough Carpentry."

I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 6 Section "Rough Carpentry."

J. Install ground hydrants with 1 cu. yd. (0.75 cu. m) of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

K. Install draining-type post hydrants with 1 cu. yd. (0.75 cu. m of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. (0.03 cu. m) of concrete block at grade.

L. Install non-freeze, non-draining-type post hydrants set in concrete or pavement.

M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

N. Install water hammer arresters in water piping according to PDI-WH 201.

O. Install air vents at high points of water piping.

P. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

Q. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

R. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

S. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.

2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.

4. Locate at base of each vertical soil and waste stack.

T. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

U. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

V. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.

b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.

c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

W. Install deep-seal traps on floor drains and other waste outlets, if indicated.

X. Install floor-drain trap-seal primer fittings on inlet to floor drains that

require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet.

Y. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

Z. Install vent caps on each vent pipe passing through roof.

AA. Install wood-blocking reinforcement for wall-mounting-type specialties.

BB. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.02 CONNECTIONS:

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 16 Section "Grounding and Bonding."

C. Connect wiring according to Division 16 Section "Conductors and Cables."

3.03 LABELING AND IDENTIFYING:

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.

2. Intermediate atmospheric-vent backflow preventers.

3. Reduced-pressure-principle backflow preventers.

4. Double-check backflow-prevention assemblies.

5. Carbonated-beverage-machine backflow preventers.

6. Dual-check-valve backflow preventers.

7. Reduced-pressure-detector, fire-protection backflow-preventer assemblies.

8. Double-check, detector-assembly backflow preventers.

9. Water pressure-reducing valves.

10. Calibrated balancing valves.

11. Primary, thermostatic, water mixing valves.

12. Manifold, thermostatic, water-mixing-valve assemblies.

13. Photographic-process, thermostatic, water-mixing-valve assemblies.

14. Primary water tempering valves.

15. Outlet boxes.

16. Hose stations.

17. Supply-type, trap-seal primer valves.

18. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Mechanical Identification."

3.04 FIELD QUALITY CONTROL:

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker and backflow preventers according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING:

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

PART 4: MEASUREMENT AND PAYMENT

4.01 PIPING SPECIALTIES

A. Piping Specialties will not be measured for payment.

B. Piping Specialties will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15124

EXPANSION FITTINGS AND LOOPS FOR HVAC AND PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Expansion-compensator packless expansion joints.

2. Metal-bellows packless expansion joints.

3. Grooved-joint expansion joints.

4. Pipe loops and swing connections.

5. Alignment guides and anchors.

1.03 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.04 ACTION SUBMITTALS

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

B. Delegated-Design Submittal: For each anchor and alignment guide 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. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.

2. Anchor Details: Detail fabrication of each anchor indicated. Show

dimensions and methods of assembly and attachment to building structure.

3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 PACKLESS EXPANSION JOINTS

A. Metal, Expansion-Compensator Packless Expansion Joints:

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. Flex-Weld, Inc.

b. Hyspan Precision Products, Inc.

c. Metraflex, Inc.

2. Minimum Pressure Rating: 150 psig (1035 kPa) unless otherwise indicated.

3. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.

   a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.

   b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Threaded.

4. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.

   a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.

   b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged.

B. Metal-Bellows Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Badger Industries, Inc.

   b. Flex-Hose Co., Inc.

   c. Flex-Weld, Inc.

   d. Hyspan Precision Products, Inc.

   e. Metraflex, Inc.

   f. Universal Metal Hose; a subsidiary of Hyspan Precision Products, Inc.

   g. U.S. Bellows, Inc.

2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

3. Type: Circular, corrugated bellows with external tie rods.

4. Minimum Pressure Rating: 150 psig (1035 kPa) unless otherwise indicated.

5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.

6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

   a. End Connections for Copper Tubing NPS 2 (DN 50) and Smaller: Solder joint or threaded.

   b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Solder joint or threaded.

   c. End Connections for Copper Tubing NPS 5 (DN 125) and Larger: Flanged.

7. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

   a. End Connections for Steel Pipe NPS 2 (DN 50) and Smaller: Threaded.

   b. End Connections for Steel Pipe NPS 2-1/2 (DN 65) and Larger: Flanged.

2.02 GROOVED-JOINT EXPANSION JOINTS

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. Anvil International, Inc.

   2. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Seven, flexible type for steel-pipe dimensions. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.

2.03 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following

a. Advanced Thermal Systems, Inc.

b. Flex-Hose Co., Inc.

c. Flex-Weld, Inc.

d. Hyspan Precision Products, Inc.

e. Metraflex, Inc.

f. U.S. Bellows, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.

2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.

3. Washers: ASTM F 844, steel, plain, flat washers.

4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.

b. Expansion Plug: Zinc-coated steel.

c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.

c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.01 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install packed-type expansion joints with packing suitable for fluid service.

C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."

D. Install rubber packless expansion joints according to FSA-NMEJ-702.

E. Install grooved-joint expansion joints to grooved-end steel piping

3.02 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.03 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.

2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

PART 4: MEASUREMENT AND PAYMENT

4.01 EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING:

A. Expansion Fittings and Loops for HVAC and Plumbing Piping will not be measured for payment.

B. Expansion Fittings and Loops for HVAC and Plumbing Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15127

METERS AND GAGES FOR HVAC AND PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Dial-type pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.
7. Sight flow indicators.
8. Orifice flowmeters.
9. Venturi flowmeters.

B. Related Sections:

1. Section 15192 "Facility Fuel-Oil Piping" for oil meters.

1.03 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Miljoco Corporation.

   b. Tel-Tru Manufacturing Company.

   c. Trerice, H. O. Co.

   d. Weiss Instruments, Inc.

   e. Winters Instruments - U.S.

2. Standard: ASME B40.200.

3. Case: Cast aluminum 9-inch (229-mm) nominal size unless otherwise indicated.

4. Case Form: Adjustable angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.

7. Window: Glass or plastic.

8. Stem: Aluminum and of length to suit installation.

   a. Design for Air-Duct Installation: With ventilated shroud.

   b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches (32 mm), with ASME B1.1 screw threads.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.02 DUCT-THERMOMETER MOUNTING BRACKETS

A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem.

2.03 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

3. Material for Use with Copper Tubing: CNR or CUNI.

4. Material for Use with Steel Piping: CRES.

5. Type: Stepped shank unless straight or tapered shank is indicated.

6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, (DN 15, DN 20, or NPS 25,) ASME B1.20.1 pipe threads.

7. Internal Threads: 1/2, 3/4, and 1 inch (13, 19, and 25 mm), with ASME B1.1 screw threads.

8. Bore: Diameter required to match thermometer bulb or stem.

9. Insertion Length: Length required to match thermometer bulb or stem.

10. Lagging Extension: Include on thermowells for insulated piping and tubing.

11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

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

2.04 PRESSURE GAGES

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMETEK, Inc.; U.S. Gauge.

b. Ashcroft Inc.

c. Ernst Flow Industries.

d. Miljoco Corporation.

e. Trerice, H. O. Co.

f. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

g. Weiss Instruments, Inc.

h. WIKA Instrument Corporation - USA.

2. Standard: ASME B40.100.

3. Case: Liquid-filled Sealed type(s); cast aluminum or drawn steel; 6-inch (152-mm) nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15) ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in [psi and kPa.

8. Pointer: Dark-colored metal.

9. Window: Glass or plastic.

10. Ring: Stainless steel.

11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.05 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel ball, with NPS 1/4 or NPS 1/2 (DN 8 or DN 15), ASME B1.20.1 pipe threads.

2.06 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.07 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.

6. Trerice, H. O. Co.

7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.

8. Weiss Instruments, Inc.

B. Furnish two test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch (25- to 51-mm diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.08 SIGHT FLOW INDICATORS

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. Dwyer Instruments, Inc.

2. Emerson Process Management; Brooks Instrument.

3. Ernst Co., John C., Inc.

4. Ernst Flow Industries.

5. OPW Engineered Systems; a Dover company.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig (860 kPa).

E. Minimum Temperature Rating: 200 deg F (93 deg C).

F. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

G. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged.

2.09 FLOWMETERS

A. Orifice Flowmeters:

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. ABB; Instrumentation and Analytical.

   b. Bell & Gossett; ITT Industries.

2. Description: Flowmeter with sensor, hoses or tubing, fittings, valves, indicator, and conversion chart.

3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Wafer-orifice-type, calibrated, flow-measuring element; for installation between pipe flanges.

   a. Design: Differential-pressure-type measurement for water.

   b. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.

   c. Minimum Pressure Rating: 300 psig (2070 kPa).

   d. Minimum Temperature Rating: 250 deg F (121 deg C).

5. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected sensor and having two 12-foot (3.7-m) hoses, with carrying case.

   a. Scale: Gallons per minute (Liters per second).

   b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

6. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).

7. Conversion Chart: Flow rate data compatible with sensor and indicator.

8. Operating Instructions: Include complete instructions with each flowmeter.

B. Venturi Flowmeters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB; Instrumentation and Analytical.

b. Gerand Engineering Co.

c. Hyspan Precision Products, Inc.

d. Victaulic Company.

2. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.

3. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.

4. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.

a. Design: Differential-pressure-type measurement for water.

b. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.

c. Minimum Pressure Rating: 300 psig (2070 kPa).

d. Minimum Temperature Rating: 250 deg F (121 deg C).

e. End Connections for NPS 2 (DN 50) and Smaller: Threaded.

f. End Connections for NPS 2-1/2 (DN 65) and Larger: Flanged or welded.

g. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.

5. Portable Indicators: Hand-held, differential-pressure type, calibrated for connected flowmeter element and having two 12-foot (3.7-m) hoses, with carrying case.

a. Scale: Gallons per minute (Liters per second).

b. Accuracy: Plus or minus 2 percent between 20 and 80 percent of scale range.

6. Display: Shows rate of flow, with register to indicate total volume in gallons (liters).

7. Conversion Chart: Flow rate data compatible with sensor.

8. Operating Instructions: Include complete instructions with each flowmeter.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

I. Install remote-mounted pressure gages on panel.

J. Install valve and snubber in piping for each pressure gage for fluids (except steam).

K. Install valve and syphon fitting in piping for each pressure gage for steam.

L. Install test plugs in piping tees.

M. Install flow indicators in piping systems in accessible positions for easy viewing.

N. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters according to manufacturer's written instructions.

O. Install flowmeter elements in accessible positions in piping systems.

P. Install wafer-orifice flowmeter elements between pipe flanges.

Q. Install differential-pressure-type flowmeter elements, with at least minimum straight lengths of pipe, upstream and downstream from element according to manufacturer's written instructions.

R. Install connection fittings in accessible locations for attachment to portable indicators.

S. Mount thermal-energy meters on wall if accessible; if not, provide brackets to support meters.

T. Install thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.

2. Inlet and outlet of each hydronic boiler and water heater.

3. Inlet and outlet of each hydronic coil in air-handling units.

4. Two inlets and two outlets of each hydronic heat exchanger.

5. Outside-, return-, supply-, and mixed-air ducts.

U. Install pressure gages in the following locations:

1. Discharge of each pressure-reducing valve.

2. Suction and discharge of each pump.

3.02 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy meter transmitters to meters.

3.03 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.04 THERMOMETER SCHEDULE

A. Thermometers shall be Industrial-style, liquid-in-glass type.

3.05 THERMOMETER SCALE-RANGE SCHEDULE

A. Range shall match mid range of operating conditions.

3.06 PRESSURE-GAGE SCHEDULE

A. Pressure gages shall be sealed, direct-mounted, metal case.

3.07 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Range shall match mid range of operating conditions.

3.08 FLOWMETER SCHEDULE

A. Flowmeters for Dual-service heating piping -Water Piping: Orifice or Venturi type.

B. Flowmeters for Heating, Hot-Water Piping: Orifice or Venturi type.

PART 4: MEASUREMENT AND PAYMENT

4.01 METERS AND GAGES FOR HVAC PIPING:

A. Meters and Gages for HVAC and Plumbing Piping will not be measured for payment.

B. Meters and Gages for HVAC and Plumbing Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15130

PUMPS FOR PLUMBING

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following all-bronze and bronze-fitted centrifugal pumps for domestic cold- and hot-water circulation:

1. Close-coupled, in-line, sealless centrifugal pumps.

2. Submersible sump pumps.

3. Sump pump basins and pits.

4. Packaged drainage pumps.

1.03 SUBMITTALS:

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE:

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.05 DELIVERY, STORAGE, AND HANDLING:

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.06 COORDINATION:

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CLOSE COUPLED, IN-LINE, SEALLESS CENTRIFUGAL PUMPS:

A. Available Manufacturers:

1. Armstrong Pumps Inc.

2. Bell & Gossett Domestic Pump; ITT Industries.

3. Grundfos Pumps Corp.

4. Taco, Inc.

B. Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps as defined in HI 5.1-5.6.

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.

2. Casing: Bronze, with threaded companion-flange connections.

3. Impeller: Corrosion-resistant material.

4. Motor: Single speed, unless otherwise indicated. Comply with requirements in Division 15 Section "Motors."

2.03 SUBMERSIBLE SUMP PUMPS

A. Available Manufacturers:

1. Bell & Gossett Domestic Pump; ITT Industries.

2. Federal Pump Corp.

3. Gorman-Rupp Company (The).

4. Goulds Pumps; ITT Industries.

5. Grundfos Pumps Corp.

6. Myers, F. E.; Pentair Pump Group (The).

7. Stancor, Inc.

B. Description: Factory-assembled and -tested, simplex single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and HI 1.1-1.2 and HI 1.3 for submersible sump pumps.

C. Casing: Cast iron; with cast-iron inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.

D. Impeller: ASTM B 584, cast bronze or stainless steel; statically and dynamically balanced, semiopen nonclog design, overhung, single suction, keyed and secured to shaft.

E. Pump and Motor Shaft: Steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.

F. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 15 Section "Motors."

1. Moisture-Sensing Probe: Internal moisture sensor with moisture alarm.

G. Pump Discharge Piping: Factory or field fabricated, ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe or copper tube.

H. Basin Cover: Cast iron or steel with bituminous coating and strong enough to support controls. See Part 2 "Sump Pump Basins" Article for other requirements.

I. Controls: NEMA 250, Type 1 enclosure, pedestal-mounted float switch; with float, float rod, and rod buttons.

J. Controls: NEMA 250, Type 6, 120-V ac, float switch, mounted on discharge piping.

2.04 SUMP PUMP BASINS

A. Description: Factory fabricated basin with sump, pipe connections, and separate cover.

B. Sump: Fabricate watertight, with sidewall openings for pipe connections.

1. Material: Cast iron or fiberglass.

2. Reinforcement: Mounting plates for pumps, fittings, and accessories.

3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

C. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Material: Cast iron.

2. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.05 SUMP PUMP PITS

A. Description: Concrete pit with sump, pipe connections, curb frame, and separate cover.

B. Sump: Construct of watertight, cast-in-place, reinforced concrete with sidewall openings for pipe connections. Cast-in-place concrete, formwork, and reinforcement are specified in Division 3 Section "Cast-in-Place Concrete."

1. Pipe Connections: Sleeved openings large enough for mechanical

sleeve seals for drainage piping. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods," and drainage piping is specified in Division 15 Section "Storm & Condensate Drainage Piping."

C. Curb Frame and Cover:

1. Curb Frame Material: Galvanized steel or steel with bituminous coating.

a. Pattern: Angle-cross-section shape with flat top surface.

2. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

a. Material: Cast iron or steel with bituminous coating.

b. Reinforcement: Steel or cast iron, capable of supporting foot traffic for pits installed in foot-traffic areas.

2.06 PACKAGED DRAINAGE PUMP UNITS

A. Submersible Units: Factory-assembled and -tested, single-stage, centrifugal, end-suction, automatic-operation, submersible, drainage pump unit.

1. Available Manufacturers:

a. Bell & Gossett Domestic Pump; ITT Industries.

b. Goulds Pumps; ITT Industries.

c. Grundfos Pumps Corp.

d. Stancor, Inc.

e. Zoeller Company.

2. Pump Body: Metal.

3. Impeller: Brass.

4. Pump Seals: Mechanical type.

5. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection. Comply with requirements in Division 15 Section "Motors."

6. Power Cord: Three-conductor, waterproof cable of length required but not less than 72 inches (1830 mm), with grounding plug and cable-sealing assembly for connection at pump.

7. Control: Motor-mounted float switch.

2.07 CONTROLS:

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Available Manufacturers:

a. Honeywell International, Inc.

b. Square D.

c. White-Rodgers Div.; Emerson Electric Co.

2. Type: Water-immersion sensor, for installation in hot-water circulation piping.

3. Range: 65 to 200 deg F (18 to 93 deg C).

4. Operation of Pump: On or off.

5. Transformer: Provide if required.

6. Power Requirement: 120 V, ac.

7. Settings: Start pump at 110 deg F (43 deg C) and stop pump at 125 deg F (52 deg C).

B. Timers: Electric time clock for control of hot-water circulation pump.

1. Available Manufacturers:

a. Honeywell International, Inc.

b. Intermatic, Inc.

c. Johnson Controls, Inc.

d. Maple Chase Company.

e. TORK.

2. Type: Programmable, seven-day clock with manual override on-off switch.

3. Enclosure: Suitable for wall mounting.

4. Operation of Pump: On or off.

5. Transformer: Provide if required.

6. Power Requirement: 24 V, ac.

7. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

2.08 FLEXIBLE CONNECTORS:

A. Available Manufacturers:

1. Flexicraft Industries.

2. Flex-Weld, Inc.

3. Hyspan Precision Products, Inc.

4. Metraflex, Inc.

5. Proco Products, Inc.

B. Description: Corrugated, bronze inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze-welded to tubing. Include 125-psig (860-kPa) minimum working-pressure rating and ends matching pump connections.

2.09 BUILDING-AUTOMATION-SYSTEM INTERFACE:

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.

2. Alarm status.

PART 3: EXECUTION

3.01 EXAMINATION:

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 IN-LINE PUMP INSTALLATION:

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Install in-line, sealless centrifugal pumps with motor and pump shafts horizontal.

D. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 15 Section "Mechanical Vibration and Seismic Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 15 Section "Hangers and Supports."

3.03 CONTROL INSTALLATION:

A. Install immersion-type thermostats in hot-water return piping.

B. Install timers on wall in engineer's office.

3.04 SUMP PUMP INSTALLATION

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

B. Install sump pumps according to applicable requirements in HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sump pumps on basin or pit floor.

E. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

F. Construct sump pump pits and connect to drainage piping. Set pit curb frame recessed in and anchored to concrete. Fasten pit cover to pit curb flange. Install cover so top surface is flush with finished floor.

G. Install packaged, submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.

H. Support piping so weight of piping is not supported by pumps.

3.05 CONNECTIONS:

A. Piping installation requirements are specified in other Division 15

Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 15 Section "Domestic Water Piping."

1. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 15 Section "Valves" for general-duty valves for domestic water piping and Division 15 Section "Plumbing Specialties" for strainers.

2. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 15 Section "Meters and Gages" for pressure gages and gage connectors.

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."

F. Connect thermostats and timers to pumps that they control.

G. Interlock pump with water heater burner and time delay relay.

3.06 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Check piping connections for tightness.

3. Clean strainers on suction piping.

4. Set thermostats and timers for automatic starting and stopping operation of pumps.

5. Perform the following startup checks for each pump before starting:

a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

7. Start motor.

8. Open discharge valve slowly.

9. Adjust temperature settings on thermostats.

10. Adjust timer settings.

3.07 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

PART 4: MEASUREMENT AND PAYMENT

4.01 PUMPS

A. Pumps will not be measured for payment.

B. Pumps will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15140

DOMESTIC WATER PIPING

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes domestic water piping inside the building.

B. Water meters will be furnished and installed by utility company.

C. Water meters will be furnished by utility company for installation by Contractor.

D. Related Sections include the following:

1. Division 2 Section "Water Distribution" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

2. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and fittings.

3. Division 15 Section "Plumbing Specialties" for water distribution piping specialties.

1.03 DEFINITIONS:

A. CPVC: Chlorinated polyvinyl chloride plastic.

B. PEX: Crosslinked polyethylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.04 PERFORMANCE REQUIREMENTS:

A. Provide components and installation capable of producing domestic water piping systems with 80 psig (550 kPa), unless otherwise indicated.

1.05 SUBMITTALS:

A. Product Data: For pipe, tube, fittings, and couplings.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

C. Field quality-control test reports.

1.06 QUALITY ASSURANCE:

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

B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS:

A. Refer to Part 3 "Pipe and Fitting Applications" Article for applications of pipe, tube, fitting, and joining materials.

B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.03 STEEL PIPE AND FITTINGS:

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.

3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.

4. Cast-Iron Flanges: ASME B16.1, Class 125.

5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

6. Steel-Piping, Double Expansion Joints: Compound, galvanized steel fitting with telescoping body and two slip-pipe sections. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

2.04 COPPER TUBE AND FITTINGS:

A. Soft Copper Tube: ASTM B 88, Types K and L (ASTM B 88M, Types A and B), water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought- copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.05 CPVC PIPING:

A. CPVC Schedule **80** Pipe: ASTM F 441/F 441M.

1. CPVC Schedule 40 Fittings: ASTM F 438, socket type.

2. CPVC Schedule 80 Fittings: ASTM F 439, socket type or ASTM F 437, threaded type.

B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.

C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.06 PEX PIPE AND FITTINGS:

A. PEX Distribution System: ASTM F 877, SDR 9 tubing.

1. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper crimp rings and matching PEX tube dimensions.

2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877 and with plastic or corrosion-resistant-metal valve for each outlet.

2.07 VALVES:

A. Bronze and cast-iron, general-duty valves are specified in Division 15 Section "Valves."

B. Balancing and drain valves are specified in Division 15 Section "Plumbing Specialties."

C. Union Ball Valves: MSS SP-122, with full-port ball, threaded detachable end connectors, and pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).

D. Non-Union Ball Valves: MSS SP-122, with full- or reduced-port ball, socket or threaded ends, and pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).

E. Butterfly Valves: With lever handle and pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).

F. Check Valves: Swing or ball-check design and pressure rating not less than 150 psig (1035 kPa) at 73 deg F (23 deg C).

2.08 WATER METERS:

A. Shall be furnished and installed by Baltimore City water supply/utility company.

B. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility, or encoder-type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility.

PART 3: EXECUTION

3.01 EXCAVATION:

A. Excavating, trenching, and backfilling are specified in Division 2 Section "Earthwork."

3.02 PIPE AND FITTING APPLICATIONS:

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

B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Grooved joints may be used on aboveground grooved-end piping.

D. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

E. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 2 Section "Water Distribution."

F. Domestic Water Piping on Service Side of Water Meter inside the Building: Use the following piping materials for each size range:

1. NPS 4 to NPS 6 (DN 100 to DN 150): Steel pipe; gray-iron, threaded fittings; and threaded joints.

2. NPS 4 to NPS 6 (DN 100 to DN 150): Steel pipe with grooved ends; steel-piping, grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

G. Under-Building-Slab, Domestic Water Piping on House Side of Water Meter, NPS 4 (DN 100) and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

H. Aboveground Domestic Water Piping: Use any of the following piping materials for each size range:

1. NPS 1 (DN 25) and Smaller: Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

2. NPS 1 (DN 25) and Smaller: CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

3. NPS 1-1/4 and NPS 1-1/2 (DN 32 and DN 40): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

4. NPS 2 (DN 50): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

5. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

6. NPS 4 to NPS 6 (DN 100 to DN 150): Steel pipe; gray-iron, threaded fittings; and threaded joints.

3.03 VALVE APPLICATIONS:

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

3. Hot-Water-Piping, Balancing Duty: Calibrated, Memory-stop balancing valves.

4. Drain Duty: Hose-end drain valves.

B. Cast-iron, grooved-end valves may be used with grooved-end piping.

C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.

D. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.

2. Install stop-and-waste drain valves where indicated.

E. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Balancing valves are specified in Division 15 Section "Plumbing Piping Specialties."

F. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 15 Section "Plumbing Piping Specialties."

3.04 PIPING INSTALLATION:

A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Install under-building-slab copper tubing according to CDA's "Copper Tube Handbook."

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 15 Section "Basic Mechanical Materials and Methods."

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 15 Section "Meters and Gages," and drain valves and strainers are specified in Division 15 Section "Plumbing Specialties."

F. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 15 Section "Plumbing Specialties."

G. Install domestic water piping level and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

3.05 JOINT CONSTRUCTION:

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

C. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

D. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

3.06 WATER METER INSTALLATION:

A. Rough-in domestic water piping according to utility company's requirements.

B. Water meters will be furnished and installed by utility company.

3.07 HANGER AND SUPPORT INSTALLATION:

A. Pipe hanger and support devices are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

c. Longer than 100 Feet (30 m): MSS Type 49, spring cushion rolls, if indicated.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.

4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.

5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.

6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

F. Install supports for vertical steel piping every 15 feet (4.5 m).

G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

H. Install supports for vertical copper tubing every 10 feet (3 m).

I. Install hangers for CPVC piping with the following maximum horizontal

spacing and minimum rod diameters:

1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.

J. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.08 CONNECTIONS:

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve, and extend and connect to the following:

1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."

3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.09 FIELD QUALITY CONTROL:

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.10 ADJUSTING:

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.

   b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING:

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

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

   b. Fill and isolate system according to either of the following:

      i. Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.

      ii. Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

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

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

PART 4: MEASUREMENT AND PAYMENT

4.01 DOMESTIC WATER PIPING

A. Domestic Water Piping will not be measured for payment.

B. Domestic Water Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15150

SANITARY WASTE AND VENT PIPING

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.

2. Special pipe fittings.

3. Encasement for underground metal piping.

1.03 DEFINITIONS:

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. LLDPE: Linear, low-density polyethylene plastic.

D. NBR: Acrylonitrile-butadiene rubber.

E. PE: Polyethylene plastic.

F. PVC: Polyvinyl chloride plastic.

G. TPE: Thermoplastic elastomer.

1.04 PERFORMANCE REQUIREMENTS:

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

2. Sanitary Sewer, Force-Main Piping: 100 psig (690 kPa).

1.05 SUBMITTALS:

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE:

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

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS:

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS:

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.04 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS:

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

i. ANACO.

ii. Fernco, Inc.

iii. Ideal Div.; Stant Corp.

iv. Mission Rubber Co.

v. Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

i. ANACO.

ii. Clamp-All Corp.

iii. Ideal Div.; Stant Corp.

iv. Mission Rubber Co.

v. Tyler Pipe; Soil Pipe Div.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

i. MG Piping Products Co.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

   a. ANACO.

2.05 STEEL PIPE AND FITTINGS:

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12**,** galvanized, threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.

3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.

4. Cast-Iron Flanges: ASME B16.1, Class 125.

5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

D. Grooved-Joint Systems:

1. Available Manufacturers:

   a. Anvil International.

   b. Star Pipe Products; Star Fittings Div.

   c. Victaulic Company.

   d. Ward Manufacturing, Inc.

2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.

3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable

for water, and bolts and nuts.

2.06 STAINLESS-STEEL PIPE AND FITTINGS:

A. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.

B. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.

1. Material: EPDM, unless NBR is indicated.

2.07 DUCTILE-IRON PIPE AND FITTINGS:

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint Systems:

1. Available Manufacturers:

a. Victaulic Company.

2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.08 COPPER TUBE AND FITTINGS:

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.09 ABS PIPE AND FITTINGS:

A. Solid-Wall ABS Pipe: ASTM D 2661, Schedule 40.

B. Cellular-Core ABS Pipe: ASTM F 628, Schedule 40.

C. ABS Socket Fittings: ASTM D 2661, made to ASTM D 3311, drain, waste, and vent patterns.

2.10 PVC PIPE AND FITTINGS:

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.

1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

2.11 SPECIAL PIPE FITTINGS:

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. Dallas Specialty & Mfg. Co.

b. Fernco, Inc.

c. Logan Clay Products Company (The).

d. Mission Rubber Co.

e. NDS, Inc.

f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. ANACO.

D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Available Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Dresser, Inc.; DMD Div.

c. EBAA Iron Sales, Inc.

d. Ford Meter Box Company, Inc. (The); Pipe Products Div.

e. JCM Industries, Inc.

f. Romac Industries, Inc.

g. Smith-Blair, Inc.

h. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard

3. Gasket Material: Natural or synthetic rubber.

4. Metal Component Finish: Corrosion-resistant coating or material.

E. Flexible Ball Joints: Ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include gasketed ball-joint section and ductile-iron gland, rubber gasket, and steel bolts.

1. Available Manufacturers:

a. EBAA Iron Sales, Inc.

F. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Available Manufacturers:

a. EBAA Iron Sales, Inc.

b. Romac Industries, Inc.

c. Star Pipe Products; Star Fittings Div.

G. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Available Manufacturers:

a. SIGMA Corp.

2.12 ENCASEMENT FOR UNDERGROUND METAL PIPING:

A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch (0.10-mm) or LLDPE film of 0.008-inch (0.20-mm) minimum thickness.

B. Form: Sheet or tube.

C. Color: Black or natural.

PART 3: EXECUTION

3.01 EXCAVATION:

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS:

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Stainless-steel pipe and fittings, gaskets, and gasketed joints.

5. Copper DWV tube, copper drainage fittings, and soldered joints.

6. Solid-wall ABS pipe, ABS socket fittings, and solvent-cemented joints.

7. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

8. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Copper DWV tube, copper drainage fittings, and soldered joints.

a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, Type M (Type C); copper pressure fittings; and soldered joints.

5. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

6. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Aboveground, vent piping NPS 5 (DN 125) and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, and heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.

F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller shall be the following:

1. Extra-Heavy Service class, cast-iron soil piping; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, stainless-steelcouplings; and hubless-coupling joints.

3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

G. Underground, soil and waste piping NPS 5 (DN 125) and larger shall be the following:

1. Extra-Heavy class, cast-iron soil piping; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-iron couplings; and hubless-coupling joints.

3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be the following:

1. Steel pipe, pressure fittings, and threaded joints.

I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 (DN 65 to DN 150) shall be the following:

1. Grooved-end steel pipe, grooved-joint system fittings and couplings, and grooved joints.

J. Underground sanitary-sewage force mains NPS 4 (DN 100) and smaller shall be the following:

1. Steel pipe, pressure fittings, and threaded joints.

   a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

2. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile-iron

3.03 PIPING INSTALLATION:

A. Sanitary sewer piping outside the building is specified in Division 2 Section "Sanitary Sewerage."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

D. Install underground, steel, force-main piping

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15

F. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken

continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.

2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.

3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

K. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION:

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.05 VALVE INSTALLATION:

A. General valve installation requirements are specified in Division 15 Section "Valves."

B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.

2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.

1. Horizontal Piping: Horizontal backwater valves.

2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.

3. Install backwater valves in accessible locations.

4. Backwater valve are specified in Division 15 Section "Plumbing Specialties."

3.06 HANGER AND SUPPORT INSTALLATION:

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Install individual, straight, horizontal piping runs according to the following:

a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.

4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.

5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.

4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.

5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.

6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

H. Install supports for vertical steel piping every 15 feet (4.5 m).

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 (DN 50): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

2. NPS 3 (DN 80): 96 inches (2400 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 (DN 100): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

4. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

J. Install supports for vertical stainless-steel piping every 10 feet (3 m).

K. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

L. Install supports for vertical copper tubing every 10 feet (3 m).

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS:

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main or sanitary manhole.

2. Sewage Pumps: To sewage pump discharge.

3.08 FIELD QUALITY CONTROL:

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as

follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or

portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.09 CLEANING:

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

PART 4: MEASUREMENT AND PAYMENT

4.01 SANITARY WASTE AND VENT PIPING

A. Sanitary Waste and Vent Piping will not be measured for payment.

B. Sanitary Waste and Vent Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15160

STORM & CONDENSATE DRAINAGE PIPING

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following storm drainage piping inside the building:

1. Pipe, tube, and fittings.

2. Special pipe fittings.

3. Encasement for underground metal piping.

B. Related Sections include the following:

1. Division 15 Section " Pumps for Plumbing."

1.03 DEFINITIONS:

A. LLDPE: Linear, low-density polyethylene plastic.

B. PE: Polyethylene plastic.

C. TPE: Thermoplastic elastomer.

1.04 PERFORMANCE REQUIREMENTS:

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water (30 kPa).

2. Storm Drainage, Force-Main Piping: 100 psig (690 kPa).

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall be capable of withstanding the effects of seismic events determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures."

1.05 SUBMITTALS:

A. Product Data: For pipe, tube, fittings, and couplings.

B. Shop Drawings:

1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.

2. Controlled-Flow Storm Drainage System: Include calculations, plans, and details.

C. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE:

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

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS:

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS:

A. Pipe and Fittings: ASTM A 74, Service and Extra-Heavy class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.04 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS:

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.

1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

i. ANACO.

ii. Fernco, Inc.

iii. Ideal Div.; Stant Corp.

iv. Mission Rubber Co.

v. Tyler Pipe; Soil Pipe Div.

2. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

i. ANACO.

ii. Clamp-All Corp.

iii. Ideal Div.; Stant Corp.

iv. Mission Rubber Co.

v. Tyler Pipe; Soil Pipe Div.

3. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

a. Available Manufacturers:

i. MG Piping Products Co.

C. Rigid, Unshielded Couplings: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Available Manufacturers:

a. ANACO.

2.05 STEEL PIPE AND FITTINGS:

A. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Standard Weight or Schedule 40, galvanized. Include ends matching joining method.

B. Drainage Fittings: ASME B16.12**,** galvanized, threaded, cast-iron drainage pattern.

C. Pressure Fittings:

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.

3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.

4. Cast-Iron Flanges: ASME B16.1, Class 125.

5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

D. Grooved-Joint Systems:

1. Available Manufacturers:

a. Anvil International.

b. Star Pipe Products; Star Fittings Div.

c. Victaulic Co. of America.

d. Ward Manufacturing, Inc.

2. Grooved-End, Steel-Piping Fittings: ASTM A 47/A 47M, galvanized, malleable-iron casting; ASTM A 106, galvanized-steel

pipe; or ASTM A 536, galvanized, ductile-iron casting; with dimensions matching steel pipe.

3. Grooved-End, Steel-Piping Couplings: AWWA C606, for steel-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

2.06 DUCTILE-IRON PIPE AND FITTINGS:

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Gaskets: AWWA C111, rubber.

C. Grooved-Joint Systems:

1. Available Manufacturers:

a. Victaulic Co. of America.

2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.

3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

D. Flanges: ASME 16.1, Class 125, cast iron.

2.07 COPPER TUBE AND FITTINGS:

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, Types L and M (ASTM B 88M, Types B and C), water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Soft Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B), water tube, annealed temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2.08 ENCASEMENT FOR UNDERGROUND METAL PIPING:

A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch (0.10-mm) or LLDPE film of 0.008-inch (0.20-mm) minimum thickness.

B. Form: Sheet or tube.

C. Color: Black or natural.

PART 3: EXECUTION

3.01 EXCAVATION:

A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS:

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground storm and condensate drainage piping NPS 6 (DN 150) and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, and heavy-duty shielded, stainless-steel couplings; and coupled joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Copper DWV tube, copper drainage fittings, and soldered joints.

5. Dissimilar Pipe-Material Couplings: Flexible, Shielded nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

C. Aboveground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, and heavy-duty shielded, stainless-steel couplings; and coupled joints.

3. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Underground storm drainage piping NPS 6 (DN 150) and smaller shall be any of the following:

1. Extra-heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; standard, and heavy-duty shielded, stainless-steel couplings; and coupled joints.

3. Steel pipe, drainage fittings, and threaded joints.

4. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

E. Underground, storm drainage piping NPS 8 (DN 200) and larger shall be any of the following:

1. Extra-Heavy class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

2. Hubless cast-iron soil pipe and fittings; heavy-duty shielded, cast-

iron couplings; and coupled joints.

F. Aboveground storm drainage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) shall be the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

G. Aboveground storm drainage force mains NPS 2-1/2 and NPS 6 (DN 65 and DN 150) shall be any of the following:

1. Hard copper tube, Type L (Type B); copper pressure fittings; and soldered joints.

2. Steel pipe, pressure fittings, and threaded joints.

H. Underground storm drainage force mains NPS 4 (DN 100) and smaller shall be any of the following:

1. Soft copper tube, Type L (Type B); wrought-copper pressure fittings; and soldered joints.

2. Steel pipe, pressure fittings, and threaded joints.

a. Include grooved-joint system fittings and couplings and grooved joints where indicated.

3.03 PIPING INSTALLATION:

A. Storm sewer and drainage piping outside the building are specified in Division 2 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 15.

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 15 Section "Plumbing Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install underground, steel, force-main piping

F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

I. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

J. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

L. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

M. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.

2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

N. Install force mains at elevations indicated.

O. Install engineered controlled-flow storm drainage piping in locations indicated.

P. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION:

A. Basic piping joint construction requirements are specified in Division 15

B. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

F. Grooved Joints: Cut groove ends of pipe and assemble grooved ends of pipes, grooved-end fittings, and grooved-end-piping couplings according to AWWA C606.

3.05 VALVE INSTALLATION:

A. General valve installation requirements are specified in Division 15 Section "Plumbing Valves."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.

1. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.

2. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

3.06 HANGER AND SUPPORT INSTALLATION:

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.

b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.

c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.

3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.

4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.

5. NPS 8 to NPS 12 (DN 200 to DN 300): 60 inches (1500 mm) with

7/8-inch (22-mm) rod.

6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).

F. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.

4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.

5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.

6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.

7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.

H. Install supports for vertical steel piping every 15 feet (4.5 m).

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.

4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.

5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.

6. NPS 8 (DN 200): 10 feet (3 m) with 3/4-inch (19-mm) rod.

J. Install supports for vertical copper tubing every 10 feet (3 m).

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS:

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

D. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main or storm manhole.

2. Sump Pumps: To sump pump discharge.

3.08 FIELD QUALITY CONTROL:

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is

performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.09 CLEANING:

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

PART 4: MEASUREMENT AND PAYMENT

4.01 STORM DRAINAGE PIPING

A. Storm Drainage Piping will not be measured for payment.

B. Storm Drainage Piping will not be paid directly, but will be included in the lump sum bid price for maintenance building.

END OF SECTION

SECTION 15179

HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes special-duty valves and specialties for the following:

1. Heating water piping
2. Condenser-water piping (Ground Loop Heat pump) piping within the building.
3. Makeup-water piping.
4. Condensate-drain piping.
5. Blowdown-drain piping.
6. Air-vent piping.
7. Safety-valve-inlet and -outlet piping.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air-control devices.
3. Hydronic specialties.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.06 QUALITY ASSURANCE

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

1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Heating Water Piping: 200 psig at 200 deg F (93 deg C).

2. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).

3. Condensate-Drain Piping: 150 deg F (66 deg C).

4. Blowdown-Drain Piping: 200 deg F (93 deg C).

5. Air-Vent Piping: 200 deg F (93 deg C).

6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.02 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in 15112 "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 15900 "HVAC Instrumentation and Controls."

C. Bronze, Calibrated-Orifice, Balancing Valves:

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. Armstrong Pumps, Inc.

    b. Bell & Gossett Domestic Pump.

    c. Flow Design Inc.

    d. Gerand Engineering Co.

    e. Griswold Controls.

    f. Nexus Valve, Inc.

    g. Taco.

    h. Tour & Andersson; available through Victaulic Company.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.

4. Plug: Resin.

5. Seat: PTFE.

6. End Connections: Threaded or socket.

7. Pressure Gage Connections: Integral seals for portable differential pressure meter.

8. Handle Style: Lever, with memory stop to retain set position.

9. CWP Rating: Minimum 125 psig (860 kPa).

10. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

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. Armstrong Pumps, Inc.

    b. Bell & Gossett Domestic Pump.

    c. Flow Design Inc.

d. Gerand Engineering Co.

e. Griswold Controls.

f. Nexus Valve, Inc.

g. Taco.

h. Tour & Andersson.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.

4. Stem Seals: EPDM O-rings.

5. Disc: Glass and carbon-filled PTFE.

6. Seat: PTFE.

7. End Connections: Flanged or grooved.

8. Pressure Gage Connections: Integral seals for portable differential pressure meter.

9. Handle Style: Lever, with memory stop to retain set position.

10. CWP Rating: Minimum 125 psig (860 kPa).

11. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

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. AMTROL, Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett Domestic Pump.

d. Conbraco Industries, Inc.

e. Spence Engineering Company, Inc.

f. Watts Regulator Co.

2. Body: Bronze or brass.

3. Disc: Glass and carbon-filled PTFE.

4. Seat: Brass.

5. Stem Seals: EPDM O-rings.

6. Diaphragm: EPT.

7. Low inlet-pressure check valve.

8. Inlet Strainer: Stainless Steel, removable without system shutdown.

9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves: ASME labeled.

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. AMTROL, Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett Domestic Pump.

d. Conbraco Industries, Inc.

e. Spence Engineering Company, Inc.

f. Watts Regulator Co.

2. Body: Bronze or brass.

3. Disc: Glass and carbon-filled PTFE.

4. Seat: Brass.

5. Stem Seals: EPDM O-rings.

6. Diaphragm: EPT.

7. Wetted, Internal Work Parts: Brass and rubber.

8. Inlet Strainer: Stainless Steel, removable without system shutdown.

9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

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. Flow Design Inc.

b. Griswold Controls.

c. Nexus Valve, Inc.

2. Body: Brass or ferrous metal.

3. Piston and Spring Assembly: Stainless steel, tamper proof, self-cleaning, and removable.

4. Combination Assemblies: Include bronze or brass-alloy ball valve.

5. Identification Tag: Marked with zone identification, valve number, and flow rate.

6. Size: Same as pipe in which installed.

7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.

8. Minimum CWP Rating: 175 psig (1207 kPa).

9. Maximum Operating Temperature: 200 deg F (93 deg C).

2.03 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller;

flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: Stainless-steel, 40-mesh strainer, or perforated stainless-steel basket.

4. CWP Rating: 125 psig (860 kPa).

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig (860 kPa).

C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.

2. End Connections: Grooved ends.

3. Strainer Screen: **40**-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.

4. CWP Rating: 750 psig (5170 kPa).

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.

2. End Connections: Threaded or flanged to match equipment connected.

3. Performance: Capable of 3/4-inch (20-mm) misalignment.

4. CWP Rating: 150 psig (1035 kPa).

5. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.

2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.

3. Performance: Capable of misalignment.

4. CWP Rating: 150 psig (1035 kPa).

5. Maximum Operating Temperature: 250 deg F (121 deg C).

F. Expansion Fittings: Comply with requirements in Section 15124 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.01 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.02 HYDRONIC SPECIALTIES INSTALLATION

A. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.

B. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

C. Install air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

D. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

PART 4: MEASUREMENT AND PAYMENT

4.01 HYDRONIC PIPING:

A. Hydronic Piping Specialties will not be measured for payment.

B. Hydronic Piping Specialties will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15181

HYDRONIC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Condenser water (Ground Loop Heat pump) piping within the building
3. Makeup-water piping.
4. Condensate-drain piping.
5. Blowdown-drain piping.
6. Air-vent piping.
7. Safety-valve-inlet and -outlet piping.

B. Related Sections include the following:

1. Section 15185 "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.03 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 150 psig (kPa) at 200 deg F (93 deg C).
2. Makeup-Water Piping: 80 psig (552 kPa) at 150 deg F (66 deg C).
3. Condensate-Drain Piping: 150 deg F (66 deg C).

4. Blowdown-Drain Piping: 200 deg F (93 deg C).

5. Air-Vent Piping: 200 deg F (93 deg C).

6. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Pressure-seal fittings.

2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

3. Air control devices.

4. Hydronic specialties.

5. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

B. Shop Drawings: Detail, at 1/4 (1:50) scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Field quality-control test reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow

charts, and carrying case.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. DWV Copper Tubing: ASTM B 306, Type DWV.

C. Wrought-Copper Fittings: ASME B16.22.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Anvil International, Inc.

b. S. P. Fittings; a division of Star Pipe Products.

c. Victaulic Company.

2. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze casting.

3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.

D. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. T-DRILL Industries Inc.

E. Wrought-Copper Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.

2. End Connections: Butt welding.

3. Facings: Raised face.

H. Grooved Mechanical-Joint Fittings and Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.

b. National Fittings, Inc.

c. Victaulic Company.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47/A 47M, Grade 32510 malleable iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.04 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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. McDonald, A. Y. Mfg. Co.

b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

c. Wilkins; a Zurn company.

2. Description:

a. Standard: ASSE 1079.

b. Pressure Rating: 150 psig (1035 kPa).

c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

b. Wilkins; a Zurn company.

2. Description:

a. Standard: ASSE 1079.

b. Factory-fabricated, bolted, companion-flange assembly.

c. Pressure Rating: 150 psig (860 kPa) minimum at 180 deg F (82 deg C) .

d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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 Products & Systems, Inc.

b. Pipeline Seal and Insulator, Inc.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.

b. Pressure Rating: 150 psig (1035 kPa) .

c. Gasket: Neoprene or phenolic.

d. Bolt Sleeves: Phenolic or polyethylene.

e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

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. Grinnell Mechanical Products.

b. Precision Plumbing Products, Inc.

c. Victaulic Company.

2. Description:

a. Standard: IAPMO PS 66

b. Electroplated steel nipple. complying with ASTM F 1545.

c. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).

d. End Connections: Male threaded or grooved.

e. Lining: Inert and noncorrosive, propylene.

2.05 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 15112 "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 15900 "HVAC Instrumentation and Controls."

C. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.

b. Bell & Gossett Domestic Pump; a division of ITT Industries.

c. Flow Design Inc.

d. Gerand Engineering Co.

e. Taco.

f. Tour & Andersson; available through Victaulic Company

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.

4. Plug: Resin.

5. Seat: PTFE.

6. End Connections: Threaded or socket.

7. Pressure Gage Connections: Integral seals for portable differential pressure meter.

8. Handle Style: Lever, with memory stop to retain set position.

9. CWP Rating: Minimum 125 psig (860 kPa).

10. Maximum Operating Temperature: 250 deg F (121 deg C).

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.

b. Bell & Gossett Domestic Pump; a division of ITT Industries.

c. Flow Design Inc.

d. Gerand Engineering Co.

e. Taco.

f. Tour & Andersson; available through Victaulic Company.

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.

3. Ball: Brass or stainless steel.

4. Stem Seals: EPDM O-rings.

5. Disc: Glass and carbon-filled PTFE.

6. Seat: PTFE.

7. End Connections: Flanged or grooved.

8. Pressure Gage Connections: Integral seals for portable differential

pressure meter.

9. Handle Style: Lever, with memory stop to retain set position.

10. CWP Rating: Minimum 125 psig (860 kPa).

11. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Diaphragm-Operated, Pressure-Reducing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Amtrol, Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett Domestic Pump; a division of ITT Industries.

d. Spence Engineering Company, Inc.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.

3. Disc: Glass and carbon-filled PTFE.

4. Seat: Brass.

5. Stem Seals: EPDM O-rings.

6. Diaphragm: EPT.

7. Low inlet-pressure check valve.

8. Inlet Strainer: <Insert materials>, removable without system shutdown.

9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:

a. Amtrol, Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett Domestic Pump; a division of ITT Industries.

d. Spence Engineering Company, Inc.

e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.

3. Disc: Glass and carbon-filled PTFE.

4. Seat: Brass.

5. Stem Seals: EPDM O-rings.

6. Diaphragm: EPT.

7. Wetted, Internal Work Parts: Brass and rubber.

8. Inlet Strainer: stainless steel, removable without system shutdown.

9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

2.06 AIR CONTROL DEVICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amtrol, Inc.

2. Armstrong Pumps, Inc.

3. Bell & Gossett Domestic Pump; a division of ITT Industries.

4. Taco.

B. Manual Air Vents:

1. Body: Bronze.

2. Internal Parts: Nonferrous.

3. Operator: Screwdriver or thumbscrew.

4. Inlet Connection: NPS 1/2 (DN 15).

5. Discharge Connection: NPS 1/8 (DN 6).

6. CWP Rating: 150 psig (1035 kPa).

7. Maximum Operating Temperature: 225 deg F (107 deg C).

C. Automatic Air Vents:

1. Body: Bronze or cast iron.

2. Internal Parts: Nonferrous.

3. Operator: Noncorrosive metal float.

4. Inlet Connection: NPS 1/2 (DN 15).

5. Discharge Connection: NPS 1/4 (DN 8).

6. CWP Rating: 150 psig (1035 kPa).

7. Maximum Operating Temperature: 240 deg F (116 deg C).

D. Bladder-Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig (860-kPa) working pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

E. Buffer Tanks

1. Tank: Welded steel, rated for 125-psig (860-kPa) working

pressure and 375 deg F (191 deg C) maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

F. Tangential-Type Air Separators:

1. Tank: Welded steel; ASME constructed and labeled for 125-psig (860-kPa) minimum working pressure and 375 deg F (191 deg C) maximum operating temperature.

2. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.

3. Tangential Inlet and Outlet Connections: Threaded for NPS 2 (DN 50) and smaller; flanged connections for NPS 2-1/2 (DN 65) and larger.

4. Blowdown Connection: Threaded.

5. Size: Match system flow capacity.

G. Air Purgers:

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.

2. Maximum Working Pressure: 150 psig (1035 kPa).

3. Maximum Operating Temperature: 250 deg F (121 deg C).

2.07 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig (860 kPa).

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig (860 kPa).

C. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.

2. End Connections: Grooved ends.

3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.

4. CWP Rating: 750 psig (5170 kPa).

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.

2. End Connections: Threaded or flanged to match equipment connected.

3. Performance: Capable of 3/4-inch (20-mm) misalignment.

4. CWP Rating: 150 psig (1035 kPa).

5. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Expansion fittings are specified in Section 15124 "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 (DN 50) and smaller, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 (DN 65) and larger, shall be any of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

C. Makeup-water piping installed aboveground shall be either of the following:

1. Type L (B), drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

D. Condensate-Drain Piping: DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints or storm water piping .

E. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

F. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

2. Outlet: Type L B, copper tubing with soldered or flared joints.

G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.02 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.03 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 15112 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping**,** NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 15124 "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Section 15077 "Identification for HVAC Piping and Equipment."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15093 "Sleeves

and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15093 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15098 "Escutcheons for HVAC Piping."

3.04 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.

2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.

4. Spring hangers to support vertical runs.

5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).

2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).

3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).

4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (10 mm).

6. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 3/8 inch (10 mm).

7. NPS 4 (DN 100): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).

8. NPS 6 (DN 150): Maximum span, 17 feet (5.2 m); minimum rod size, 1/2 inch (13 mm).

9. NPS 8 (DN 200): Maximum span, 19 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).

10. NPS 10 (DN 250): Maximum span, 20 feet (6.1 m); minimum rod size, 3/4 inch (19 mm).

11. NPS 12 (DN 300): Maximum span, 23 feet (7 m); minimum rod size, 7/8 inch (22 mm).

12. NPS 14 (DN 350): Maximum span, 25 feet (7.6 m); minimum rod size, 1 inch (25 mm).

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).

2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).

3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).

6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.05 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.06 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and

elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outletand air separator, to expansion tank with a 2 percent upward slope toward tank.

D. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

E. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 15127 "Meters and Gages for HVAC Piping."

3.08 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.

2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.

2. Inspect pumps for proper rotation.

3. Set makeup pressure-reducing valves for required system pressure.

4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).

5. Set temperature controls so all coils are calling for full flow.

6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, to specified values.

7. Verify lubrication of motors and bearings.

PART 4: MEASUREMENT AND PAYMENT

4.01 HYDRONIC PIPING:

A. Hydronic Piping will not be measured for payment.

B. Hydronic Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15182

GROUND-LOOP HEAT-PUMP PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes piping for vertical, direct-buried, ground-loop, heat-pump systems that operate between 35 and 104 deg F.

B. Related Sections include the following:

1. Division 15 Section "Hydronic Piping" for for piping interfaces with this piping within the building.

1.03 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Ground-Loop, Heat-Pump Piping: 160 psig.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Pipe and fittings.

2. Joining method and equipment.

3. Propylene glycol solution.

B. Field quality-control test reports.

PART 2 - PRODUCTS

2.01 PIPES AND FITTINGS

A. PE Pipe: ASTM D 2239, SDR Number 11 to meet required system working pressure.

1. Molded HDPE Fittings: ASTM D 2683 or ASTM D 3261, HDPE

resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

B. U-Bend Assembly: Factory fabricated with embossed depth stamp every 24 inches from U-bend.

2.02 BOREHOLE BACKFILL

A. Surface Seal: Bentonite with thermal conductivity greater than 1.2 Btu/h x sq. ft. x deg F.

B. Backfill below Surface Seal: Natural or manufactured sand specified in Division 2.

2.03 ANTIFREEZE SOLUTION

A. Propylene Glycol: Minimum 99 percent propylene glycol with corrosion inhibitors and environmental stabilizer additives to be mixed with water to protect the piping circuit and connected equipment from physical damage from freezing or corrosion.

B. Quantity: Sufficient quantity for up to a 20% solution for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

C. Dilution Water: Chloride content shall be less than 25 ppm, sulfate less than 25 ppm, and hardness less than 100 ppm.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavating, trenching, warning tape, and backfilling are specified in Division 2

3.02 PIPING INSTALLATION

A. Install PE piping in boreholes according to ASTM D 2774 or ASTM F 645.

1. Clean PE pipe and fittings and make heat-fusion joints according to ASTM D 2657. Minimize number of joints.

B. Purge, flush, and pressure test piping before backfilling boreholes.

C. After installation of loop pipe in borehole, fill piping loop with water or antifreeze solution, and pump backfill into borehole to discharge at base of borehole.

D. Fill borehole with backfill to a point at least 60 inches below grade and backfill remainder with surface seal material.

E. Extend piping from vertical wells horizontally as shown on drawings and connect to water-source, ground-loop, heat-pump piping systems at outside face of building wall in locations and pipe sizes indicated on the drawings.

1. Backfill to 24 inches above pipe with mud developed from excavated rock-free soil or with sand, pea gravel, or fly ash. Backfill from slurry level to grade with excavated soil, compacting as specified for pipe burial in Division 2.

2. Extend pipe from trench at an elevation that is at least 12 inches below frost line. Seal membrane after installing piping.

3. Terminate water-service piping at building entrance until building water-source, ground-loop, heat-pump piping systems are installed. Terminate piping with caps. Make connections to building water-source, ground-loop, heat-pump piping systems when those systems are installed. Provide sleeve at exterior wall/floor penetrations and seal annular spaces.

4. Install continuous detectable warning tape for underground piping. Locate tape a minimum of 24 inches below finished grade, directly over piping. Underground warning tapes are specified in Division 2.

5. Purge, flush, and pressure test piping before backfilling trenches.

3.03 ANTIFREEZE SOLUTION FILL

A. Fill system with required quantity of propylene glycol and water to provide minus 10 deg F freezing temperature.

B. Test the dilute solution using gas chromatography to verity concentration of propylene glycol, and forward report to Architect.

3.04 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

3.05 FIELD QUALITY CONTROL

A. Piping Tests: Fill piping 24 hours before testing and apply test pressure to stabilize piping. Use potable water only.

B. Hydrostatic Tests: Test at not less than 1-1/2 times the pipe working-

pressure rating allowing for static pressure of borehole depth.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 30 minutes. Slowly increase to next test pressure increment and hold for 30 minutes. After testing at maximum test pressure, reduce pressure to 30 psig. Hold for 90 minutes, and measure pressure at 30-minute intervals. Repair leaks and retest until no leaks exist.

C. Prepare reports of testing activity.

PART 4: MEASUREMENT AND PAYMENT

4.01 GROUNDLOOP HEAT-PUMP PIPING:

A. Ground- Loop Heat-Pump Piping will not be measured for payment.

B. Ground- Loop Heat-Pump Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15183

REFRIGERANT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.03 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig (793 kPa).

2. Suction Lines for Heat-Pump Applications: 225 psig (1551 kPa).

3. Hot-Gas and Liquid Lines: 225 psig (1551 kPa).

B. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig (1586 kPa).

2. Suction Lines for Heat-Pump Applications: 380 psig (2620 kPa).

3. Hot-Gas and Liquid Lines: 380 psig (2620 kPa).

C. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).

2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).

3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.04 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the

following:

1. Thermostatic expansion valves.

2. Solenoid valves.

3. Filter dryers.

4. Strainers.

5. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot (1:50).

2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.05 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control test reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.07 QUALITY ASSURANCE

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

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.08 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.09 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07720 "Roof Accessories."

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.

2. End Connections: Socket ends.

3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.

4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).

5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.02 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.

2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.

3. Operator: Rising stem and hand wheel.

4. Seat: Nylon.

5. End Connections: Socket, union, or flanged.

6. Working Pressure Rating: 500 psig (3450 kPa).

7. Maximum Operating Temperature: 275 deg F (135 deg C).

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.

2. Packing: Molded stem, back seating, and replaceable under pressure.

3. Operator: Rising stem.

4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.

5. Seal Cap: Forged-brass or valox hex cap.

6. End Connections: Socket, union, threaded, or flanged.

7. Working Pressure Rating: 500 psig (3450 kPa).

8. Maximum Operating Temperature: 275 deg F (135 deg C).

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.

2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.

3. Piston: Removable polytetrafluoroethylene seat.

4. Closing Spring: Stainless steel.

5. End Connections: Socket, union, threaded, or flanged.

6. Maximum Opening Pressure: 0.50 psig (3.4 kPa).

7. Working Pressure Rating: 500 psig (3450 kPa).

8. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.

2. Core: Removable ball-type check valve with stainless-steel spring.

3. Seat: Polytetrafluoroethylene.

4. End Connections: Copper spring.

5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.

2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.

3. Seat: Polytetrafluoroethylene.

4. End Connections: Threaded.

5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and **24**-V ac coil.

6. Working Pressure Rating: 400 psig (2760 kPa).

7. Maximum Operating Temperature: 240 deg F (116 deg C).

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.

2. Piston, Closing Spring, and Seat Insert: Stainless steel.

3. Seat Disc: Polytetrafluoroethylene.

4. End Connections: Threaded.

5. Working Pressure Rating: 400 psig (2760 kPa).

6. Maximum Operating Temperature: 240 deg F (116 deg C).

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.

2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.

3. Packing and Gaskets: Non-asbestos.

4. Capillary and Bulb: Copper tubing filled with refrigerant charge.

5. Suction Temperature: matching system operation.

6. Superheat: Adjustable.

7. Reverse-flow option (for heat-pump applications).

8. End Connections: Socket, flare, or threaded union.

9. Working Pressure Rating: 450 psig (3100 kPa).

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.

2. Screen: 100-mesh stainless steel.

3. End Connections: Socket or flare.

4. Working Pressure Rating: 500 psig (3450 kPa).

5. Maximum Operating Temperature: 275 deg F (135 deg C).

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.

2. Drain Plug: Brass hex plug.

3. Screen: 100-mesh monel.

4. End Connections: Socket or flare.

5. Working Pressure Rating: 500 psig (3450 kPa).

6. Maximum Operating Temperature: 275 deg F (135 deg C).

J. Moisture/Liquid Indicators:

1. Body: Forged brass.

2. Window: Replaceable, clear, fused glass window with indicating

element protected by filter screen.

3. Indicator: Color coded to show moisture content in ppm.

4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.

5. End Connections: Socket or flare.

6. Working Pressure Rating: 500 psig (3450 kPa).

7. Maximum Operating Temperature: 240 deg F (116 deg C).

K. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.

2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.

3. Desiccant Media: Activated alumina or charcoal.

4. Designed for reverse flow (for heat-pump applications).

5. End Connections: Socket.

6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.

7. Maximum Pressure Loss: 2 psig (14 kPa).

8. Rated Flow: matching system operation

9. Working Pressure Rating: 500 psig (3450 kPa).

10. Maximum Operating Temperature: 240 deg F (116 deg C).

L. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.

2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.

3. Desiccant Media: Activated alumina or charcoal.

4. Designed for reverse flow (for heat-pump applications).

5. End Connections: Socket.

6. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.

7. Maximum Pressure Loss: 2 psig (14 kPa).

8. Rated Flow: matching system operation.

9. Working Pressure Rating: 500 psig (3450 kPa).

10. Maximum Operating Temperature: 240 deg F (116 deg C).

M. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.

2. End Connections: Socket or flare.

3. Working Pressure Rating: 500 psig (3450 kPa).

4. Maximum Operating Temperature: 275 deg F (135 deg C).

N. Receivers: Comply with ARI 495.

1. Comply with UL 207; listed and labeled by an NRTL.

2. Body: Welded steel with corrosion-resistant coating.

3. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.

4. End Connections: Socket or threaded.

5. Working Pressure Rating: 500 psig (3450 kPa).

6. Maximum Operating Temperature: 275 deg F (135 deg C).

O. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.

2. End Connections: Socket or threaded.

3. Working Pressure Rating: 500 psig (3450 kPa).

4. Maximum Operating Temperature: 275 deg F (135 deg C).

2.03 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work

include, but are not limited to, the following:

1. Atofina Chemicals, Inc.

2. DuPont Company; Fluorochemicals Div.

3. Honeywell, Inc.; Genetron Refrigerants.

4. INEOS Fluor Americas LLC.

B. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS FOR REFRIGERANTS

A. Suction Lines NPS 4 (DN 100) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Safety-Relief-Valve Discharge Piping: Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints

3.02 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.

2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.

3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.

2. Thermostatic expansion valves.

3. Hot-gas bypass valves.

4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.03 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and

service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Section 15900 "HVAC Instrumentation and Controls" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08311 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.

2. Install horizontal suction lines with a uniform slope downward to compressor.

3. Install traps and double risers to entrain oil in vertical runs.

4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:

1. Shot blast the interior of piping.

2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.

3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.

4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.

5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.

6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

R. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

S. Identify refrigerant piping and valves according to Section 15077 "Identification for HVAC Piping and Equipment."

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15093 "Sleeves and Sleeve Seals for HVAC Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15093 "Sleeves and Sleeve Seals for HVAC Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15098 "Escutcheons for HVAC Piping."

3.04 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Construct joints according to ASTM B 828 or CDA's

"Copper Tube Handbook."

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.

3.05 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.

2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.

3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.

4. Spring hangers to support vertical runs.

5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).

2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).

3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).

4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

6. NPS 2 and larger (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2 and larger (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).

E. Support multifloor vertical runs at least at each floor.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.

3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

a. Fill system with nitrogen to the required test pressure.

b. System shall maintain test pressure at the manifold gage throughout duration of test.

c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.

3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).

4. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.

2. Verify that compressor oil level is correct.

3. Open compressor suction and discharge valves.

4. Open refrigerant valves except bypass valves that are used for other purposes.

5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

PART 4: MEASUREMENT AND PAYMENT

4.01 REFRIGERANT PIPING:

A. Refrigerant Piping will not be measured for payment.

B. Refrigerant Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15185

HYDRONIC PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Close-coupled, in-line centrifugal pumps.

2. Separately coupled, base-mounted, end-suction centrifugal pumps.

1.03 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: For each pump.

1. Show pump layout and connections.

2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

3. Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

B. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with

labels describing contents.

1. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.01 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong Pumps Inc.

2. Aurora Pump; Division of Pentair Pump Group.

3. ITT Corporation; Bell & Gossett.

4. Peerless Pump Company.

5. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange or union-end connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.

3. Pump Shaft: Stainless steel.

4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket. Include water slinger on shaft between motor and seal.

5. Pump Bearings: Permanently lubricated ball bearings.

D. Motor: Single speed and rigidly mounted to pump casing.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

E. Capacities and Characteristics:

1. See contract drawings for schedule of capacities.

2.02 SEPARATELY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong Pumps Inc.

2. Aurora Pump; Division of Pentair Pump Group.

3. ITT Corporation; Bell & Gossett.

4. Peerless Pump Company.

5. TACO Incorporated.

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal.

C. Pump Construction:

1. Casing: Radially split, cast iron, with replaceable bronze wear rings, threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and threaded companion-flange or flanged connections. Provide integral mount on volute to support the casing, and provide attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For pumps not frequency-drive controlled, trim impeller to match specified performance.

3. Pump Shaft: Stainless steel.

4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and EPT bellows and gasket.

5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.

D. Shaft Coupling: Molded-rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be drop-out type to allow disassembly and removal without removing pump shaft or motor. EPDM coupling sleeve for variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, secured to mounting frame, with adjustable alignment.

1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

H. Capacities and Characteristics:

1. See contract drawings for schedule of capacities.

2.03 PUMP SPECIALTY FITTINGS

A. Suction Diffuser:

1. Angle pattern.

2. 175-psig (1204-kPa) pressure rating, ductile-iron body and end cap, pump-inlet fitting.

3. Bronze startup and bronze or stainless-steel permanent strainers.

4. Bronze or stainless-steel straightening vanes.

5. Drain plug.

6. Factory-fabricated support.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Equipment Mounting: Install base-mounted pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases specified in Section 03300 " Cast-in-Place Concrete."

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct bases to withstand, without damage to equipment, seismic force required by code.

   a. Construct concrete bases 4 inches (100 mm) high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of base-mounted pumps unless otherwise indicated or unless required for seismic-anchor support.

3. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.

E. Equipment Mounting: Comply with requirements for vibration isolation devices specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

F. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support weight of in-line pumps.

1. Comply with requirements for seismic-restraint devices specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

2. Comply with requirements for hangers and supports specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment."

3.03 ALIGNMENT

A. Engage a factory-authorized service representative to perform alignment service.

B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.

C. Comply with pump and coupling manufacturers' written instructions.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.04 CONNECTIONS

A. Where installing piping adjacent to pump, allow space for service and maintenance.

B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install check valve and throttling valve with memory stop on discharge side of pumps.

E. Install suction diffuser and shutoff valve on suction side of pumps.

F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

G. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

H. Connect wiring according to Section 16120 "Conductors and Cables."

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Check piping connections for tightness.

3. Clean strainers on suction piping.

4. Perform the following startup checks for each pump before starting:

a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

6. Start motor.

7. Open discharge valve slowly.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

PART 4: MEASUREMENT AND PAYMENT

4.01 HYDRONIC PUMPS:

A. Hydronic Pumps will not be measured for payment.

B. Hydronic Pumps will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15189

HVAC WATER TREATMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following HVAC water-treatment systems:

1. Bypass chemical-feed equipment and controls.

2. Chemical treatment test equipment.

3. HVAC water-treatment chemicals.

1.03 DEFINITIONS

A. EEPROM: Electrically erasable, programmable read-only memory.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. TDS: Total dissolved solids.

1.04 PERFORMANCE REQUIREMENTS

A. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

B. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

C. Closed hydronic systems, including heating and Dual-service heating and cooling piping water systems, including boiler make-up water, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.

2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.

3. Boron: Maintain a value within 100 to 200 ppm.

4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.

5. Soluble Copper: Maintain a maximum value of 0.20 ppm.

6. TDS: Maintain a maximum value of 10 ppm.

7. Ammonia: Maintain a maximum value of 20 ppm.

8. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.

9. Microbiological Limits:

   a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.

   b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.

   c. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.

   d. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.

   e. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.05 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass Filter feeders.

2. Water meters.

3. Chemical test equipment.

4. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

B. Manufacturer Seismic Qualification Certification: Submit certification that water filtration units and components will withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.

2. Water Analysis: Illustrate water quality available at Project site.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sensors, injection pumps, water filtration units, and controllers to include in emergency, operation, and maintenance manuals.

1.08 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.09 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for cooling, Dual-service heating and cooling piping -water piping and heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.

2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.

3. Periodic field service and consultation.

4. Customer report charts and log sheets.

5. Laboratory technical analysis.

6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aqua-Chem, Inc.; Cleaver-Brooks Div.

2. ONDEO Nalco Company.

3. Filter Specialists, Inc.

4. Hayward Industrial Products, Inc.

5. Parker Hannifin Corp.; Process Filtration Div.

6. USFilter.

2.02 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders with filters:

1. Steel, with filter cartridges for removing particles from water and corrosion-resistant exterior coating, minimum 3-1/2-inch (89-mm) fill opening in the top, and NPS 3/4 (DN 20) bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

2. Capacity: 10 gal. (38 L) .

3. Minimum Working Pressure: 125 psig (860 kPa.

4. Filter Design:

a. Cartridge: Replaceable; of shape to fit housing.

b. Water Flow Rate: 5% of system flow or as indicated on drawings.

c. Filtration Efficiency: 98 percent.

d. Particle Size: 10 microns and larger.

e. Clean Pressure Loss: 2 psig (14 kPa).

f. Pressure Loss at Replacement: 5 psig (41 kPa).

g. Media Material: Polypropylene.

2.03 AUTOMATIC CHEMICAL-FEED EQUIPMENT

A. Water Meter:

1. AWWA C701, turbine-type, totalization meter.

2. Body: Epoxy-coated cast iron.

3. Minimum Working-Pressure Rating: 150 psig (1035 kPa).

4. Maximum Pressure Loss at Design Flow: 3 psig (20 kPa).

5. Registration: Gallons (Liters) or cubic feet (cubic meters).

6. End Connections: Flanged.

7. Controls: Flow-control switch with normally open contacts; rated for maximum 10 A, 250-V ac; and that will close at adjustable

increments of total flow.

B. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

C. Injection Assembly:

1. Quill: Minimum NPS 1/2 (DN 15) with insertion length sufficient to discharge into at least 25 percent of pipe diameter.

2. Ball Valve: Two-piece, stainless steel as described in "Stainless-Steel Pipes and Fittings" Article below; and selected to fit quill.

3. Packing Gland: Mechanical seal on quill of sufficient length to allow quill removal during system operation.

4. Assembly Pressure/Temperature Rating: Minimum 600 psig (4137 kPa) at 200 deg F (93 deg C).

D. Self-Contained Breathing Apparatus: Open-circuit, pressure-demand, compressed air includes completely assembled, portable, self-contained devices designed for hazardous breathing environment application.

1. Face Piece: EPDM or silicone rubber construction material, one-size-fits-all with double-sealing edge, stainless-steel speaking diaphragm and lens retainer, five adjustable straps to hold face piece to head (two straps on each side and one on top), exhalation valve in mask, close-fitting nose piece to ensure no CO_2 buildup, and perspiration drain to avoid skin irritation and to prevent eyepiece, spectacle, and lens fogging.

2. Backplate: Orthopedically designed of chemical and impact-resistant, glass-fiber composite.

3. Harness and Carrier Assembly: Large triangular back pad, backplate, and adjustable waist and shoulder straps. Modular in design, detachable components, and easy to clean and maintain. Shoulder straps padded with flame-resistant material, reinforced with stainless-steel cable, and attached with T-nuts, washers, and screws.

4. Air Cylinder: 60-minute, low-pressure, air-supply-loaded fiberglass cylinders fitted with quick-fill assembly for refilling and air transfer.

5. Wall-Mounting Cabinet: Leakproof, corrosion-resistant, clear, plastic case.

6. Tested and Certified: By the National Institute for Occupational Safety and Health and by the Mine Safety and Health Administration, according to 42 CFR 84, Subpart H.

2.04 STAINLESS-STEEL PIPES AND FITTINGS

A. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.

B. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.

C. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig (1725-kPa) SWP and 600-psig (4140-kPa) CWP ratings.

2.05 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

2.06 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.01 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.02 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install seismic restraints for equipment and floor-mounting accessories and anchor to building structure. Refer to Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment" for seismic restraints.

C. Install water testing equipment on wall near water chemical application equipment.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.

F. Bypass Feeders: Install in closed hydronic systems, including hot-water heating and Dual-service heating and cooling piping water, and equipped with the following:

1. Install bypass feeder with filters in a bypass circuit around circulating pumps, unless otherwise indicated on Drawings.

2. Install water meter in makeup water supply.

3. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.

4. Install a swing check on inlet after the isolation valve.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Section 15181 "Hydronic Piping."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Section 15112 "General-Duty Valves for HVAC Piping."

E. Refer to Section 15140 "Domestic Water Piping" for backflow preventers required in makeup water connections to potable-water systems.

F. Confirm applicable electrical requirements in electrical Sections for connecting electrical equipment.

G. Ground equipment according to Section 16060 "Grounding and Bonding."

H. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.

2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.

4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.

5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.

7. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.

8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Remove and replace malfunctioning units and retest as specified above.

E. At **six**-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that chemical-feed systems are maintaining water quality within performance requirements specified

in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

F. Comply with ASTM D 3370 and with the following standards:

1. Silica: ASTM D 859.

2. Steam System: ASTM D 1066.

3. Acidity and Alkalinity: ASTM D 1067.

4. Iron: ASTM D 1068.

5. Water Hardness: ASTM D 1126.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

B. Training: Provide a "how-to-use" self-contained breathing apparatus video that details exact operating procedures of equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 HVAC WATER TREATMENT

A. HVAC Water Treatment will not be measured for payment.

B. HVAC Water Treatment will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15192

FACILITY FUEL-OIL PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes fuel-oil, waste oil and diesel-fuel-oil distribution systems and the following:

1. Pipes, tubes, and fittings.
2. Piping and tubing joining materials.
3. Piping specialties.
4. Valves.
5. Fuel-oil AST accessories.
6. Fuel-oil storage tank piping specialties.
7. Fuel-transfer pumps.
8. Fuel maintenance system.
9. Liquid-level gage system.
10. Leak-detection and monitoring system.
11. Concrete bases.

1.03 DEFINITIONS

A. AST: Aboveground storage tank.

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. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

E. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

F. FRP: Glass-fiber-reinforced plastic.

1.04 PERFORMANCE REQUIREMENTS

A. Maximum Operating-Pressure Ratings: 3-psig (21-kPa) fuel-oil supply pressure at oil-fired appliances.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1. Piping specialties.

2. Valves: Include pressure rating, capacity, settings, and electrical connection data of selected models.

3. Each type and size of fuel-oil storage tank. Indicate dimensions, weights, loads, components, and location and size of each field connection.

4. Fuel-oil storage tank accessories.

5. Fuel-oil storage tank piping specialties.

6. Fuel-oil storage tank pumps.

7. Fuel-oil transfer pumps.

8. Fuel maintenance system.

9. Liquid-level gage system.

10. Leak-detection and monitoring system.

B. Shop Drawings: For facility fuel-oil piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints

and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot (1:50).

2. For fuel-oil storage tanks and pumps, include details of supports and anchors.

C. Delegated-Design Submittal: For fuel-oil piping and equipment 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. Detail fabrication and assembly of anchors and seismic restraints.

2. Design Calculations: Calculate requirements for selecting seismic restraints.

3. Detail fabrication and assembly of pipe anchors, hangers, supports for multiple pipes, and attachments of the same to building structure.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which fuel-oil piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which fuel-oil piping and tanks are shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Brazing certificates.

E. Welding certificates.

F. Field quality-control reports.

G. Warranty: Sample of special warranty.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-oil equipment and accessories to include in emergency, operation, and maintenance manuals.

1.08 MATERIALS MAINTENANCE 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. Strainer: One for each strainer type and size.

2. Filter: One for each filter type and size.

1.09 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.

F. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

D. Store PE pipes and valves protected from direct sunlight.

1.11 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-oil storage systems, piping and related equipment that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. See Part 3 piping schedule articles for where pipes, tubes, fittings, and joining materials are applied in various services.

B. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.

3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

a. Material Group: 1.1.

b. End Connections: Threaded or butt welding to match pipe.

c. Lapped Face: Not permitted underground.

d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.

e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K (ASTM B 88M, Type A).

1. Copper Fittings: ASME B16.22, wrought copper, streamlined pattern.

2. Flare Fittings: Comply with ASME B16.26 and SAE J513.

a. Copper fittings with long nuts.

b. Metal-to-metal compression seal without gasket.

c. Dryseal threads complying with ASME B1.20.3.

2.02 PIPING SPECIALTIES

A. Flexible Connectors: Comply with UL 567.

1. Metallic Connectors:

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:

i. American Flexible Hose Co., Inc.

ii. Hose Master, Inc.

iii. Metraflex Company (The).

iv. Tru-Flex Metal Hose Corp.

v. Unaflex.

b. Listed and labeled for aboveground applications by an NRTL acceptable to authorities having jurisdiction.

c. Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.

d. Minimum Operating Pressure: 150 psig (1035 kPa).

e. End Connections: Socket, flanged, or threaded end to match connected piping.

f. Maximum Length: 30 inches (762 mm.)

g. Swivel end, 50-psig (345-kPa) maximum operating pressure.

h. Factory-furnished anode.

B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig (860 kPa).

C. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 (DN 50) and smaller; flanged ends for NPS 2-1/2 (DN 65) and larger.

3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

4. CWP Rating: 125 psig (860 kPa).

D. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.

2. End Connections: Grooved ends.

3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.

4. CWP Rating: 750 psig (5170 kPa).

E. Manual Air Vents:

1. Body: Bronze.

2. Internal Parts: Nonferrous.

3. Operator: Screwdriver or thumbscrew.

4. Inlet Connection: NPS 1/2 (DN 15).

5. Discharge Connection: NPS 1/8 (DN 6).

6. CWP Rating: 150 psig (1035 kPa).

7. Maximum Operating Temperature: 225 deg F (107 deg C).

2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for fuel oil.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F (540 deg C) complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 MANUAL FUEL-OIL SHUTOFF VALVES

A. See valve schedule in Part 3 for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller for Liquid Service: Comply with UL 842.

1. CWP Rating: 125 psig (860 kPa).

2. Threaded Ends: Comply with ASME B1.20.1.

3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

4. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.

5. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with UL 842.

1. CWP Rating: 125 psig (860 kPa).

2. Flanged Ends: Comply with ASME B16.5 for steel flanges.

3. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.

4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

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. BrassCraft Manufacturing Company; a Masco company.

b. Conbraco Industries, Inc.; Apollo Div.

c. McDonald, A. Y. Mfg. Co.

d. Perfection Corporation; A Subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.

3. Ball: Chrome-plated bronze.

4. Stem: Bronze; blowout proof.

5. Seats: Reinforced TFE; blowout proof.

6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in the valve schedule.

8. CWP Rating: 600 psig (4140 kPa).

9. Service Mark: Initials "WOG" shall be permanently marked on valve body.

2.05 SPECIALTY VALVES

A. Pressure Relief Valves: Comply with UL 842.

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. Anderson Greenwood; Division of Tyco Flow Control.

b. Fulflo Specialties, Inc.

c. Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.

2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

3. Body: Brass, bronze, or cast steel.

4. Springs: Stainless steel, interchangeable.

5. Seat and Seal: Nitrile rubber.

6. Orifice: Stainless steel, interchangeable.

7. Factory-Applied Finish: Baked enamel.

8. Maximum Inlet Pressure: 150 psig (1035 kPa).

9. Relief Pressure Setting: 30 psig (207 kPa) unless otherwise noted.

B. Oil Safety Valves: Comply with UL 842.

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. Anderson Greenwood; Division of Tyco Flow Control.

b. Suntec Industries Incorporated.

c. Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.

2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

3. Body: Brass, bronze, or cast steel.

4. Springs: Stainless steel.

5. Seat and Diaphragm: Nitrile rubber.

6. Orifice: Stainless steel, interchangeable.

7. Factory-Applied Finish: Baked enamel.

8. Manual override port.

9. Maximum Inlet Pressure: 30 psig (207 kPa).

10. Maximum Outlet Pressure: 3 psig (21 kPa).

C. Emergency Shutoff Valves: Comply with UL 842.

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. Ameron International; Fiberglass Pipe Group.

b. Conley Corporation.

c. EMCO Wheaton; a Gardner Denver Company.

d. OPW.

2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

3. Single poppet valve.

4. Body: ASTM A 126, cast iron.

5. Disk: FPM.

6. Poppet Spring: Stainless steel.

7. Stem: Plated brass.

8. O-Ring: FPM.

9. Packing Nut: PTFE-coated brass.

10. Fusible link to close valve at 165 deg F (74 deg C).

11. Thermal relief to vent line pressure buildup due to fire.

12. Air test port.

13. Maximum Operating Pressure: 0.5 psig (3.45 kPa).

D. Mechanical Leak Detector: Comply with UL 842.

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. FE Petro, Inc.

b. Red Jacket Pumps; a division of Veeder-Root.

2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

3. Body: ASTM A 126, cast iron.

4. O-Rings: Elastomeric compatible with fuel oil.

5. Piston and Stem Seals: PTFE.

6. Stem and Spring: Stainless steel.

7. Piston Cylinder: Burnished brass.

8. Indicated Leak Rate: Maximum 3 gph (3 mL/s) at 10 psig (69 kPa).

9. Leak Indication: Reduced flow.

2.06 FUEL-OIL PIPING SPECIALTIES

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. EBW, Inc.

2. OPW.

3. Preferred Utilities Manufacturing Corporation.

4. Universal Valve Company.

B. Show fuel-oil tank specialty fittings on plans, details, and piping schematics.

C. Fitting Materials: Cast iron, malleable iron, brass, or corrosion-resistant metal; suitable for fuel-oil service.

1. Surface, Flush-Mounted Fittings: Waterproof.

2. Mounted Fittings: Weatherproof.

D. Spill-Containment Fill Boxes: Flush mounting, with drainage feature to drain oil into tank, threaded fill-pipe connection, and wrench operation.

E. Supply and Sounding Drop Tubes: Fuel-oil supply piping or fitting, inside tank, terminating 6 inches (150 mm) above bottom of tank, and with end cut at a 45-degree angle (1:1 slope).

F. Pipe Adapters and Extensions: Compatible with piping and fittings.

G. Suction Strainers and Check Valves: Bronze or corrosion-resistant metal

components.

H. Foot Valves and Antisiphon Valves: Poppet-type, bronze or corrosion-resistant metal components.

I. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

J. Metal Manholes: 22-inch- (560-mm-) minimum diameter frame and cover. Furnish manhole units of adequate size for access to fittings if size is not indicated.

K. Monitoring Well Caps: Locking pipe plug.

2.07 DUPLEX FUEL-OIL TRANSFER PUMP SETS

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. Hydronic Modules Corporation.

2. Preferred Utilities Manufacturing Corporation.

3. Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.

B. Description: Comply with HI M109.

1. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

2. Type: Positive-displacement, rotary type.

3. Impeller: Carbon vane.

4. Housing: Cast-iron foot mounted.

5. Bearings: Bronze, self-lubricating.

6. Shaft: Polished steel.

7. Seals: Mechanical.

8. Base: Steel.

9. Pressure Relief: Built in.

10. Discharge Check Valve: Built in.

C. Drive: Direct close coupled.

D. Controls:

1. Run pumps to maintain minimum manifold pressure on call for from building EMS.

2. Stage pumps on pressure at a common supply manifold.

3. Alternate pumps to equalize run time.

4. Alarm motor failure.

5. Manual reset dry-run protection. Stop pumps if fuel level falls below pump suction.

6. Deenergize and alarm pump locked rotor condition.

7. Alarm open circuit, high and low voltage.

8. Indicating lights for power on, run, and off normal conditions.

9. Interface with automatic control system is specified in Section 15900 "HVAC Instrumentation and Controls." to control and indicate the following:

a. Start/stop pump set when required by schedule, fuel-fired appliance operation, day tank level control, or weather conditions.

b. Operating status.

c. Alarm off-normal status.

E. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

F. Piping Furnished with Pumps: Steel with ferrous fittings and threaded or

welded joints.

G. Strainers Furnished with Pumps: Duplex, basket type with corrosion-resistant-metal-screen baskets.

H. Capacities and Characteristics: See design drawings for capacities and characteristics.

2.08 FUEL MAINTENANCE SYSTEM

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. Fuel Technologies, International, LLC.

B. Description: Factory fabricated and wired fuel maintenance system for fuel-oil filtration; with enclosure, filter, fuel-oil pump, and controls; FMG approved, listed, and labeled by an NRTL acceptable to authorities having jurisdiction.

1. Enclosure: NEMA 250, Type 3R, painted steel containing pumps, filters, accessories, and controls. Hinged door on the front of enclosure.

2. Pump: Comply with HI M109, steel-gear-with-crescent, positive-displacement, direct- coupled, rotary-type.

3. Materials: Cast-iron housing; bronze bearings; steel shaft; mechanical seals; and built-in, pressure relief bypass valve.

4. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

b. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

5. Piping: Steel with malleable-iron fittings and threaded joints or wrought-steel fittings and welded joints.

6. Multistage Filter: Spin-on, replaceable types.

a. Stage 1: 100-mesh strainer.

b. Stage 2: Centrifuge to separate particulates and water from oil.

c. Stage 3: Coalescing water and particulate filter.

d. Stage 4: 30-micron particulate removal.

e. Stage 5: 10-micron particulate removal.

f. Stage 6: Minimum 99.5 percent water removal with see-through bowl and water-sensor probe.

g. Stage 7: 1.5 micron particulate removal.

7. Multiple-Tank Manifolds:

a. Manifold fabricated of Schedule 80, black steel pipe and threaded nipples for two tanks.

b. Solenoid valves for supply and return piping to each tank.

c. Strainers for each tank supply connection.

8. Programmable Logic Controller:

a. Alarm on maximum 15-in. Hg (51-kPa) vacuum at pump suction indicating plugged filter.

b. Alarm on high water level in filter.

c. Alarm leak in enclosure.

d. Touch screen; with minimum 2-line, 20-character, backlit, LCD display.

e. Controller strip heater with thermostat.

9. Interface with automatic control system is specified in Section 15900 "HVAC Instrumentation and Controls" to control and indicate the following:

a. Start/stop system when required by schedule.

b. Operating status.

c. Alarm off-normal status.

C. Capacities and Characteristics: See design drawings for capacities and characteristics.

2.09 LEAK-DETECTION, LEVEL AND MONITORING SYSTEM

A. Cable and Sensor System: Comply with UL 1238.

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. Containment Solutions, Inc.

   b. EBW, Inc.

   c. Highland Tank & Manufacturing Company, Inc.

   d. MSA; Instrument Div.

   e. Pneumercator Inc.

   f. Raychem Corp; Tyco Electronics Corporation.

   g. Veeder-Root; a Danaher Corporation Company.

2. Calibrated, leak-detection and monitoring system with probes and other sensors and remote alarm panel for multi-tank/multi-application fuel-oil storage tanks and fuel-oil piping systems.

3. Include fittings and devices required for testing.

4. Controls: Electrical, operating on 120-V ac.

5. Calibrated, liquid-level gage complying with UL 1238 with probes or other sensors and remote annunciator panel.

6. Remote Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.

7. Controls: Electrical, operating on 120-V ac.

B. Hydrostatic System: Comply with UL 1238.

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. Containment Solutions, Inc.

   b. EBW, Inc.

c. Gems Sensors Inc.

d. Highland Tank & Manufacturing Company, Inc.

e. MSA; Instrument Div.

f. Pneumercator Inc.

g. Raychem Corp; Tyco Electronics Corporation.

h. Veeder-Root; a Danaher Corporation Company.

C. Description: Calibrated, liquid-level gage system complying with UL 1238 with probes or other sensors and remote annunciator panel for multi-tank/multi-application fuel-oil storage tanks and fuel-oil piping systems. System shall be capable of monitoring leak detection for "Fuel Handling System" Section 15198 as well as the system specified in this section.

D. Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.

1. Calibrated, leak-detection and monitoring system with brine antifreeze solution, reservoir sensor, and electronic control panel to monitor leaks in inner and outer tank walls.

2. Include fittings and devices required for testing.

3. Controls: Electrical, operating on 120-V ac.

4. Calibrated, liquid-level gage complying with UL 1238 with probes or other sensors and remote annunciator panel.

5. Remote Annunciator Panel: With visual and audible, high-tank-level and low-tank-level alarms, fuel indicator with registration in gallons (liters), and overfill alarm. Include gage volume range that covers fuel-oil storage capacity.

6. Controls: Electrical, operating on 120-V ac.

2.10 FUEL OIL

A. Fuel Oil: ASTM D 396, Grade No. 2.

B. Waste Oil: Waste Oil collected from maintenance systems.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for fuel-oil piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.

B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.03 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

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 free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Verify final equipment locations for roughing-in.

I. Comply with requirements for equipment specifications in plumbing and HVAC Sections for roughing-in requirements.

J. Conceal pipe installations in walls, pipe spaces, or utility spaces; above ceilings; below grade or floors; and in floor channels unless indicated to be exposed to view.

K. Prohibited Locations:

1. Do not install fuel-oil piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

2. Do not install fuel-oil piping in solid walls or partitions.

L. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

M. Connect branch piping from top or side of horizontal piping.

N. Install unions in pipes NPS 2 (DN 50) and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.

O. Do not use fuel-oil piping as grounding electrode.

P. Install duplex basket strainer on inlet side of fuel-oil pump.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15093 "Sleeves and Sleeve Seals for HVAC Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15093 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15098 "Escutcheons for HVAC Piping."

T. Provide flexible connections for piping prior to penetrations through 3 hour wall construction.

3.04 VALVE INSTALLATION

A. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.

B. Install valves in accessible locations.

C. Protect valves from physical damage.

D. Install metal tag attached with metal chain indicating fuel-oil piping systems.

E. Identify valves as specified in Section 15077 "Identification for HVAC Piping and Equipment."

F. Install oil safety valves at inlet of each oil-fired appliance.

G. Install pressure relief valves in distribution piping between the supply and return lines.

H. Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping.

I. Install manual air vents at high points in fuel-oil piping.

J. Retain paragraph below for systems with fuel-oil or diesel-fuel-oil dispensers.

K. Install emergency shutoff valves at dispensers.

3.05 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Bevel plain ends of steel pipe.

2. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

G. Flared Joints: Comply with SAE J513. Tighten finger tight, then use wrench according to fitting manufacturer's written recommendations. Do not overtighten.

H. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.06 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1-1/4 (DN 32) and Smaller: Maximum span, 84 inches (2130 mm); minimum rod size, 3/8 inch (10 mm).

2. NPS 1-1/2 (DN 40): Maximum span, 108 inches (2740 mm); minimum rod size, 3/8 inch (10 mm).

3. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).

4. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 1/2 inch (13 mm).

5. NPS 3 (DN 80): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).

6. NPS 4 (DN 100): Maximum span, 13 feet (4 m); minimum rod size, 5/8 inch (16 mm).

C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet (4.5 m).

D. Install hangers for horizontal, drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20) and Smaller: Maximum span, 60 inches (1524 mm); minimum rod size, 3/8 inch (10 mm).

2. NPS 1 (DN 25): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).

3. NPS 1-1/4 (DN 32): Maximum span, 84 inches (2130 mm); minimum rod size, 3/8 inch (10 mm).

4. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

5. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2740 mm); minimum rod size, 1/2 inch (13 mm).

6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).

7. NPS 4 (DN 100): Maximum span, 11 feet (3.4 m); minimum rod size, 5/8 inch (16 mm).

E. Support vertical copper tube at each floor and at spacing not greater than 10 feet (3 m).

3.07 FUEL-OIL PUMP INSTALLATION

A. Transfer Pumps:

1. Install pumps with access space for periodic maintenance including removal of motors, impellers, and accessories.

2. Set pumps on and anchor to concrete base.

B. Install two-piece, full-port ball valves at suction and discharge of pumps.

C. Install mechanical leak-detector valves at pump discharge.

D. Install duplex basket strainer on inlet side of fuel-oil pumps.

E. Install check valve on discharge of fuel-oil pumps.

F. Install suction piping with minimum fittings and change of direction.

G. Install vacuum and pressure gage, upstream and downstream respectively, at each pump to measure the differential pressure across the pump. Pressure gages are specified in Section 15127 "Meters and Gages."

3.08 FUEL MAINTENANCE SYSTEM INSTALLATION

A. Install suction line, with foot valve, at one end of storage tank, 1 inch (25 mm) from the bottom of tank.

B. Install return line at the opposite end of storage tank from suction line.

3.09 LIQUID-LEVEL GAGE SYSTEM INSTALLATION

A. Install liquid-level gage system. Locate panel inside building where indicated.

3.10 LEAK-DETECTION AND MONITORING SYSTEM INSTALLATION

A. Install leak-detection and monitoring system. Install alarm panel inside building where indicated and connect to EMS.

1. Double-Wall, Fuel-Oil Storage Tanks: Install probes in interstitial space, piping and tanks.

2. Install liquid-level gages and probes.

3.10 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.

C. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

D. Connect piping to equipment with ball valve and union. Install union between valve and equipment.

E. Install flexible piping connectors at final connection to burners or oil-fired appliances that must be moved for maintenance access.

3.11 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.

1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.12 FIELD PAINTING OF ABOVEGROUND PIPING

A. Comply with requirements in Section 09911 "Exterior Painting" for

painting interior and exterior fuel-oil piping.

B. Paint exposed, exterior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Exterior alkyd enamel matching topcoat.

c. Topcoat: Exterior alkyd enamel (semigloss).

d. Color: Gray.

C. Paint exposed, interior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Interior latex matching topcoat.

c. Topcoat: Interior latex (semigloss).

d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Interior alkyd matching topcoat.

c. Topcoat: Interior alkyd (semigloss).

d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.13 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than

4 inches (100 mm) larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (457-mm) centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Use 3000-psig (20.7-MPa), 28-day, compressive-strength concrete and reinforcement as specified in Section 03300 "Cast-in-Place Concrete."

3.14 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:

a. Fuel-Oil Distribution Piping: Minimum 50 psig (34.5 kPa) for minimum 30 minutes.

b. Suction Piping: Minimum 20-in. Hg (68 kPa) for minimum 30 minutes.

c. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig (69 kPa).

2. Inspect and test fuel-oil piping according to NFPA 31, "Tests of

Piping" Paragraph; and according to requirements of authorities having jurisdiction.

3. Test liquid-level gage for accuracy by manually measuring fuel-oil levels at not less than five different depths while filling tank and checking against gage indication.

4. Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.

5. Start fuel-oil transfer pumps to verify for proper operation of pump and check for leaks.

6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

7. Bleed air from fuel-oil piping using manual air vents.

D. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.15 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain**,** leak-detection and monitoring systems and fuel-oil pumps.

3.16 PIPING SCHEDULE

A. Aboveground fuel-oil piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.

2. Steel pipe with wrought-steel fittings and welded joints.

3.17 ABOVEGROUND MANUAL FUEL-OIL SHUTOFF VALVE SCHEDULE

A. Distribution piping valves for pipe NPS 2 (DN 50) and smaller shall be:

1. One-piece, bronze ball valve with bronze trim.

B. Distribution piping valves for pipe NPS 2-1/2 (DN 65) and larger shall be:

1. Two-piece, full-port, bronze ball valves with bronze trim.

C. Valves in branch piping for single appliance shall be:

1. Two-piece, full-port, bronze ball valves with bronze trim.

PART 4: MEASUREMENT AND PAYMENT

4.01 FACILITY FUEL-OIL PIPING:

A. Facility Fuel-Oil Piping will not be measured for payment.

B. Facility Fuel-Oil Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15193

ABOVEGROUND STORAGE TANKS

PART 1: GENERAL

1.01 SUMMARY:

A. This section describes requirements for providing the equipment, labor and materials necessary to furnish and install aboveground storage tanks (ASTs) as specified herein and as shown on the Contract Drawings.

B. Requirements include furnishing and installing all equipment and accessories necessary to make complete and operational systems.

C. This Section includes furnishing and installing the following:

1. One (1) 8,000-gallon horizontal, cylindrical, steel, double-wall AST to store heating oil shall be furnished in the Maintenance Building. The AST shall be provided with factory-installed equipment and appurtenances as specified herein and as shown on the Contract Drawings.

2. One (1) 1,000-gallon horizontal, cylindrical, steel, double-wall AST to store low sulfur diesel oil for the generator shall be furnished in the Maintenance Building. The AST shall be provided with factory-installed equipment and appurtenances as specified herein and as shown on the Contract Drawings.

3. One (1) 2,000-gallon horizontal, cylindrical, steel, double-wall AST to store waste oil shall be furnished in the Maintenance Building. The AST shall be provided with factory-installed equipment and appurtenances as specified herein and as shown on the Contract Drawings.

4. The AST systems shall be manufactured and assembled by a single manufacturer. The item shall include all labor, equipment, materials, transport, fittings, and all other incidentals for providing in-place storage system as specified herein and as shown on the Contract Documents.

1.02 SUBMITTALS:

A. Product Data: For tank, include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Indicate

dimensions, weights, loads, components, and location and size of each field connection.

1.03 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.

F. Labeling for Hazards of Materials: All storage tanks shall be labeled in accordance with NFPA 704 Identification of the Hazards of Materials for Emergency Response.

G. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.

1.04 STANDARDS

A. Work shall be performed in accordance with applicable federal, state and local fire protection, environmental and safety codes and regulations and the latest version of the following industry standards:

B. Compliance with applicable requirements set forth by the U.S. Environmental Protection Agency (USEPA) and the State of Maryland Department of the Environment (MDE) and all local authorities having jurisdiction in addition to the following:

1. 40 CFR, Part 280 and all referenced standards therein.

2. COMAR, Title 26 and all referenced standards therein.

3. COMAR, 29.06.01 Fire Prevention Code

C. Flammable and Combustible Liquid Code, NFPA/30, Code for Motor Fuel Dispensing Facilities and Repair Garages, NFPA/30A, National Electrical

Code, NFPA/70, and Recommended Practice for Handling Releases of Flammable and Combustible Liquids and Gases, NFPA/329, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9904.

D. Article 79-Flammable and Combustible Liquids, Uniform Fire Code, 1994 Edition, International Fire Code Institute, 5360 Workman Mill Rd, Whittier, CA 90601, (310) 699-0124.

E. Identification of the Hazards of Materials for Emergency Response, NFPA 704, Hazardous Waste Operations and Emergency Response and Excavating, OSHA/29 CFR 1910.120 & 29 CFR 1926 Subpart P., Occupational Safety and Health Administration, U.S. Department of Labor, Region V, 230 S. Dearborn Street, Room 3244, Chicago, IL 60604.

F. Occupational Safety and Health Standards, Flammable and Combustible Liquids, 29CFR 1910.106, Personal Protective Equipment 29CFR 1910 Subpart I, Excavations 29CFR 1926.650 Subpart P, U. S. Department of Labor, Occupational Safety and Health Administration (OSHA), Washington, D.C.

G. STI R912: Installation Instructions for Factory Fabricated Aboveground Storage Tanks; STI R931: Double Wall Aboveground Storage Tank Installation and Testing Instructions; STI R942: Installation and Testing Instructions for Thermally Insulated Lightweight Double Wall Fireguard® Aboveground Storage Tanks

H. Where differences exist between standards, the Contractor shall use the most conservative. If in doubt, describe differences in writing to the Administration for his approval before performing the work.

I. The codes and standards listed are the latest as of this publication. Codes and standards are continuously updated. The Contractor shall confirm the construction standard edition enforced by the authority having jurisdiction.

1.05 PERFORMANCE REQUIREMENTS:

A. Unless otherwise specified, equipment furnished under this section shall be fabricated and installed in compliance with the instructions of the manufacturer.

B. The Contractor shall ensure that all equipment, accessories and installation materials comply with the specification and that adequate provision is made in the tank design and fabrication for mounting the specified system equipment and accessories.

C. The Contractor is solely responsible for construction means, methods, techniques, sequences and procedures and for safety precautions and

programs.

D. All electrical work shall conform to the national electric code NFPA 70, latest edition.

E. The contractor shall provide all labor, equipment and material required to provide a complete and functional system.

F. To avoid delays in construction, the Contractor shall ensure that all components of the system are available at the time of installation.

G. The Contractor shall coordinate his work with other work being performed at the construction site and to minimize interference with the Authority's normal activities which may continue during construction.

H. The Contractor shall obtain necessary permits, arrange for inspections and obtain approval of the appropriate federal, State, and local authorities.

1.06 COORDINATION:

A. Field verify all relevant site conditions such as locations of proposed utilities, proposed locations of service piping and equipment impacted by the performance of the work described and indicated on the documents.

B. Coordinate sizes and connections of equipment provided with actual field conditions.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.07 WARRANTY:

A. When warranties are required, verify with Administration's counsel that special warranties stated in this article are not less than remedies available to Administration under prevailing local laws.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of storage tanks and flexible, double-containment piping and related equipment that fail in materials or workmanship within specified warranty period.

1. Storage Tanks:

a. Failures include, but are not limited to, the following when used for storage of fuel oil at temperatures not exceeding 150 deg F:

1) Structural failures including cracking, breakup, and

collapse.

2) Corrosion failure including external and internal corrosion of steel tanks.

b. Warranty Period: 30 years from date of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Lift and support storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

PART 2: PRODUCTS

2.04 HORIZONTAL DOUBLE WALL STEEL ASTs

A. Acceptable manufacturers, subject to compliance with requirements:

1. Highland Tank & Manufacturing Company, Inc.;

2. Containment Solutions, Inc.;

3. Modern Welding Company, Inc.;

4. or approved equal.

B. Basis of Design Criteria:

1. Tanks shall be constructed and listed in accordance with UL-2085. The 2-hour fire rating shall exceed all requirements of NFPA 30 and 30A for "fire resistant" tanks and meet the requirements of UFC Articles 52 and 79, Appendix II-F and Appendix Standard A-II-F-1 for “protected” aboveground tanks. Tanks design shall comply with PEI/RP200-03.

2. Tanks shall be constructed as a UL-142 listed secondary containment tank, utilizing an inner primary storage tank and an outer secondary leak containment tank.

3. The tank design shall be resistant to bullet penetration in accordance with Appendix II F of the UFC.

4. A minimum of 3” of porous lightweight monolithic thermal

insulation material surround the primary storage tank and shall be UL-listed to allow the detection of leaks from the primary tank.

5. The fueling system shall be designed to meet or exceed the minimum requirements of NFPA Sections 30 and 30A, the UFC, and the NEC.

6. All fittings shall be threaded NPT risers and supplied with thread protectors and shall be located above the liquid storage level. All unused/spare tank openings shall be properly sealed using threaded pipe plugs, flanges or caps, using compatible thread sealant materials.

7. The primary tanks shall be pressure-tested in accordance with UL-142 (minimum 3 to maximum 5 psi) at the factory, and shall also be field tested by the Contractor to a maximum 3 psi or as specified by the tank manufacturer.

8. The primary tanks shall secure the interstitial barrier material to ensure UL certified protection.

9. Total tank storage volume:

   a. One (1) 8,000 gallons heating oil.

   b. One (1) 1,000 gallons low sulfur diesel oil for the generator.

   c. One (1) 2,000 gallons waste oil.

10. Tanks shall be horizontal cylindrical with dimensions as shown on the contract drawings.

11. The tanks shall be constructed of UL-specified steel thickness, with continuous welds.

12. The tanks shall be constructed of ASTM A1011 or A36 carbon steel.

14. The tanks shall include fittings as shown on the Contract Drawings.

15. Tanks shall be marked on all sides with warning signs: “FLAMMABLE” or “COMBUSTIBLE”, “NO SMOKING”, product identification and other signs as required by applicable codes. Equipment shall be marked using the API 1637 color-symbol system. UL Certification Plate label shall be permanently affixed to the tanks.

16. Electrical work shall be done by a licensed electrician and in accordance with NFPA 70 and the sections included with the Contract Documents. All electrical work shall be rated for hazardous area as required. Tanks shall be electrically grounded using a zinc grounding rod and in accordance with NFPA 780.

C. Shop painting of ASTs

1. Apply manufacturer's standard prime coat to exterior steel surface of AST and supports.

2. Prepare exterior steel surface of AST and tank supports.

3. Shop Cleaning: After fabrication, blast clean according to SSPC-SP 6/NACE No. 3.

4. After cleaning, remove dust or residual from cleaned surfaces.

5. If surface develops rust before prime coat is applied, repeat surface preparation.

6. Apply manufacturer’s standard prime coat to shop-cleaned, dry surface same day as surface preparation.

7. Apply manufacturer’s standard two-component, epoxy finish coats.

D. Venting of ASTs:

1. Provide one 2-inch normal atmospheric or pressure/vacuum vent for the primary tank(s).

2. Vent installation shall comply with applicable sections of the fire and mechanical codes, including, but not limited to, NFPA 30A (2-4.5.e), NFPA 30 (2-3.5), or UFC (7902.1.10).

3. Provide one 8-inch emergency vent for each primary tank or primary tank compartment. Emergency venting shall comply with provisions of NFPA 30A (2-4.5.f), NFPA 30 (2-3.6), or UFC (7902.2.6).

4. Provide one emergency vent for each secondary containment tank interstice.

a. The venting capacity shall be determined by the tank configuration, secondary tank capacity, and the product stored.

b. Emergency venting shall comply with provisions of NFPA 30A (2-4.5), NFPA 30 (2-3.6), or UFC (7902.2.6) (Article 79 5.3), and UL 142, and UL 2085.

c. Vents shall be located as close to the center of the tank as possible.

2.02 SECONDARY CONTAINMENTS

A. Acceptable manufacturers:

1. Highland Tank & Manufacturing Company, Inc.;

2. Containment Solutions, Inc.,;

3. Modern Welding Company, Inc.

B. Basis of Design Criteria:

1. Secondary containment, UL-142 listed, shall be furnished with each tank.

2. Minimum capacity- 110% of the contained tank.

3. Dimensions as shown on the contract drawings.

4. 1/4” (min.) mild carbon steel, welded seams inside and outside,

5. 2-inch FNPT drains in opposite corners,

6. Factory finished with commercial grit blast (SSPC-6), epoxy primer coat and a polyurethane finish coating.

7. Tanks shall be securely supported in the center of the containment.

8. Tank shall be furnished with steel supports per manufacturer’s standard and 1-1/8-inch dia. holes for anchoring to ground slab.

2.03 AST ACCESSORIES:

A. Supply Tube: Extension of supply piping fitting into tank, terminating 6 inches above tank bottom and cut at a 45-degree angle.

B. Striker Plates: 1/4-inch (min.) steel, inside tank, on bottom below fill, vent, sounding, gage, and other tube openings.

C. Sounding and Gage Tubes: Extension of fitting into tank, terminating 6 inches above tank bottom and cut at a 45-degree angle.

D. Each tank shall be delivered as a complete UL-listed assembly with factory supplied lifting lugs at balancing points to facilitate handling and installation. Welded-on supports, as shown on the contract drawings, shall be included to set tanks level on a solid foundation. The supports shall meet Seismic Zone 4 rating.

E. Each tank shall be delivered with one factory-supplied ladder and walkway as shown on the Contract Drawings.

1. Ladders and handrails shall be constructed of carbon steel. Walkway shall be constructed of 1-inch fiberglass grating.

2. Ladders, walkway, and handrails shall be installed outside of the tank, anchored to top and side wall. Shipped loosely and field installed.

3. Ladders, walkway, and handrails shall be OSHA approved and painted safety yellow.

F. Fill Limiting Valve: Clay & Bailey F-40, Universal Valve 49, or OPW 61f STOP.

G. Spill Prevention: Minimum 10 gallon spill containment chamber at tank fill port for collection of hose drippage. A manually operated valve allows the spill containment chamber to be drained into inner tank

H. All fasteners shall be stainless steel.

2.04 FUEL OIL

A Provide 400 gallons of ASTMD 975, Grade Ultra Low Sulfur fuel in the 1000 gallon generator tank for testing and operations. Contractor shall utilize this fuel for all testing necessary to confirm system is operating properly.

B. Provide 1000 gallons of ASTMD 975, Grade fuel oil in the 8000 gallon heating boiler tank for testing and operations. Contractor shall utilize this fuel for all testing necessary to confirm system is operating properly

PART 3: EXECUTION

3.01 PREPARATION:

A. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.02 AST TANK INSTALLATION

A. Tank Handling and Storage:

1. Tanks shall be handled, lifted, stored and secured in accordance with the manufacturer's instructions.

2. Unload with equipment having sufficient lifting capacity to avoid damage to the tank. Securely store the tank at the job site.

B. Equipment Installation:

1. Contractor shall install tanks in accordance with the manufacturers' installation instructions, industry standard recommended practices and federal, state and local regulations.

2. Tank installation shall be in strict accordance with Steel Tank Institute Installation and Testing Instructions for Thermally Insulated, Lightweight, Double Wall Tanks, and in accordance with manufacturer’s recommendations.

3. Calibration and start-up of equipment shall be performed by factory-trained and qualified personnel.

4. Examine roughing-in for fuel piping systems to verify actual locations of piping connections before equipment installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 FIELD PAINTING OF AST:

A. Prepare and touch up damaged exterior surface of AST and supports as specified in "Shop Painting of AST" Article.

3.04 EQUIPMENT TEST AND CHECK-OUT

A. The equipment shall be tested in the presence of the Administration’s Representative to his/her satisfaction and demonstrated to be correctly connected and installed. Submit a testing schedule to the Administration for approval prior to the start of the equipment test and check-out.

B. Testing and check-out procedures of the manufacturer shall be carried out completely. Testing shall be in strict accordance with Steel Tank Institute Installation and Testing Instructions for Thermally Insulated, Lightweight, Double Wall Tanks, and in accordance with manufacturer’s recommendations.

C. Equipment tests shall not only be performed to demonstrate that the equipment has been properly installed and connected and operates properly, but also to demonstrate that the equipment performs the work for which it is intended.

D. Tested equipment found to be defective or inoperable to any extent shall

be reported to the Administration immediately.

E. Any operating difficulty or defective item shall be repaired or replaced and put into proper operation by the Contractor immediately, at no additional expense to the Administration.

F. Contractor shall protect equipment and surrounding areas from damage resulting from testing operations, and shall clean-up any spills or leakage resulting from testing.

G. Contractor shall bear all expenses of all tests, including the furnishing of all necessary instruments, lubricants, hydraulic fluid, supplies, data recorders, and operation personnel. Provide and bear all expenses for fuel/power required to operate the equipment during the tests.

H. Perform testing of the equipment and system in accordance with the requirements specified in Contract Documents. Perform and document all testing procedures recommended by the manufacturer. Include the following tests:

1. Test system performance by measuring quantity of product dispensed over time at each designated "TEST" fluid and semi-solid control handle. Minimum measured output over time shall meet of exceed the "Minimum Delivery Rate" for the corresponding fluid as specified. Tests shall be performed three (3) times within a span of five (5) minutes at each control handle.

2. Test meter at each metering control handle by measuring volume of product dispensed. Measured volume of product dispensed shall correspond with volume of product indicated on meeting control handle within +/-0.65 percent of full dial range.

3. Test each hose reel for proper extension and retraction.

I. At the sole discretion of the Engineer, the Contractor may be required by repeat any tests, at no cost to the Administration.

J. Contractor shall perform the following tests to demonstrate fueling system

K. Features and compliance:

1. Tank Tightness: Per manufacturer’s written instruction;

2. Grounding Continuity: From tank ground rod to dispenser nozzle; and

3. Line Leak Detector to demonstrate three (3) gallons per hour sensitivity. This test shall be performed by an independent third-

party certified by MDE.

3.05 INSPECTION AND TRAINING

A. The system installation shall be inspected and approved by the Engineer. The Engineer shall submit a comprehensive checklist of quality and safety items critical to the system and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

B. Contractor shall be responsible to repair any quality or safety items, as found by the Engineer, at no cost to the Administration.

C. Contractor shall be responsible to provide as a minimum two (2) 2-hour training sessions of complete system operation and maintenance. The Contractor shall coordinate the session dates with the Administration.

PART 4: MEASUREMENT AND PAYMENT

4.01 ABOVEGROUND STORAGE TANKS AND ACCESSORIES

A. Aboveground Storage Tanks and Accessories will not be measured for payment.

B. Aboveground Storage Tanks and Accessories will not be paid for directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15194

FUEL GAS PIPING

PART 1: GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes fuel gas piping within the building. Products include the following:

1. Pipe, tube, fittings, and joining materials.
2. Protective pipe and fitting coating.
3. Piping specialties.
4. Specialty valves.
5. Pressure regulators.
6. Gas pressure boosters

B. Related Sections include the following:

1. Section 03300 “Cast-in-Place Concrete” for concrete pads.

1.03 PROJECT CONDITIONS

A. Gas System Pressure: One pressure range. 0.5 psig (3.45 kPa) or less.

B. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft. (37.3 MJ/cu. m).
2. Nominal Specific Gravity: 0.6.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

2. Service-meter bars. Include service-meter size of selected models.

3. Service meters. Include pressure rating and capacity of selected models.

4. Service-meter bypass fittings.

5. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

B. Shop Drawings: For fuel gas piping. Include plans and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For natural gas specialties and accessories to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with proper precautions and do not leave on premises from end of one day to beginning of next day.

1.07 COORDINATION

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed

utility interruptions.

2. Do not proceed with utility interruptions without Architect's written permission.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2: PRODUCTS

2.01 MANUFACTURERS

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 PIPES, TUBES, FITTINGS, AND JOINING MATERIALS

A. Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; black. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.

2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.

3. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.

4. Joint Compound and Tape: Suitable for natural gas.

5. Steel Flanges and Flanged Fittings: ASME B16.5.

6. Gasket Material: Thickness, material, and type suitable for natural gas.

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

1. Copper Fittings: ASME B16.22, wrought copper, streamlined pattern.

2. Brazing Filler Metals: AWS A5.8, Silver Classification BAg-1. Filler metal containing phosphorus is prohibited.

3. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.

4. Gasket Material: Thickness, material, and type suitable for natural gas.

2.04 PROTECTIVE COATING

A. Furnish pipe and fittings with factory-applied, corrosion-resistant polyethylene coating for use in contact with materials that may corrode the pipe.

2.05 PIPING SPECIALTIES

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

2.06 SPECIALTY VALVES

A. Valves, NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

C. Appliance Connector Valves: ANSI Z21.15 and CSA International listed.

1. Available Manufacturers:

a. American Valve Inc.

b. Brass Craft Manufacturing Co.

c. Conbraco Industries, Inc.; Apollo Div.

d. Key Gas Components, Inc.

e. Legend Valve and Fitting, Inc.

f. Mueller Co.; Mueller Gas Products Div.

g. Robert Manufacturing Co.

h. Watts Industries, Inc.; Water Products Div.

D. Gas Stops: Bronze body with AGA stamp, plug type with bronze plug and flat or square head, ball type with chrome-plated brass ball and lever handle, or butterfly valve with stainless-steel disc and fluorocarbon elastomer seal and lever handle; 2-psig (13.8-kPa) minimum pressure rating.

E. Gas Valves, NPS 2 (DN 50) and Smaller: ASME B16.33 and CSA International-listed bronze body and 125-psig (860-kPa) pressure rating.

1. Available Manufacturers:

a. Crane Valves.

b. Flow Control Equipment, Inc.

c. Grinnell Corp.

d. Honeywell International Inc.

e. Legend Valve and Fitting, Inc.

f. Milwaukee Valve Company.

g. Mueller Co.; Mueller Gas Products Div.

h. NIBCO INC.

i. Watts Industries, Inc.; Water Products Div.

2. Tamperproof Feature: Include design for locking.

F. Plug Valves, NPS 2-1/2 (DN 65) and Larger: ASME B16.38 and MSS SP-78 cast-iron, lubricated plug valves, with 125-psig (860-kPa) pressure rating.

1. Available Manufacturers:

a. Flow Control Equipment, Inc.

b. Milliken Valve Co., Inc.

c. Nordstrom Valves, Inc.

d. Olson Technologies, Inc.; Homestead Valve Div.

e. Walworth Co.

2. Tamperproof Feature: Include design for locking.

G. Automatic Gas Valves: ANSI Z21.21, with electrical operator for actuation by appliance automatic shutoff device.

1. Available Manufacturers:

a. ASCO General Controls.

b. ASCO Power Technologies, LP; Division of Emerson.

c. Eaton Corporation; Controls Div.

d. Eclipse Combustion, Inc.

e. GPS Gas Protection Systems Inc.

f. Honeywell International Inc.

g. Johnson Controls.

H. Electrically Operated Gas Valves: UL 429, bronze, aluminum, or cast-iron body solenoid valve; 120-V ac, 60 Hz, Class B, continuous-duty molded coil. Include NEMA ISC 6, Type 4, coil enclosure and electrically opened and closed dual coils. Valve position shall normally be closed.

1. Available Manufacturers:

a. ASCO General Controls.

b. ASCO Power Technologies, LP; Division of Emerson.

c. Eclipse Combustion, Inc.

d. Magnatrol Valve Corp.

e. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.

f. Watts Industries, Inc.

2.07 PRESSURE REGULATORS

A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. Available Manufacturers:

   a. Line Pressure Regulators:

      i. American Meter Company.

      ii. Eclipse Combustion, Inc.

      iii. Fisher Controls International, Inc.; Division of Emerson.

      iv. Invensys.

      v. Maxitrol Company.

      vi. National Meter Industries, Inc.

      vii. Richards Industries, Inc.; Jordan Valve Div.

   b. Appliance Pressure Regulators:

      i. Eaton Corporation; Controls Div.

      ii. Harper Wyman Co.

      iii. Maxitrol Company.

      iv. SCP, Inc.

2. NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

3. NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

4. Line Pressure Regulators: ANSI Z21.80 with 2-psig- (13.8-kPa-) minimum inlet pressure rating.

B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

2.08 GAS PRESSURE BOOSTER

A. Manufacturers:

1. Basis of Design: BoosterPak model series LS as manufactured by Eclipse combustion, Inc.

2. Subject to compliance with project requirements, provide basis-of-

design product or comparable product by following manufacturers:

a. Fisher Controls International, Inc.; Division of Emerson.

b. Haskell

c. Maxi-pro Tech

d. Spencer Turbines

B. Description: Complete gas pressure booster system shall be factory assembled. Skid mounted, piped and wired for installation on housekeeping pad. The assembly shall consist of the following:

1. Blower: The booster blower shall be designed to deliver gas at any volume within the capacity range of the booster without encountering any surge characteristics. The rotor shall be constructed of materials designed to prevent friction sparks and shall be magnetically coupled to the motor which shall allow for easy replacement of the motor without disassembly of field piping or wiring or removal of gas booster. The booster shall include a motor which shall be specifically designed and labeled for 115V, 1 phase, 60 hz power.

2. Check Valves: Check valves shall be of swing disk type constructed of heavy-duty cast iron with a lightweight aluminum disk and removable top with gasket for ease of inspection and service. Valves shall be designed to withstand a back-pressure differential of a minimum of 7 psig across the valve seat and all sizes shall require no more than 1.5 inches w.c. forward-pressure differential to open. Valves sized up to and including 2 ½ inches shall be screwed connection. Sizes 3 inches and larger shall be flanged. Check valves shall be FM approved.

3. Control System: The control system shall be a standard cataloged item that has been particularly designed for the booster system. The control panel shall be mounted on the base of the gas booster system and completely integrated. Primary and control voltage shall be 115/1/60. The circuitry shall also include a programmable controller for the stop and start sequencing, alarm functions and off delay timing. The enclosure shall be rated for the environmental conditions and have UL and CSA listing. Internal panel components shall include but not be limited to a door interlocked disconnect with provision for padlocking, motor starter sized according to NEMA standards or at least one size larger than IEC standards, properly sized motor overload and short-circuit protection, booster on/off/automatic selector switch, alarm, alarm silence pushbutton, adjustable time delays to eliminate booster

short cycling, indicating lights with a rated life of at least 20,000 hours. DIN-rail mounted terminals, and numbered wiring.

4. Low Gas Pressure Switch: Wired to the gas booster control system shall be a UL wired and FM approved low inlet gas pressure switch, which shall be set to open when the gas service inlet pressure falls below 3” w.c. When the switch opens it shall de-energize the booster motor control circuit disabling the gas booster and activating both an audible and visual alarm on the face of the booster control panel. The switch shall be of the manual reset type. Also wired to the gas booster control system shall be a low discharge gas pressure switch. The low discharge pressure switch shall be set to close at a pressure at least 3-4” w.c. below that of the gas booster system rated discharge pressure. When the switch closes it shall activate both an audible and visual alarm on the gas booster control panel. The switch shall be of the automatic reset type.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for fuel oil piping system to verify actual locations of piping connections before equipment installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Close equipment shutoff valves before turning off fuel gas to premises or section of piping. Perform leakage test as specified in "Field Quality Control" Article to determine that all equipment is turned off in affected piping section.

3.03 SERVICE ENTRANCE PIPING

A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.

1. Exterior fuel gas distribution system piping, service pressure regulator, and service meter will be provided by gas utility.

B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Dielectric fittings are specified in Division 15.

C. Install strainer upstream from each earthquake valve. Strainers are specified in Division 15 Section "Plumbing Piping Specialties."

3.04 PIPING APPLICATIONS

A. Flanges, unions, transition, and special fittings with pressure ratings same as or higher than system pressure rating may be used in applications below, unless otherwise indicated.

B. Fuel Gas Piping, 2 psig (13.8 kPa) or Less:

1. NPS 3/4 and NPS 1 (DN 20 and DN 25): Steel pipe, malleable-iron threaded fittings, and threaded joints or Hard copper tube, copper fittings, and brazed joints.

2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): Steel pipe, malleable-iron threaded fittings, and threaded joints.

3. NPS 2-1/2 (DN 65) and Larger: Steel pipe, steel welding fittings, and welded joints.

C. Underground Fuel Gas Piping: Steel pipe, steel welding fittings, and welded joints. Encase in containment conduit.

D. Gas Service Piping at Meters and Regulators, More Than 5 psig (34.5 kPa): Steel pipe, steel welding fittings, and welded joints.

3.05 VALVE APPLICATIONS

A. Shutoff Valves at equipment connections: Gas stop or gas valve.

B. Piping Line Valves, NPS 2 (DN 50) and Smaller: Gas valve.

C. Piping Line Valves, NPS 2-1/2 (DN 65) and Larger: Plug valve or general-duty valve.

3.06 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 15.

B. Concealed Locations: Except as specified below, install concealed gas piping in airtight conduit constructed of Schedule 40, seamless, black steel pipe with welded joints. Vent conduit to outside and terminate with screened vent cap.

1. Above-Ceiling Locations: Gas piping may be installed in accessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves above ceilings.

2. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.

3. Prohibited Locations: Do not install gas piping in or through circulating air ducts, ventilating ducts, or elevator shafts.

   a. Exception: Accessible above-ceiling space specified above.

C. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches (75 mm) long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

D. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.

E. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

F. Connect branch piping from top or side of horizontal piping.

G. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

H. Install corrugated, stainless-steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

I. Install strainer on inlet of each line pressure regulator and automatic and electrically operated valve.

J. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

K. Install flanges on valves, specialties, and equipment having NPS 2-1/2 (DN 65) and larger connections.

L. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

M. Provide flexible connections on piping prior to penetrations through 3 hour wall construction.

3.07 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Use materials suitable for fuel gas.

1. Brazed Joints: Make with brazing alloy with melting point greater than 1000 deg F (540 deg C). Brazing alloys containing phosphorus are prohibited.

C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.08 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 15 Section "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).

2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).

3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 1/2 inch (10 mm).

4. NPS 2-1/2 (DN 65): Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (16 mm).

C. Install hangers for horizontal hard copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 and NPS 7/8 (DN 20 and DN 22): Maximum span, 84 inches (2134 mm); minimum rod size, 3/8 inch (10 mm).

2. NPS 1 (DN 25): Maximum span, 96 inches (2438 mm); minimum

rod size, 3/8 inch (10 mm).

3.09 GAS PRESSURE BOOSTER INSTALLATION

A. Install gas booster base-mounted assembly on 6” thick concrete housekeeping pad. Concrete pad shall be 6” larger than the footprint of the base.

B. Ensure adequate clearance in front of the unit for operation and maintenance of controls and unit components. Leave working clearance for connecting inlet and discharge piping.

C. Extend service entrance piping to the unit and connect to building gas line at the discharge of the unit.

D. Connect to the electrical system.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.

B. Install piping adjacent to appliances to allow service and maintenance.

C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches (1800 mm) of each appliance. Install union downstream from valve.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

1. Do not use gas pipe as grounding electrode.

F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.11 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.

1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

2. Nameplates, pipe identification, and signs are specified in Division 15 Section " Identification."

3.12 PAINTING

A. Use materials and procedures in Division 9 painting Sections.

B. Paint exterior service meters, pressure regulators, and specialty valves.

1. Color: gray or school bus yellow, follow MTA standard

3.13 FIELD QUALITY CONTROL

A. Test, inspect, and purge piping according to NFPA 54 and requirements of authorities having jurisdiction.

B. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

C. Verify capacities and pressure ratings of service meters, pressure regulators, valves, and specialties.

D. Verify correct pressure settings for pressure regulators.

E. Verify that specified piping tests are complete.

PART 4: MEASUREMENT AND PAYMENT

4.01 FUEL GAS PIPING:

A. Fuel Gas Piping, including associated meters, gages, pipe, fittings, and other specialties, will not be measured for payment.

B. Fuel Gas Piping, including pipes and fittings, will not be paid directly but will be included in the lump sum bid prices for the Maintenance Building.

END OF SECTION

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Volume IV of IV

SECTION 15195

FLUID MANAGEMENT SYSTEM

PART 1:GENERAL

1.01 SUMMARY:

A. System Parameters: In the basic configuration, the fluid management system (FMS) shall record vehicle number, mileage and amounts of biodiesel fuel, engine oil, transmission fluid and coolant dispensed to buses at each service point in the Maintenance Building and the future Storage building. The FMS shall provide electronic recording of vehicle number, mileage, engine hours and operating and maintenance data from buses, automobiles, trucks, service vehicles and other motorized vehicles. This FMS shall provide a fully functional interface to a Veeder-Root storage tank-monitoring controller for monitoring of fluids stored in storage tanks, and fluid deliveries. The FMS shall provide software for fluid use and inventory reports. The FMS shall permit add-on expansion of additional liquid products, if desired by Administration at a future date. The FMS shall be fully compatible with like systems at other facilities and have interface capability to a remote central computer. The FMS shall automatically collect, record, transmit, compile and print data as specified herein.

1.02 RELATED DOCUMENTS:

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

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Also include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.04 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for

intended location and application.

E. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.

F. Labeling for Hazards of Materials: All storage tanks shall be labeled in accordance with NFPA 704 Identification of the Hazards of Materials for Emergency Response.

G. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.

1.05 STANDARDS

A. Work shall be performed in accordance with applicable federal, state and local fire protection, environmental and safety codes and regulations and the latest version of the following industry standards:

B. Compliance with applicable requirements set forth by the U.S. Environmental Protection Agency (USEPA) and the State of Maryland Department of the Environment (MDE) and all local authorities having jurisdiction in addition to the following:

1. 40 CFR, Part 280 and all referenced standards therein.

2. COMAR, Title 26 and all referenced standards therein.

3. COMAR, 29.06.01 Fire Prevention Code

C. Flammable and Combustible Liquid Code, NFPA/30, Code for Motor Fuel Dispensing Facilities and Repair Garages, NFPA/30A, National Electrical Code, NFPA/70, and Recommended Practice for Handling Releases of Flammable and Combustible Liquids and Gases, NFPA/329, National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9904.

D. Article 79-Flammable and Combustible Liquids, Uniform Fire Code, 1994 Edition, International Fire Code Institute, 5360 Workman Mill Rd, Whittier, CA 90601, (310) 699-0124.

E. Identification of the Hazards of Materials for Emergency Response, NFPA 704, Hazardous Waste Operations and Emergency Response and Excavating, OSHA/29 CFR 1910.120 & 29 CFR 1926 Subpart P., Occupational Safety and Health Administration, U.S. Department of Labor, Region V, 230 S. Dearborn Street, Room 3244, Chicago, IL 60604.

F. Occupational Safety and Health Standards, Flammable and Combustible Liquids, 29CFR 1910.106, Personal Protective Equipment 29CFR 1910 Subpart I, Excavations 29CFR 1926.650 Subpart P, U. S. Department of Labor, Occupational Safety and Health Administration (OSHA), Washington, D.C.

G. Where differences exist between standards, the Contractor shall use the

most conservative. If in doubt, describe differences in writing to the Administration for its approval before performing the work.

H. The codes and standards listed are the latest as of this publication. Codes and standards are continuously updated. The Contractor shall confirm the construction standard edition enforced by the authority having jurisdiction

1.06 PERFORMANCE REQUIREMENTS:

A. Unless otherwise specified, equipment furnished under this section shall be fabricated and installed in compliance with the instructions of the manufacturer.

B. The Contractor shall ensure that all equipment, accessories and installation materials comply with the specification and that adequate provision is made in the tank design and fabrication for mounting the specified FMS equipment and accessories.

C. The Contractor is solely responsible for construction means, methods, techniques, sequences and procedures and for safety precautions and programs.

D. All electrical work shall conform to the national electric code NFPA 70, latest edition.

E. The contractor shall provide all labor, equipment and material required to provide a complete and functional FMS.

F. To avoid delays in construction, the Contractor shall ensure that all components of the FMS are available at the time of installation.

G. The Contractor shall coordinate his work with other work being performed at the construction site and to minimize interference with the Administration's normal activities which may continue during construction.

H. The Contractor shall obtain necessary permits, arrange for inspections and obtain approval of the appropriate federal, State, and local authorities.

1.07 COORDINATION:

A. Field verify all relevant site conditions such as locations of proposed utilities, equipment, piping, ducts, and electrical conduits and wiring impacted by the performance of the work described and indicated on the documents.

B. Coordinate sizes and connections of equipment provided with actual field conditions.

C. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.07 WARRANTY:

A. At the time of installation each piece of equipment must be covered by the manufacturer's new machine service and parts warranty for a period of one year.

1.08 EXTRA MATERIALS AND DOCUMENTATION:

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2: PRODUCTS

2.01 MANUFACTURER

A. The FMS shall be FLEETWATCH System supplied by S & A Systems, Inc., Rockwall, Texas, or approved equal.

2.02 REMOTE ISLAND HEAD (RIH) UNITS

A. Each RIH shall be located at each bus and support vehicle service point and as required for control and monitoring of all fuel, oil, coolant and automatic transmission fluid (ATF) operations in the Storage and the Maintenance Buildings. One (1) spare RIH unit capable of operating in any service point shall be provided.

1. Remote Island Heads:

a. General:

i. RIH shall be the interface between fueling operator, dispenser, reel traffic sensors, as applicable, and the FMS.

ii. RIH shall have the capability to enter into a stand-alone mode of operation should the communication to the controller be lost or disrupted. RIH shall continue to authorize and record fueling transactions, store the data and transfer data to the controller upon reestablished communication.

iii. RIH shall be weatherproof, vandal resistant, and tamper proof.

iv. RIH components shall be plug-in, remove and replace, maintainable.

v. RIH shall consist of push-button console with display, mounted on upright stand.

vi. RIH shall operate in temperature range from 0 degrees F to 120 degrees F, and relative humidity range of 5 to 95 per cent, non-condensing.

b. Keypad:

i. Keypad shall be a sealed, flat, pressure sensitive unit providing 16 push-button permanently labeled as follows:

1) 0-9 digits

2) SEND (terminates data entry)

3) CLEAR (clears display)

4) RESET (restarts entry sequence)

5) YES (for entry validation)

6) NO (for entry validation)

c. Display

i. Display to be alphanumeric, backlit LCD unit with a shatterproof glass face, allowing up to 16 characters to be displayed.

d. Two-Position Key Switch:

i. Provide key-operated switch on face of RIH panel to allow selection of either manual mode or automatic mode. One key shall operate all RIH units. Provide two keys to each RIH unit, but all units shall be keyed alike.

2.03 FMS CONTROLLER UNIT

A. Unit with internal storage and communication capabilities to provide an interface with Information System/Vehicle Maintenance Software by means of direct connection or network interface.

B. FMS shall provide System Controller Unit operator with ability to:

1. Set current date and time.

2. Delete vehicle authorization from file.

3. Enter vehicle authorization and vehicle definition parameters in

file.

4. Enter employee authorization information in file.

5. Delete employee from file.

6. Place RIH units off and on line.

7. Set fluid quantity limits for exception reports.

8. Set engine oil type by vehicle for selective oil control.

9. Set request and schedule print option for each report.

10. Request Status of Fluid Storage tanks.

11. Request Record of Fluid Receipts.

12. Request Tank Alarm History.

13. Define Storage Tank Parameters.

14. Produce all reports defined in the FMS Reporting Requirements section of these specifications.

15. Define Maintenance Bay reel sets for Select Bay feature.

16. FMS shall provide the capability for all of the above data to be downloaded from a host CPU to the FMS Controller on demand from the host CPU.

C. FMS Controller Unit:

1. FMS Controller Unit shall be, at a minimum, an IBM PC Compatible running FLEETWATCH SYSTEM Controller software on a Microsoft Windows platform. Controller shall be capable of controlling, receiving, and recording data produced by all RIH units. FMS Controller shall operate independently of agency CPU.

2. FMS Controller unit shall include web-browser (HTML) based software for viewing vehicle, employee, facility and service data without compromising the integrity of the FMS database. Such software shall include varying levels of security to limit user access.

3. FMS Controller Unit shall accept fueling data, verify vehicle and employee authorization, and store data. FMS Controller and its

RIH units shall be capable of allowing simultaneous transactions of all products without possibility of any confusion of data.

4. FMS Controller memory shall be nondestructive in the event of power outage, and similar malfunctions.

5. FMS Controller shall be capable of being connected to, and automatically transmit data to a host computer system. Connection options shall be dial-up, direct connection, or network connection.

6. FMS Controller shall provide a serial connection for direct interface to a tank monitoring controller for inventory and fluid receipt data. FMS Controller software shall also include the capability for tank monitor interface through an Ethernet network connection. Provide software for this FMS Controller to provide complete fluid use and receipt reports and detailed tank status reports.

7. FMS Controller Unit shall have capability to store 500,000 separate fueling transactions and 15,000 vehicle authorization numbers.

8. FMS Controller Unit shall have capability to store 15,000 employee ID authorization numbers.

9. FMS Controller Unit shall have capability to store the mileage input at the last servicing, the calculated miles per gallon for each authorized vehicle, an upper and lower limit of acceptable miles per gallon for each vehicle, and shall be capable of performing the data verification checks and calculations described in the "SEQUENCE OF OPERATIONS" section of this specification.

2.04 FIXED RECEIVERS AND HAND-ACTIVATED RECEIVERS

A. Fixed Radio Frequency Receivers shall be located in each bus service point for capture of vehicle number and other data defined in this specification. Hand Activated Radio Frequency Receiver units shall be located in each support vehicle service point.

2.05 CONTROL VALVES AND PULSE GENERATORS

A. Contractor shall furnish control valves and pulse generators not included in other specification sections or contract drawings that are required by the FMS. Locate as required per each service point and in the maintenance shop area.

2.06 TRAFFIC LANE SENSORS

A. Contractor shall furnish traffic lane sensors, in each fuel island, connected

to RIH to automatically terminate transaction.

2.07 SOFTWARE AND PROGRAMS

A. Software and programs as necessary for functioning of RIH and FMS Controller Unit shall verify accurate data transmission using reasonableness checks, parity checks, and other checks required to ensure accurate data transmission. Data in FMS Controller Unit shall not be erased until accurate data transmission and storage verification is received from the host computer during a transmission session.

2.08 VEHICLE-MOUNTED EQUIPMENT

A. Vehicle-mounted equipment shall be supplied as required for automatic capture of vehicle number, mileage, engine hours and electronic engine data, where applicable.

2.09 FMS OPERATION

A. FMS shall provide mileage, engine hours, biodiesel fuel, engine oil, transmission fluid and coolant record management by automatically recording, storing, compiling, and printing formatted transaction data continuously on a 24-hour per day basis.

B. FMS shall be automatic except for operator functions specified herein. FMS shall operate unattended except for normal service operator inputs, operator file updates, periodic status monitoring, and printer paper and ribbon replacement. Operator transactions and printer messages shall be in conversational language. Input and output codes shall not be used, unless format and storage capacities absolutely dictate their use. All operator transactions and printer messages shall be defined in plain language and be bound in the FMS manual.

C. FMS shall verify all bus or vehicle identification inputs against bus and vehicle authorization file.

D. FMS shall verify all employee identification inputs against employee authorization file.

E. Sequence of Operations – Biodiesel Service Point. RIH display shall prompt fueling operator, in conversational language, for each data item to be entered by fueling operator.

1. FMS shall be activated by entry (or verification) of the fueling operator ID number after the bus or vehicle has stopped in the fuel lane.

2. After entry of a valid employee ID number, the RIH unit shall electronically activate the radio frequency receiver unit to

electronically read the vehicle number and other data as defined in the Special Equipment Section of these specifications. In the support vehicle service points, the fueling operator shall be prompted to use the Hand Activated receiver for vehicle number and data capture, if equipped.

3. At this point solenoid valves in the fuel, engine oil, coolant, and ATF lines shall be energized and opened by the RIH unit. Only the engine oil specified for the fueling vehicle should be energized.

4. As fuel, engine oil, ATF, or coolant are dispensed into bus or vehicle, quantities of products dispensed shall be sensed and recorded initially by the RIH unit. Electronic pulser/transducers shall sense fuel in tenths of a gallon, and other liquids in tenths of a quart.

5. Biodiesel fuel dispensed shall be displayed on the RIH display as follows:

FUEL B<XXX> YYYYY

where B is biodiesel, XXX is the calculated expected fuel required quantity, if available, and *** if not available. YYYYY is the actual quantity in tenths of fuel dispensed.

6. Successive pushing of the SEND button shall cycle the display to show quantities of each of the other fluids dispensed.

7. Products and quantities of each dispensed item shall be transmitted by the RIH unit to the FMS Controller Unit, which shall have capability to retain a minimum of 500,000 fueling transactions.

8. Upon completion of servicing, vehicle traffic sensor installed in each service point shall sense departure of bus or vehicle and cause RIH to terminate transaction.

9. Transaction shall be automatically terminated at end of any 5-minute interval following cessation of servicing operation.

F. Sequence of Operations – Biodiesel Service Point Back-up Mode of Operation. The sequence of operations for servicing vehicles for which there is a malfunction in the on-board electronic module, shall be as follows:

1. The sequence shall begin as described above with the entry of the employee ID and the use of the radio frequency receiver unit.

2. After a short time-out period, during which a vehicle number and mileage are not received by any receiver unit, the RIH unit will

automatically proceed with a prompt ENTER VEH NUMBER and require entry through the keypad of a valid vehicle number for the vehicle to be serviced.

3. For the next step the FMS shall provide the user the capability to ENTER MILEAGE or the FMS shall automatically calculate mileage based upon fuel dispensed to the vehicle if a mileage is not entered.

4. At this point solenoid valves in the biodiesel, engine oils, coolant, and ATF lines shall be energized and opened by the RIH unit and succeeding steps would be identical to those described in the preceding paragraph.

G. Sequence of Operations – Support Vehicle Fueling Service Point

1. The sequence of operations for the support vehicle fueling service point shall be the same as the Biodiesel service point with the exception that transaction termination shall be by time out or pushing RESET button only.

H. Sequence of Operations – Maintenance Shop Area

1. RIH display shall prompt operator, in conversational language, for each data item to be entered by mechanic operator.

   FMS shall be activated by selection of a maintenance bay. RIH shall prompt operator to select a maintenance bay:

   Prompts: SELECT BAY

   where the operator shall enter the corresponding bay number.

2. Next, FMS shall prompt the operator for entry of the mechanic operator ID:

   Prompts: ENTER EMP ID

   RE-ENTER EMP ID (if invalid)

3. The next prompt shall be for entry of the vehicle number for the vehicle to be serviced.

   Prompts: ENTER VEH NUM

   RE-ENTER VEH NUM (if invalid)

4. At this point solenoid valves in the engine oil, coolant, and ATF lines in the selected maintenance bay shall be energized and

opened by the RIH unit. Only the engine oil specified for the vehicle to be serviced should be energized.

5. As engine oil, ATF, or coolant are dispensed into the vehicle, quantities of products dispensed shall be sensed and recorded initially by the RIH unit. Electronic pulser/transducers shall sense all products dispensed in tenths of a quart.

6. Successive pushing of the SEND button shall cycle the display to show quantities of each of the fluids dispensed.

7. Products and quantities of each dispensed item shall be transmitted by the RIH unit to the FMS Controller Unit.

8. Transaction shall be automatically terminated at end of any 5-minute interval following cessation of servicing operation or by pushing the RESET button.

2.10 FEATURES AND CONSTRUCTION

A. FMS Reporting Requirements

The following reports shall be the minimum provided by the FMS Controller software:

1. Detailed Transaction Report - all data associated with a fueling transaction. Format shall be aligned for ease of reading, and shall include the transaction number for monitoring of real-time activities by management. Asterisks shall denote excess consumption of consumables. Reports shall consist of:

a. Date and time of transaction.

b. Transaction number.

c. Totals by servicing lane.

d. Vehicle number (authorized or not).

e. Employee ID.

f. Manual or electronic entry of vehicle number.

g. Fuel type (biodiesel).

h. Fuel quantity.

i. Engine oil quantity.

j. ATF quantity.

k. Coolant fluid quantity.

2. Daily Transaction Report - Printed upon request and consisting of the entire previous day's transactions by fleet, shift, service lane, facility, vehicle number and employee number.

3. Buses not fueled - Printed daily. This report consists of all in-service buses which have not been fueled at a given time and date.

4. Transaction Year-to-Date and Month-to-Date - by commodity, on request.

5. Commodity Exception Report - by day, week or month, by commodity.

6. Unauthorized Vehicle Service Report - Transactions of those vehicles serviced that are not in the vehicle authorization file. An authorized code number shall replace vehicle number. This report is to be printed each day.

7. Vehicle Authorization Status Report - A Master list, printed on request, of valid vehicle numbers consisting of:

a. Vehicle number.

b. Facility assigned.

c. Fuel type.

8. Fueling Operator Authorization Status Report - The complete fueling worker authorization file by name, identification number, and facility assigned. This report is to be printed on request.

9. Tank Inventory Report - Shows total gallons of fluid, inches of fluid, inches of water, and temperature in degrees for each tank in the FMS.

10. Fluid Use, Receipt, and Inventory Report.

B. Printer:

1. A laser printer shall be provided for the FMS Controller. All reports specified shall be printed by the FMS Controller on this printer.

C. Traffic Sensors:

1. Provide traffic sensor in each service point to sense departure of bus or vehicle. Traffic sensor shall consist of a buried loop magnetic-type traffic detector or a proximity detector.

2.11 BUS AND VEHICLE MOUNTED DATA RECORDER FMS:

A. FMS shall include a fixed radio frequency receiver unit positioned in each biodiesel bus service lane to allow electronic reading of bus number and other data defined in these specifications from vehicles equipped with bus-mounted data recorders. These receiver units shall send a beacon signal that would cause the bus-mounted data recorder to transmit the vehicle number and other data (specified below) for that bus. The receiver unit shall receive such transmitted data, perform data verification checks, and transfer this information directly to the RIH unit.

B. FMS shall include a hand activated radio frequency receiver unit positioned in each support vehicle service point to allow electronic reading of vehicle number and other data defined in these specifications from vehicles equipped with vehicle data recorders. These receiver units shall, upon activation by user, send a beacon signal that would cause the vehicle-mounted data recorder to transmit the vehicle number and other data (specified below) for that vehicle. The receiver unit shall receive such transmitted data, perform data verification checks, and transfer this information directly to the RIH unit.

C. Data Loggers (Bus-mounted): Included with the FMS shall be 300 bus-mounted data recorder units suitable for mounting on a transit bus and connecting directly to a data logger connector on the bus. Bus-mounted data recorders shall be programmable by the Administration with vehicle number and codes for defining the set of data to be recorded and reported. Programming software and hardware shall be provided to allow the Administration to program or re-program the bus-mounted data recorder units at any time. Bus-mounted data recorders provided shall include a minimum one-year warranty on all parts, including batteries. Bus-mounted data recorders shall be programmed to respond to a beacon signal sent from a Receiver Unit and upon receipt of such beacon signal shall transmit via radio frequency the bus number and other defined data to the Receiver Unit. Data logger shall be J1708/1939 or approved equal. Bus-mounted data recorders shall as a minimum provide the following capability:

1. Data always collected and reported:

   Vehicle Number

   Vehicle Total Mileage

   Vehicle Total Engine Hours

2. Fault Indicators captured and reported:

   Fault Codes reported shall include Subsystem ID and Failure Mode Identifier. Record the last 10 unique Active Fault Codes reported with the Date and Time of the beginning and ending of the last occurrence observed.

3. Last value observed:

   The Bus-mounted data recorder shall report the last value observed for 10 items. The user shall be able to define these 10 items using M.I.D. and P.I. D. codes as defined in SAEJ1587 documentation.

Examples:	M.I.D.	P.I.D.
Engine Idle Hours	128	235
Idle Fuel Used	128	346

4. Maximum and minimum value observed in 24 hours:

   The Bus-mounted data recorder shall report the maximum and minimum values observed during the previous 24 hour time period for 10 items defined using M.I.D. and P.I.D. codes. The date and time of the minimum and maximum occurrences shall also be reported. The user shall be able to define the codes for the items to be reported.

Examples;	M.I.D.	P.I.D.
Engine Coolant Temperature	128	110
Engine Oil Pressure	128	100
Engine Oil Temperature	128	175
Transmission Oil Temperature	130	177
Ambient Air Temperature	128	171

D. Speedometer Tap Data Loggers (Bus-mounted) for Buses with Non-electronic Engines:

1. FMS shall include Speedometer Tap Data Loggers for buses without an electronic engine. Each Speedometer Tap data logger shall be suitable for mounting on a transit bus and connecting directly to a speedometer connector on the bus. These bus-mounted data recorders shall be programmable by the Administration with vehicle number, number of pulses per mile, starting odometer,

starting engine hours, and starting idle hours of data to be recorded and reported. Programming software and hardware shall be provided to allow the Administration to program or re-program the bus-mounted data recorder units at any time. Bus-mounted data recorders shall be programmed to respond to an encoded beacon signal sent from a Receiver Unit and upon receipt of such beacon signal shall transmit via radio frequency the bus number and other defined data to the Receiver Unit. Speedometer Tap Bus-mounted data recorders shall as a minimum provide the following capability:

a. Data always collected and reported:

i. Vehicle Number

ii. Vehicle Total Mileage

iii. Vehicle Total Engine Hours

b. Electrical Interface:

i. Provide an interface to a sending unit from the vehicle ECM to count a square wave signal ranging from approximately 0V to > 5V to determine distance traveled.

ii. Provide a switched power input (active high signal > 5V) for use in determining when the engine is running in order to calculate idle hours and engine hours.

E. GPS-based Data Loggers (for all other vehicles):

1. FMS shall include as an option GPS-based Data Loggers for non-electronic buses not utilizing the Speedometer Tap Data Logger and any support vehicles. This device is a GPS-based odometer calculating distance traveled using GPS coordinates. The GPS-based Data Loggers shall be programmable by the Administration with vehicle number and initial starting mileage and electronically identify the vehicle each time the vehicle is fueled. GPS-based Data Loggers shall be programmed to respond to a beacon signal sent from a Receiver Unit and upon receipt of such beacon signal shall transmit via radio frequency the vehicle number, mileage and engine hours to the Receiver Unit.

a. Programming software and hardware shall be provided to allow the Administration to program or re-program the GPS-based Data Loggers units at any time.

PART 3: EXECUTION

3.01 PREPARATION:

A. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.02 EQUIPMENT TEST AND CHECKOUT

A. The equipment shall be tested in the presence of the Administration's Representative to his/her satisfaction and demonstrated to be correctly connected and installed. Submit a testing schedule to the Administration for approval prior to the start of the equipment test and check-out.

B. Testing and check-out procedures of the manufacturer shall be carried out completely.

C. Equipment tests shall not only be performed to demonstrate that the equipment has been properly installed and connected and operates properly, but also to demonstrate that the equipment performs the work for which it is intended.

D. Tested equipment found to be defective or inoperable to any extent shall be reported to the Administration immediately.

E. Any operating difficulty or defective item shall be repaired or replaced and put into proper operation by the Contractor immediately, at no additional expense to the Administration.

F. Contractor shall protect equipment and surrounding areas from damage resulting from testing operations, and shall clean-up any spills or leakage resulting from testing.

G. Contractor shall bear all expenses of all tests, including the furnishing of all necessary instruments, lubricants, hydraulic fluid, supplies, data recorders, and operation personnel. Provide and bear all expenses for fuel/power required to operate the equipment during the tests.

H. Perform testing of the equipment and FMS in accordance with the requirements specified in Contract Documents. Perform and document all testing procedures recommended by the manufacturer. Include the following tests:

1. Test FMS performance by measuring quantity of product dispensed over time at each designated "TEST" fluid and semi-solid control handle. Minimum measured output over time shall meet of exceed the "Minimum Delivery Rate" for the corresponding fluid as specified. Tests shall be performed three (3) times within a span of five (5) minutes at each control handle.

2. Test meter at each metering control handle by measuring volume of product dispensed. Measured volume of product dispensed shall correspond with volume of product indicated on meeting control handle within +/-0.65 percent of full dial range.

3. Test each hose reel for proper extension and retraction.

I. At the sole discretion of the Engineer, the Contractor may be required by repeat any tests, at no cost to the Administration.

J. Electronic transfer of correct vehicle number and other defined data from the bus- mounted data recorder module to the RIH unit.

1. Unlocking of fluid solenoid valves after input of valid vehicle and employee ID.

2. Correct measurement of quantity of biodiesel dispensed.

3. Relocking of fluid valves upon automatic detection of vehicle exit from service point.

4. Default time-out and relock of valves after five minutes of no flow with vehicle remaining in service point.

5. All of the above five (5) tests with the RIH unit in standalone mode.

6. Correct data transmission from RIH unit to FMS Controller with subsequent logging of the service transaction.

7. Correct data transmission from Tank Monitoring Controller to FMS Controller.

8. Storage of service transactions and subsequent transfer from FMS Controller to host computer or network server.

9. Printing of all specified reports from the FMS Controller.

3.03 INSPECTION AND TRAINING

A. The FMS installation shall be inspected and approved by the Engineer. The Engineer shall submit a comprehensive checklist of quality and safety items critical to the FMS and verify that the installation has been in accordance with these standards and applicable fire and environmental codes.

B. Contractor shall be responsible to repair any quality or safety items, as found by the Engineer, at no cost to the Administration.

C. Contractor shall provide training for computer, servicing, and maintenance personnel in use and maintenance of the FMS hardware and software supplied. Such training shall consist of one one-hour on-site training session for service personnel at the service points during actual servicing. Training shall also be provided at the location of the FMS Controller to provide computer personnel with an overview of the total FMS operation and detailed instructions on running of reports and file maintenance. Such training is to consist of a two-hour training session. A one-hour training session shall also be provided to train designated personnel in the maintenance and troubleshooting of FMS Equipment.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

A. Fluid Management System will not be measured for payment.

B. Fluid Management System will not be paid for directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15198

FLUID HANDLING SYSTEMS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

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

B. Provide integration with leak detection specified in Section 15192 “Facility Fuel Oil Piping”.

1.02 SUMMARY

A. This Section includes vehicle maintenance fluids handling systems, including pumps, hose reels, valves, and other accessories.

B. Related Sections include the following:

1. Section "Meters and Gages" for thermometers and pressure gages.

2. Section “Hangers and Supports” for pipe and equipment support materials and procedures for hanging the piping.

1.03 PERFORMANCE REQUIREMENTS

A. General: Provide all equipment and piping for various lube oils such as motor oil, transmission fluid, windshield washer fluid, differential oil, chassis grease, etc. meeting the materials and installation requirements of local codes and authorities having jurisdiction.

1.04 SUBMITTALS

A. Product Data: For the following:

1. Pumps and Pump Assemblies.

2. Hose reel assemblies.

3. Aboveground storage tanks (AST).

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Coordination Drawings: For lube oil and other fluid handling systems. Include relationship to other services that serve same work area.

D. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

E. Piping Material Certification: Signed by Installer certifying that piping materials comply with NFPA 99 requirements.

F. Qualification Data: For testing agency.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For lube pumps, hose reels and other specialties to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory and that is acceptable to authorities having jurisdiction.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70, "National Electrical Code."

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Contractor shall furnish products and manufacturer’s meeting “Buy America” requirements under 49 CFR part 661.

B. Basis-of-Design products are described herein-below. However, subject to compliance with all the requirements of the project, comparable products by other US based manufacturers shall be acceptable. All products such as pumps and pump controls, hoses, hose reels, valves, connectors and flow controls shall be compatible with each other and shall be products of single manufacturer.

2.02 PUMP ASSEMBLIES

A. Pumps for Engine Oil (LR-7), ATF (LR-8) and Gear oil (LR-9):

1. Graco pump # 205626 (quantity of 3 required)

   a. The 10:1 ratio positive displacement oil pump shall have a Fireball 425 Series pneumatically operated 4 ¼” diameter air motor, a 4” pumping stroke length and cycle on demand only. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The air motor shall feature a non-metallic poppet valve. The air motor and lower pump section shall be of the in-line design. The pump to be wall mounted and to include hose & fitting kit, FRL, air & fluid shutoff valves, and wall mount bracket.

2. Characteristics:

a.	Pump ratio:	10:1
b.	Continuous duty flow rate:	4.1 gpm
c.	Maximum fluid pressure:	1,800 psi
d.	Maximum air inlet pressure:	180 psi
e.	Fluid outlet size:	3/4” NPT
f.	Air inlet size:	1/2" NPT
g.	Air Consumption:	32 cfm per 4.1 gpm.

3. Components at each pump: The following components are to be installed at each pump:

a.	Thermal Relief Kit	Model # 240429
b.	Wall mount bracket	Model # 203987
c.	Hose and fitting kit	Model # 222066
d.	Low level cut-off	Model # 203688
e.	Bleed type air shut-off valve	Model # 110225
f.	Air filter/regulator/lubricator, ½” ports	Model # 217072

g.	Automatic drain valve for filter	Model # 106151
h.	¾” fluid shut-off valve	Model # 108537
i.	Pump runaway valve	Model # 224040
j.	½” air coupler	Model # 110199
k.	½” air coupler	Model # 110196

B. Pumps for Coolant (LR-11) and Windshield Washer Fluid (LR-13):

1. Graco System # 244680 (QTY. 2 required)

   a. The 1:1 ratio positive displacement pump shall have a pneumatically operated 1” body design, the diaphragm pump to be aluminum with stainless steel trim and interior components.

   b. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The pump shall be of a double diaphragm design and have a maximum suction lift of 12 feet. The pump shall be wall mounted, and have a single inlet for pumping a premix of water and antifreeze.

2. Characteristics:

a.	Pump ratio:	1:1
b.	Free flow rate:	40 gpm
c.	Maximum fluid pressure:	120 psi
d.	Maximum air inlet pressure:	120 psi
e.	Fluid outlet size:	1” NPT
f.	Air inlet size:	½” NPT

3. Components at each pump:

a.	Pressure relief kit	Model # 238428
b.	Air filter	Model # 106148
c.	Automatic drain for filter:	Model # 106151
d.	Air regulator	Model # 109075

e.	Air line lubricator	Model # 214847
f.	3/8” air shut-off valve	Model # 110224
g.	Wall mount bracket	Model # 189233
h.	Fluid connecting hose	Model # 115042
i.	Air connecting hose	Model # 205418
j.	3/8” air coupler	Model # 110198
k.	3/8” air connector	Model # 169971
l.	Fluid shut-off valve	Model # 108537
m.	Suction hose kit	Model # 236054

C. Chassis Grease Pump System (LR-10):

1. Graco # 226018 400 lb. Topper System (Quantity of 1 required)

   a. The 50:1 ratio positive displacement grease pump shall have a Fireball 425 Series pneumatically operated 4 1/4" diameter air motor, a 4" pumping stroke length and cycle on demand only. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The design of the air motor shall incorporate a valve in piston design which increases the pump's durability, longevity and gives uniform delivery on both the up and down strokes. The air motor cylinder material is to be hard coated aluminum and corrosive resistant steel. The air motor and lower pump section shall be of the in-line design. The pump to be of the “Topper” type with down tube for a 400 pound drum, an integral inductor plate, hose and fitting kit and a pump elevator.

2. Characteristics:

a.	Pump ratio:	50:1
b.	Continuous duty flow rate:	5 pounds per minute
c.	Maximum fluid pressure:	7,500 psi
d.	Maximum air inlet pressure:	180 psi
e.	Fluid outlet size:	3/8” NPT

f. Air inlet size: ½” NPT

g. Air consumption: 13 CFM

3. Components at each pump:

a. ½” Filter/Reg./Lubricator Model # 217072

b. Automatic drain for air filter Model # 106151

c. ½” Air shut-off Valve Model # 110225

d. ½” Fluid shut-off, HP Model # 202869

e. Air Motor Muffler Model # 102656

f. Pump runaway valve Model # 224040

g. ½” air coupler Model # 110199

h. ½” air connector Model # 110196

D. Used Oil (MB-12) and Used Coolant Evacuation System (MB-13):

1. Graco # 24E166 (Quantity of 2 required)

a. The 1:1 ratio positive displacement oil pump shall have a pneumatically operated Husky 1” body design, the diaphragm pump to be aluminum with stainless steel trim and interior components. The air motor is to have an external muffler that operates below OSHA noise standards, and be equipped with a grounding lug. The pump shall be of double diaphragm design and have a maximum suction lift of 25 feet wet and 16 feet dry. The evacuation pump system shall include wall mount bracket, air installation kit, fluid installation kit, and drum style adapter kit.

2. Characteristics:

a. Pump ratio: 50:1

b. Continuous duty flow rate: 40 GPM

c. Maximum fluid pressure: 100 psi

d. Maximum air inlet pressure: 100 psi

e. Fluid outlet size: 1” NPT

f. Air inlet size: ½” NPT

g. Air consumption: 13 CFM

3. Components at each pump:

a. BJ Enterprises High Level Shutoff Valve Model # 7575

b. BJ Enterprises Air Solenoid Valve w/timer Model # 7570

E. Used Oil Receivers (MB-28):

1. GRACO # 238866 (Quantity to be specified)

2. Description: The receiver is to be constructed of a Black UV-stabilized polyethylene tank. The unit to have semi-pneumatic wheels, 3” inspection port, topside evacuation with cam-lock fitting and bottom drain, visual level tube, collection area for filters, tool holders, 22” x 24” drain bowl and 25 gallon capacity

F. Used Coolant Receivers (MB-29):

1. GRACO # 248632 (Qty. to be specified)

2. The receiver is to be constructed of a Green UV-stabilized polyethylene tank. The unit to have semi-pneumatic wheels, 3” inspection port, topside evacuation with cam-lock fitting and bottom drain, visual level tube, collection area for filters, tool holders, 22” x 24” drain bowl and 25 gallon capacity.

2.03 HOSE REEL ASSEMBLIES

A. Reels for Engine Oil (MB-8D, DB-1D), ATF (MB-8C, DB-1C) and Gear oil (MB-8B, DB-1B):

1. GRACO # HSM65B (Quantity as required)

2. The XD series heavy duty hose reel shall have a minimum capacity of 50 feet of 1/2” ID hose. The hose reel shall have a heavy-duty double pedestal frame with welded joints and formed ribs for strength and durability. The reel shall incorporate a fully ported axle with little restriction for fast flow. The reel shall spin on dual, sealed roller bearings for smooth extension and retraction. Dual arms will support hose guide on both sides. Reel shall have “slide-in” mounting ability and an anti-sparking ratchet assembly that will not lock out reel when hose is fully extended. The sealed rewind spring shall have an external tensioning mechanism to allow adjustment without wrapping hose around reel. The reel

shall be complete with an appropriate SD series electronic meter. Meter must be rated at 1500 psi operating pressure and be approved for indoor/outdoor use. Meter shall be powered using AA batteries.

a.	Hose length-oil:	50’ x 1/2” ID
b.	Reel outlet:	1/2" npsm
c.	Reel inlet:	1/2” npsm
d.	Pressure rating oil:	2,000 psi for assembly
e.	SDWeight:	59 lbs, approx.

3. The following accessories are to be installed at each reel:

   a. Hose Inlet Kit

   b. 1/2” Fluid Shut-Off Valve

   c. SDP5 digital preset metered dispense valve

B. Chassis Grease Reel Assembly (MB-8A, DB-1A):

1. Graco # HSH55B (Quantity as required).

2. The XD series heavy duty hose reel shall have a minimum capacity of 50 feet of 3/8” ID hose. The hose reel shall have a heavy-duty double pedestal frame with welded joints and formed ribs for strength and durability. The reel shall incorporate a fully ported axle with little restriction for fast flow. The reel shall spin on dual, sealed roller bearings for smooth extension and retraction. Dual arms will support hose guide on both sides. Reel shall have “slide-in” mounting ability and an anti-sparking ratchet assembly that will not lock out reel when hose is fully extended. The sealed rewind spring shall have an external tensioning mechanism to allow adjustment without wrapping hose around reel. The reel shall be complete with a grease dispense valve.

a.	Hose length-grease:	50’ x 3/8” ID
b.	Reel outlet:	3/8" npt
c.	Reel inlet:	3/8” npt
d.	Pressure rating grease:	4,000 for reel assembly
e.	Weight:	59 lbs, approx.

3. The following accessories are to be installed at each reel:

   a. Hose Inlet Kit

   b. HP Shut-Off Valve

   c. ProShot Grease dispense valve

   d. 3/8” three-way swivel

C. Coolant (MB-8E, DB-1E) and Washer Fluid Reels (MB-9F, DB-1F):

1. Graco # HSL65B (Quantity as required).

2. The XD series heavy duty hose reel shall have a minimum capacity of 50 feet of 1/2” ID hose. The hose reel shall have a heavy-duty double pedestal frame with welded joints and formed ribs for strength and durability. The reel shall incorporate a fully ported axle with little restriction for fast flow. The reel shall spin on dual, sealed roller bearings for smooth extension and retraction. Dual arms will support hose guide on both sides. Reel shall have “slide-in” mounting ability and an anti-sparking ratchet assembly that will not lock out reel when hose is fully extended. The sealed rewind spring shall have an external tensioning mechanism to allow adjustment without wrapping hose around reel. The reel shall be complete with an appropriate SD series electronic meter for antifreeze and a non-metered dispense valve for water. Meter must be rated at 1500 psi operating pressure and be approved for indoor/outdoor use. Meter shall be powered using AA batteries.

   a. Hose length-grease: 50’ x 3/8” ID

   b. Reel outlet: 1/2" npsm

   c. Reel inlet: 1/2” npsm

   d. Pressure rating oil: 300 psi for reel assembly

   e. SDWeight: 59 lbs, approx.

3. The following accessories are to be installed at each coolant reel:

   a. Hose Inlet Kit

   b. ½” Fluid Shut-Off Valve

   c. SDM5 Electronic Meter

4. The following accessories are to be installed at each WWF reel:

a. Hose Inlet Kit

b. ½” Fluid Shut-Off Valve

c. Water Dispense Valve

D. Compressed Air Reels (MB-8G, MB-9G):

1. Graco # HSL65B (Quantity as required).

2. The XD series heavy duty hose reel shall have a minimum capacity of 50 feet of 1/2” ID hose. The hose reel shall have a heavy-duty double pedestal frame with welded joints and formed ribs for strength and durability. The reel shall incorporate a fully ported axle with little restriction for fast flow. The reel shall spin on dual, sealed roller bearings for smooth extension and retraction. Dual arms will support hose guide on both sides. Reel shall have “slide-in” mounting ability and an anti-sparking ratchet assembly that will not lock out reel when hose is fully extended. The sealed rewind spring shall have an external tensioning mechanism to allow adjustment without wrapping hose around reel. The reel shall be complete with an air coupler.

a.	Hose length-grease:	50’ x 3/8” ID
b.	Reel outlet:	1/2" npsm
c.	Reel inlet:	1/2” npsm
d.	Pressure rating oil:	300 psi for reel assembly
e.	SDWeight:	59 lbs, approx.

3. The following accessories are to be installed at each coolant reel:

a. Hose Inlet Kit

b. ½” Fluid Shut-Off Valve

c. Air Coupler

E. Electric Power Supply Reels (MB-8H, MB-9H):

1. General Manufacturing # 4040-4201 (Quantity as required).

2. The series 4000 power supply reel shall hold 40’ of SJTO rated 12 gauge/3 wire cord with a duplex outlet with GFCI. The reel shall be rated at 20 amps max and will be manufactured with an industrial grade collector ring and brass transfer rings. The reel

will also have replaceable carbon brushes. A 5.5' power inlet cord with grounded plug will be provided with each reel.

F. Reel Mounting Hardware

1. One (1) reel mounting channel Model # 24A219
2. Two (2) reel mounting channel Model # 24A220
3. Three (3) reel mounting channel Model # 24A221
4. Six (6) reel mounting channel Model # 24A222
5. I beam mounting clamp Model # 204741

2.04 METERS

A. The following Matrix meters would be required (if standard digital metered valves are not installed.)

1. Graco # 256282 Matrix meter for motor oil
2. Graco # 256482 Matrix meter for ATF
3. Graco # 256483 Matrix meter for gear oil
4. Graco # 256485 Matrix meter for antifreeze

2.05 ABOVEGROUND STORAGE TANKS (AST)

A. Manufacturers: Basis-of-Design Product: Containment Solutions, Inc., "Lube-Cube" series.

B. General Tank Description (LR-2, LR-3, LR-4, LR-5):

1. Aboveground Storage Tanks, for Flammable and Combustible Liquids shall be designed, constructed, and listed in accordance with Underwriters Laboratories, Inc. Standard UL 142. UL 142 is the standard for Steel Aboveground Tanks for Flammable and Combustible Liquids. The listing shall meet requirements for atmospheric tanks of The National Fire Protection Association Sections 30, 30A, 31 and The Uniform Fire Code Article 79.
2. All tanks shall be designed and UL listed as atmospheric tanks with a maximum working pressure of 1 PSI.
3. The primary tank and the secondary containment tank shall have passed a proof of design hydrostatic pressure test of 25 PSI.

4. Each single wall tank shall be equipped with five (5) NPT openings, in addition to one for an emergency vent. All secondary containment Lube Cubes shall incorporate the single wall openings plus an additional two (2) NPT openings, for monitoring the interstitial space and an emergency vent. The emergency vents shall be sized per NFPA & UL 142 requirements. All openings will be from the top unless otherwise requested.

5. The tanks shall be equipped with a minimum two (2) lifting lugs.

6. The tank Manufacturer shall provide proof (upon request) of a minimum 10 years of manufacturing UL 142 listed rectangular tanks.

7. All tanks shall include a 1 year limited warranty.

8. Each tank shall be provided with threaded PVC plugs in fittings (water tight).

9. Each tank shall be provided with a minimum of two (2) support feet.

C. Primary Storage Tank (Single Wall Tank, or inside tank of Double Wall Tank)

1. The standard primary storage tank shall be rectangular in design. The tank will be constructed of UL 142 specified steel thickness, with continuous welds.

2. The primary storage tank shall be constructed of ASTM A-569 or A-36 carbon steel, as required for compatibility of product being stored.

3. The primary tank shall be pressure tested in the factory to UL 142 specifications (3 PSI).

4. The tank shall be fitted with: a 2" fill port, a 2" normal vent, either a 4", 6", 8" or 10" emergency vent port, a 2" liquid gauging port, two (2) 2" spare ports, and an 18" manway (for tanks with capacities of 5,000 gallons and larger)

D. Secondary Containment Tank (Double Wall Tanks)

1. The secondary containment tank shall be rectangular in design and constructed of UL 142 specified steel thickness, with continuous welds.

2. The secondary containment tank shall be listed by Underwriters Laboratories as secondary containment under UL 142 standard.

3. The secondary containment tank shall provide a minimum of 110% secondary containment.

4. The secondary containment tank shall be equipped with a 2 inch monitoring port and a 4", 6", 8", or 10" emergency vent port as required by Underwriters Laboratories, Inc.

5. The secondary containment tank shall be pressure tested in the factory to UL 142 specification (3 PSI).

E. Coatings:

1. The exterior surface of the secondary tank shall be cleansed of foreign material and coated with a corrosion resistant industrial paint (3 to 5 mils dry film thickness).

2. The standard color shall be desert sand.

3. An optional coating (FIBERVAULT) can be applied to the exterior surface of the secondary tank to provide resistance to corrosive environments such as salt water spray.

a. The total dry thickness shall be a minimum of 1/8 inch.

b. All threaded openings and flanges shall be protected during the coating process.

c. The coating shall be applied only when the work area and the secondary steel tank are between the temperatures of 32 and 103 degrees F.

d. The standard color shall be desert sand.

e. The coating shall provide a 10 year warranty.

PART 3: EXECUTION

3.01 PIPING INSTALLATION

A. Refer to Division 15 for basic piping installation.

3.02 HANGER AND SUPPORT INSTALLATION

A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:

   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.

   b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

   c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

C. Install supports for vertical copper tubing every 10 feet (3 m).

3.03 INSTALLATION OF REELS AND EQUIPMENT

A. Install all reels, valves, and other accessories par manufacturer’s printed instructions.

3.04 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for all the fluids, oils,, compressed air etc. according to NFPA 99. Refer to Division 15 Section " Identification" for labeling and identification materials.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

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

1. Inspect, test, and certify completed piping systems according to requirements in NFPA 99. Inspect, test, and certify each piping system, including specialties, safety devices, and source equipment.

2. Provide oil-free dry nitrogen, materials, and equipment required

for testing.

3. Include the following:

a. Piping Integrity Tests:

i. Blow Down: Clear piping before connecting service connections or outlets.

ii. Initial Pressure Tests: Subject each piping section to test pressure of 1.5 times system working pressure, before attaching system components, after installing station outlets with test caps (if supplied) in place. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.

iii. Purge Tests: Perform heavy intermittent purging of piping and full-flow purging of service connections.

b. Verification and Final Testing: Activate systems with compressed air at normal operating pressure.

i. Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test. Verify that pressure differences comply with required calibration. Repair leaks with new materials and retest systems.

ii. Pressure Relief Valve Tests: Verify proper valve operation.

iii. Secondary Equipment Tests: Verify operation of equipment if available.

iv. Labeling: Verify correct labeling.

C. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

1. Inspections performed.

2. Procedures, materials, and gases used.

3. Test methods used.

4. Results of tests.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain laboratory air and vacuum alarm system. Refer to Division 1 Section "Closeout”

PART 4: MEASUREMENT AND PAYMENT

4.01 HOSE REELS

A. Hose Reels will not be measured for payment.

B. Hose Reels will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

4.02 PUMPS, VALVES, FITTINGS AND OTHER ACCESSORIES

A. Pumps, fittings, valves and other accessories will not be measured for payment.

B. Pumps, fittings, valves and other accessories will not be paid directly, but will be included in the lump sum bid prices of the maintenance building.

END OF SECTION

SECTION 15210

PROCESS AIR AND GAS PIPING

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig (1380 kPa) and less.

B. Related Sections include the following:

1. Division 15 Section "Meters and Gages" for thermometers and pressure gages.

2. Division 15 Section "General-Service Compressed-Air Equipment" for compressed-air equipment and accessories.

1.03 DEFINITIONS:

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

D. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 125 and 200 psig (860 and 1380 kPa).

E. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 125 psig (860 kPa) and less.

F. NBR: Acrylonitrile-butadiene rubber.

G. PE: Polyethylene plastic.

1.04 SUBMITTALS:

A. Product Data: For the following:

1. Pipes, tubes, and fittings.

2. Flexible pipe connectors.

3. Plastic valves.

4. Safety valves.

5. Pressure regulators.

6. Filters.

7. Automatic drain valves.

8. Quick couplings.

9. Hose assemblies.

B. Coordination Drawings: For general-service compressed-air systems. Include relationship to other services that serve same work area.

C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

D. Welding Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX.

E. Field quality-control test reports.

1.05 QUALITY ASSURANCE:

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

C. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.

D. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPING MATERIALS:

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.03 PIPES, TUBES, AND FITTINGS:

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, black or hot dip, zinc coated. Provide Type S, Grade B, and hot-dip zinc-coated pipe options if indicated.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded. Provide Class 300 and galvanized finish if indicated.

3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded. Provide Class 300 if indicated.

4. Wrought-Steel Fittings: ASME B16.9, Schedule 40, butt welding.

5. Forged-Steel Fittings: ASME B16.11, socket type.

6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel. Provide Class 300 if indicated.

7. Steel-Piping Grooved-End Fittings: ASTM A 47/A 47M, malleable-iron casting; ASTM A 106, steel pipe; or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe; and made by keyed-coupling manufacturer. Provide galvanized finish if indicated.

a. Steel-Piping Keyed Couplings: AWWA C606 or UL 213, for steel-pipe dimensions and rated for 300-psig (2070-kPa) minimum working pressure. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide FPM or NBR gasket if indicated. Do not

provide EPDM gasket if compressed air contains oil or oil vapor.

i. Available Manufacturers:

1) Central Sprinkler Co.; Central Grooved Piping Products.

2) Grinnell Corp.

3) Star Pipe Products, Inc.; Star Fittings Div.

4) Victaulic Corp. of America.

5) Ward Manufacturing, Inc.

8. Steel-Piping Expansion Joints: Compound, galvanized-steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.

B. Light-Wall Steel Pipe: ASTM A 135, Schedule 5, carbon steel with plain ends and zinc-plated finish.

1. Steel Pressure-Seal Fittings: UL-listed and FMG-approved, carbon-steel housing with O-ring end seals suitable for compressed-air piping and rated for 300-psig (2070-kPa) minimum working pressure. Provide FPM or NBR O-ring seals if indicated. Do not provide EPDM gasket if compressed air contains oil or oil vapor.

a. Manufacturer: Victaulic Corp. of America.

C. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 5, stainless steel with plain ends.

1. Stainless-Steel Pressure-Seal Fittings: Stainless-steel housing with O-ring end seals suitable for compressed-air piping and rated for 300-psig (2070-kPa) minimum working pressure. Provide FPM or NBR O-ring seals if indicated. Do not provide EPDM gasket if compressed air contains oil or oil vapor.

a. Manufacturer: Victaulic Corp. of America.

D. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B), seamless, drawn-temper, water tube. Provide Type K (Type A) if indicated.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.

2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300. Provide Class 300 if indicated.

3. Copper Unions: ASME B16.22 or MSS SP-123.

4. Copper Grooved-End Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 584, bronze castings and made by keyed-coupling manufacturer.

   a. Copper-Tubing Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, NBR gasket suitable for compressed air, and bolts and nuts. Provide FPM gasket if indicated.

      i. Available Manufacturers:

         1) Grinnell Corp.

         2) Victaulic Corp. of America.

E. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

F. Blue ABS Piping System: Made of ASTM D 3965, ABS-resin modified to provide shatter-resistant pipe for compressed-air service. Pipe and fittings are light blue and sizes are in millimeters.

1. Transition Fittings:

   a. 20 to 63 mm: Composite union with ABS socket end, CR O-ring, and malleable-iron union nut and threaded end; with construction similar to MSS SP-107, transition union.

   b. 90 to 110 mm: Flange assembly with ABS flange, CR gasket, and metal flange of material matching piping to be connected.

2. Valves:

   a. 20 to 63 mm: ABS union ball valve with socket ends.

   b. 90 to 110 mm: ABS butterfly valve with lever handle.

3. Manufacturer: Enfield Industrial Corp.; Duraplus Div.

G. Flexible Pipe Connectors: Corrugated tubing with wire-braid covering.

1. Available Manufacturers:

a. Flex-Hose Co., Inc.

b. Flexicraft Industries.

c. Hyspan Precision Products, Inc.

d. Mercer Rubber Co.

e. Metraflex, Inc.

f. Proco Products, Inc.

g. Unaflex, Inc.

2. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

a. Working-Pressure Rating: 250 psig (1725 kPa) minimum.

b. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.

c. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

3. Stainless-Steel-Hose/Steel Pipe Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

a. Working-Pressure Rating: 250 psig (1725 kPa) minimum.

b. End Connections NPS 2 (DN 50) and Smaller: Threaded steel pipe nipple.

c. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

4. Stainless-Steel-Hose/Stainless-Steel Pipe Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

a. Working-Pressure Rating: 250 psig (1725 kPa) minimum.

b. End Connections NPS 2 (DN 50) and Smaller: Threaded stainless-steel pipe nipple.

c. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged stainless-steel nipple.

2.04 JOINING MATERIALS:

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for joining materials not in this Section.

2.05 VALVES:

A. General-Duty Valves: Refer to Division 15 Section "Valves" for metal ball, butterfly, check, gate, and globe general-duty valves.

B. Plastic General-Duty Valves: Refer to plastic piping paragraphs in "Pipes, Tubes, and Fittings" Article for plastic ball and butterfly valves.

2.06 SPECIALTIES:

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Line Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig (1380-kPa) minimum inlet pressure, unless otherwise indicated.

1. Type: Diaphragm or pilot operated.

C. Air-Line Lubricators: Sizes and capacities indicated; equip with drip chamber and sight dome for observing oil drop entering airstream; with oil-feed adjustment screw and quick-release collar for easy bowl removal.

1. Provide with automatic feed device for supplying oil to lubricator.

D. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters in sizes and ratings indicated. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock.

E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded.

F. Automatic Drain Valves: Corrosion-resistant metal body and internal

parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate.

G. Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

1. Available Manufacturers:

a. Aeroquip Corporation.

b. Bowes Manufacturing, Inc.

c. Foster Manufacturing Co., Inc.

d. Milton Industries, Inc.

e. Parker Hannifin Corporation; Fluid Connectors Group; Quick Coupling Div.

f. Rectus Corp.

g. Schrader-Bridgeport; Amflo Div.

h. Schrader-Bridgeport/Standard Thomson.

i. Snap-Tite, Inc.

j. TOMCO Products Inc.

k. Tuthill Corporation; Hansen Coupling Div.

2. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

a. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

b. Plug End: Flow-sensor-bleeder, check-valve type with serrated outlet for attaching hose.

3. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

a. Socket End: With O-ring or gasket seal, without valve, and with serrated inlet for attaching hose.

b. Plug End: With serrated outlet for attaching hose.

H. Hose Assemblies: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig (2070-kPa) minimum working pressure, unless otherwise indicated.

1. Hose: Reinforced single- or double-wire-braid, CR-covered hose for compressed-air service.

2. Hose Clamps: Stainless-steel clamps or bands.

3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with serrated ends for connecting two sections of hose.

4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with serrated ends for connecting two sections of hose.

2.07 IDENTIFICATION:

A. Refer to Division 15 Section "Mechanical Identification" for identification of piping, valves, gages, and specialties.

PART 3: EXECUTION

3.01 PIPING APPLICATIONS:

A. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below, unless otherwise indicated.

B. Joining of Dissimilar Metal Piping: Use dielectric fittings. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for dielectric fitting types.

1. NPS 2 (DN 50) and Smaller: Dielectric unions.

2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Dielectric flanges.

3. NPS 5 (DN 125) and Larger: Dielectric flange kits.

C. Specialty and Equipment Flanged Connections: Use cast-copper-alloy companion flange with gasket and brazed joint for connection to copper tube.

D. Use metal general-service compressed-air piping between air compressors and air receivers. Use of plastic piping for this application is prohibited.

E. Low-Pressure Compressed-Air Piping between Air Compressors and Receivers: Use any of the following piping materials for each size range:

1. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

2. NPS 2 (DN 50) and Smaller: Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

3. NPS 2 (DN 50) and Smaller: Copper tube, wrought-copper fittings, and brazed joints.

4. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

5. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

6. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper tube, wrought-copper fittings, and brazed joints.

7. NPS 5 to NPS 8 (DN 125 to DN 200): Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

8. NPS 5 to NPS 8 (DN 125 to DN 200): Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

F. Low-Pressure Compressed-Air Distribution Piping: Use any of the following piping materials for each size range:

1. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

2. NPS 2 (DN 50) and Smaller: Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

3. NPS 2 (DN 50) and Smaller: Copper tube, wrought-copper fittings, and brazed joints.

4. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

5. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

6. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper tube, wrought-copper fittings, and brazed joints.

7. NPS 5 to NPS 8 (DN 125 to DN 200): Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

8. NPS 5 to NPS 8 (DN 125 to DN 200): Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

G. High-Pressure Compressed-Air Piping: Use any of the following piping materials for each size range:

1. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

2. NPS 2 (DN 50) and Smaller: Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

3. NPS 2 (DN 50) and Smaller: Schedule 40, black-steel pipe; wrought- or forged-steel fittings; and welded joints.

4. NPS 2 (DN 50) and Smaller: Copper tube, wrought-copper fittings, and brazed joints.

5. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

6. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

7. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Schedule 40, black-steel pipe; wrought- or forged-steel fittings; and welded joints.

8. NPS 5 to NPS 8 (DN 125 to DN 200): Schedule 40, black-steel pipe; threaded malleable-iron fittings; and threaded joints.

9. NPS 5 to NPS 8 (DN 125 to DN 200): Schedule 40, galvanized-steel pipe; galvanized, threaded malleable-iron fittings; and threaded joints.

3.02 VALVE APPLICATIONS:

A. General-Duty Valves: Refer to Division 15 Section "Valves" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 15 Section "Valves" according to the following:

a. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.

b. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.

c. Equipment Isolation NPS 2 (DN 50) and Smaller: Safety-exhaust copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

3.03 PIPING INSTALLATION:

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Install air and drain piping with 1 percent slope downward in direction of airflow.

C. Install eccentric reducers where piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

D. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

E. Install flexible pipe connector on each connection to air compressors.

F. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver; install according to Division 15 Section "Meters and Gages."

3.04 VALVE INSTALLATION:

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping and valve installation.

B. Install metal general-duty valves according to Division 15 Section "Valves."

C. Install shutoff valve at each connection to and from general-service compressed-air specialties, equipment, and accessories. Install strainer if indicated.

D. Install check valves to maintain correct direction of fluid flow to and from compressed-air piping specialties and equipment.

E. Install safety valves on receivers in quantity and size to relieve at least the

capacity of connected air compressors.

F. Install automatic drain valves on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

G. Install safety valves where recommended by specialty manufacturers.

3.05 JOINT CONSTRUCTION:

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Pressure-Seal Joints: Select correct type of O-ring seals. Make joints with fitting manufacturer's tools and according to fitting manufacturer's written instructions.

C. Join copper tubing with brazed joints. Use silver-composition or copper-phosphorus-composition filler metal and comply with CDA's "Copper Tube Handbook," Section VII, "Brazed Joints."

D. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.06 HANGER AND SUPPORT INSTALLATION:

A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:

a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.

b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 to NPS 1/2 (DN 8 to DN 15): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

2. NPS 3/4 to NPS 1-1/4 (DN 20 to DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

3. NPS 1-1/2 (DN 40): 12 feet (3.7 m) with 3/8-inch (10-mm) rod.

4. NPS 2 (DN 50): 13 feet (4 m) with 3/8-inch (10-mm) rod.

5. NPS 2-1/2 (DN 65): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.

6. NPS 3 (DN 80): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.

7. NPS 3-1/2 (DN 90): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.

8. NPS 4 (DN 100): 17 feet (5.2 m) with 5/8-inch (16-mm) rod.

9. NPS 5 (DN 125): 19 feet (5.8 m) with 5/8-inch (16-mm) rod.

10. NPS 6 (DN 150): 21 feet (6.4 m) with 3/4-inch (19-mm) rod.

G. Install supports for vertical, Schedule 40, steel piping every 15 feet (4.6 m).

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.

7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.

8. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.

9. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.

10. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.

11. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.

12. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.

I. Install supports for vertical copper tubing every 10 feet (3 m).

3.07 CONNECTIONS:

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to specialties and equipment to allow service and maintenance.

C. Connect piping to air compressors, accessories, and specialties with shutoff valve and union or flanged connection.

3.08 LABELING AND IDENTIFICATION:

A. Install identifying labels and devices for general-service compressed-air piping systems. Refer to Division 15 Section "Mechanical Identification" for labeling and identification materials.

3.09 FIELD QUALITY CONTROL:

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

1. Test and adjust piping safety controls. Replace damaged and malfunctioning safety controls.

2. Piping Leak Tests: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

a. Repair leaks and retest until no leaks exist.

3. Report results in writing.

PART 4: MEASUREMENT AND PAYMENT

4.01 PROCESS AIR AND GAS PIPING

A. Process Air and Gas Piping will not be measured for payment.

B. Process Air and Gas Piping will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15251

GENERAL SERVICE COMPRESSED-AIR EQUIPMENT

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following general-service compressed-air equipment and related accessories:

1. Air compressors and receivers
2. Inlet-Air filters
3. Compressed-air dryers
4. Compressed-air filter assemblies

B. Related Sections include the following:

1. Division 15 Section "Process Air and Gas Piping" for compressed-air piping, valves, and related specialties.

1.03 DEFINITIONS:

A. Actual Air: Air delivered from air compressors. Flow rate is delivered compressed air measured in ACFM (actual L/s).

B. Standard Air: Free air at 68 deg F (20 deg C) and 1 atmosphere (29.92 in. Hg) before compression or expansion and measured in SCFM (standard L/s).

1.04 SUBMITTALS:

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each equipment.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

4. Wiring Diagrams: Power, signal, and control wiring.

C. Product Certificates: Certificates of shop inspection and data report for receiver tanks as required by ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Manufacturer Seismic Qualification Certification: Submit certification that compressed-air equipment and accessories will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls." Include the following:

1. Basis for Certification: Indicate whether “withstand” certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment: Identify center of gravity, and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For Installer.

F. Startup service reports.

G. Operation and Maintenance Data: For the following compressed-air equipment and accessories to include in emergency, operation, and maintenance manuals:

1. Air compressors.

2. Compressed-air dryers.

1.05 QUALITY ASSURANCE:

A. Installer Qualifications: An authorized representative of compressed-air equipment manufacturer for both installation and maintenance of units required for this Project.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of compressed-air equipment and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label receiver tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NFPA 70, "National Electrical Code."

1.06 COORDINATION:

A. Coordinate size and location of concrete bases. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for concrete bases. Refer to Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete requirements.

1.07 EXTRA MATERIALS:

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Air-Compressor Inlet-Filter Element Units: Equal to 10 percent of amount installed, but no fewer than 2 units.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

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

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

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PACKAGED AIR COMPRESSORS AND RECEIVERS:

A. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

B. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Mounting and Wiring: Factory installed and connected as an integral part of equipment package.

2. Enclosure: NEMA ICS 6, Type 12 control panel, unless otherwise indicated.

3. Motor Controllers: First compressor CR-1: Full-voltage, combination-magnetic type with under-voltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device. Second Compressor CR-2: Variable Speed controller.

a. Control Voltage: 120-V ac or less, using integral control power transformer.

b. Motor Overload Protection: Overload relay in each phase.

c. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.

i. Automatic control switches to alternate lead-lag compressors for duplex air compressors.

4. Instrumentation: Include receiver pressure gage, discharge-air pressure gage, air-filter maintenance indicator, hour meter, compressor discharge-air and coolant temperature gages, and control transformer.

5. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.

C. Motors: Comply with requirements in Division 15 Section "Motors."

D. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1; rated for working pressure at least

as high as highest discharge pressure of connected compressors; and bearing appropriate code symbols. Include safety valve, pressure gage, automatic drain, and pressure-reducing valve.

E. Fabricate base and attachment to pressure vessel with reinforcement strong enough to resist packaged equipment movement during a seismic event when base is anchored to building structure.

2.03 SCREW AIR COMPRESSORS

A. Oil-Free, Screw Air Compressors, Basis of Design Ingersoll-Rand Nirvana for variable speed and Pegasus for constant speed. Other acceptable manufacturers are listed below.

1. Manufacturers:

   a. A-C Compressor Corp.

   b. Atlas Copco Compressors, Inc.

   c. CompAir, Ltd.

   d. Gardner Denver, Inc.

2. Compressor(s): Oil-free, rotary helical-screw type with nonlubricated helical screws and lubricated gear box, and of construction that prohibits oil from entering compression chamber.

   a. Mounting: Freestanding.

   b. Coupling: Nonlubricated, flexible type.

   c. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package prepiped to unit; with air pressure circulation system with coolant stop valve, full-flow coolant filter, and thermal bypass valve.

3. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.

4. Air/Coolant Receiver and Separation System: 175-psig- (1200-kPa-) rated steel tank with ASME safety valve, coolant-level gage, multistage air-coolant separator element, minimum pressure valve, blowdown valve, discharge check valve, coolant stop valve, full-flow coolant filter, and thermal bypass valve.

5. Capacity Control: Capacity modulation between 0 and 100 percent air delivery, with operating pressures between 50 and 100 psig

(345 and 690 kPa). Include necessary control to hold constant pressure. When air demand is zero, unload compressor by using pressure switch and blowdown valve.

6. Receiver: ASME construction steel tank.

a. Orientation: Vertical arrangement.

b. Pressure Rating: 175 psig (1035 kPa) minimum.

B. Miscellaneous Devices: Safety valves, discharge-air pressure gages, pressure regulators, and shutoff valves

2.04 INLET-AIR FILTERS:

A. Description: Combination inlet filter-silencer, suitable for remote installation, for each air compressor.

1. Construction: Weatherproof housing for replaceable, dry-type filter element, with silencer tubes or other method of sound reduction.

2. Capacity: Match capacity of air compressor, with collection efficiency of 99 percent retention of particles larger than 10 microns.

2.05 COMPRESSED-AIR DRYERS:

A. Refrigerant-Type Dryers: Noncycling, air-cooled, electric-motor-driven unit with steel enclosure and capability to deliver 35 deg F (2 deg C), 100-psig (690-kPa) air at dew point. Include automatic ejection of condensate from airstream, step-down transformers, disconnect switches, inlet and outlet pressure gages, thermometers, automatic controls, and filters.

B. Dryers shall be integral to compressor unit as in basis of design compressors by Ingersoll Rand Company. Other acceptable manufacturers are listed below

1. Manufacturers:

a. Arrow Pneumatics, Inc.

b. Atlas Copco Compressors, Inc.

c. Hankison International.

d. Pioneer Air Systems, Inc.

2. Capacity: Match maximum capacity of connected air compressor.

3. Inlet Filter: 5 microns.

4. Outlet Filter: 1 micron(s).

2.06 SPECIALTIES:

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Automatic Drain Valves: Electrical- or mechanical operation type with corrosion-resistant metal body and internal parts, rated for 200-psig (1380-kPa) minimum working pressure, capable of automatic discharge of collected condensate.

C. Specialties in three paragraphs and associated subparagraphs below are usually compressed-air piping devices but may be required with compressed-air equipment. Delete if not required for equipment specified in this Section.

D. Pressure Regulators: Bronze body, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig (1725-kPa) inlet pressure, unless otherwise indicated.

1. Type: Diaphragm or pilot operated.

E. Pressure Regulators: Aluminum alloy or plastic body, diaphragm operated, direct acting, spring loaded, manual pressure-setting adjustment, and rated for 250-psig (1725-kPa) inlet pressure, unless otherwise indicated.

F. Compressed-Air Filters:

1. Available Manufacturers:

a. Arrow Pneumatics, Inc.

b. Flair Corp.

c. Ingersoll-Rand Company; Air Compressor Group.

d. Pioneer Air Systems, Inc.

2. Mechanical-Separation Filters: Two-stage air-line filters of capacity not less than that of connected equipment. Equip with

deflector plates; resin-impregnated-ribbon-type filters with edge filtration, 40 micrometers thick; and drain chock.

3. Coalescing Filters: Capacity not less than that of connected equipment; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Equip with activated carbon capable of removing water and oil aerosols.

PART 3: EXECUTION

3.01 CONCRETE BASES:

A. Install concrete bases for compressed-air equipment. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 3.

3.02 EQUIPMENT INSTALLATION:

A. Install air compressors on concrete bases. Install units level, plumb, and anchored to substrate in locations indicated. Maintain manufacturers' recommended clearances. Orient equipment so controls and devices are accessible for servicing.

1. Anchor packaged equipment to concrete base.

a. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.

b. Install epoxy-coated anchor bolts for supported equipment; extend through concrete base and anchor into structural concrete floor.

c. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

d. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Insert amount of required deflection according to supporting structure and seismic requirements.

C. Vibration Isolation: Install restrained spring isolators with a minimum deflection of 1.5 inch. Vibration isolation devices and installation requirements are specified in Division 15 Section "Mechanical Vibration

and Seismic Controls."

D. Vibration Isolation: Mount equipment with motors larger than 5 hp on vibration isolation equipment base as specified in Division 15 Section "Mechanical Vibration and Seismic Controls."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Install the following devices on compressed-air equipment:

1. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.

2. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.

3. Automatic Drain Valves: Install on intercoolers, aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.

3.03 CONNECTIONS:

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Install piping adjacent to equipment to allow service and maintenance.

D. Connect piping to air compressors and receivers, except safety relief valve connections, with flexible pipe connectors of materials suitable for service. Flexible pipe connectors and their installation are specified in Division 15 Section "General-Service Compressed-Air Piping."

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

F. Connect wiring according to Division 16 Section "Conductors and Cables."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 LABELING AND IDENTIFICATION:

A. Install identifying labels and devices for compressed-air equipment. Refer to Division 15 Section "Mechanical Identification" for labeling and identification materials.

3.05 STARTUP SERVICE:

A. Engage a factory-authorized service representative to test, inspect, and adjust components and equipment installation and to perform startup service.

B. Perform the following final checks:

1. Verify that specified tests of piping systems are complete.

2. Verify that potable-water supply connections to equipment have correct backflow preventer.

3. Check for piping connection leaks.

4. Check for lubricating oil in lubricated-type equipment.

5. Check belt drives for proper tension.

6. Verify that air-compressor inlet filters and piping are clear.

7. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.

8. Check safety valves for correct settings. Ensure that settings are greater than air-compressor discharge pressure but not greater than rating of system components.

9. Check for proper seismic restraints.

10. Test operation of equipment safety controls and devices.

11. Drain receiver tanks.

C. Verify that compressed-air equipment is installed and connected according to the Contract Documents.

D. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in Division 16 Sections.

E. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

F. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

G. Complete installation and startup checks according to manufacturer's written instructions.

H. Prepare written report documenting testing procedures and results.

3.06 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain general-service compressed-air equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 GENERAL SERVICE COMPRESSED-AIR EQUIPMENT

A. General Service Compressed-Air Equipment will not be measured for payment.

B. General Service Compressed-Air Equipment will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15410

PLUMBING FIXTURES

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Laminar-flow faucet-spout outlets.
3. Flushometers.
4. Toilet seats.
5. Protective shielding guards.
6. Fixture supports.
7. Water closets.
8. Urinals.
9. Lavatories.
10. Wash Fountains
11. Kitchen/Pantry sinks.
12. Mop Sinks.
13. Emergency Fixtures
14. Drinking Water Coolers

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 15 Section "Plumbing Piping Specialties" for backflow

preventers, floor drains, and specialty fixtures not included in this Section.

1.03 DEFINITIONS:

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

E. FRP: Fiberglass-reinforced plastic.

F. PMMA: Polymethyl methacrylate (acrylic) plastic.

G. PVC: Polyvinyl chloride plastic.

H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.04 SUBMITTALS:

A. As per Section 01300 SUBMITTALS, provide “Buy America” Compliance Certification from manufacturer showing compliance with requirements of 49 CFR part 661.

B. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE:

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single

manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements:

1. Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"**;** for plumbing fixtures for people with disabilities.

2. Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

3. All valves and fittings shall comply with Maryland Lead Free Law, HB 372

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.

2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.

3. Slip-Resistant Bathing Surfaces: ASTM F 462.

4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.

5. Vitreous-China Fixtures: ASME A112.19.2M.

6. Emergency Fixtures: ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

G. Comply with the following applicable standards and other requirements

specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.

2. Faucets: ASME A112.18.1.

3. Hose-Connection Vacuum Breakers: ASSE 1011.

4. Hose-Coupling Threads: ASME B1.20.7.

5. Integral, Atmospheric Vacuum Breakers: ASSE 1001.

6. NSF Potable-Water Materials: NSF 61.

7. Pipe Threads: ASME B1.20.1.

8. Sensor-Actuated Faucets and Electrical Devices: UL 1951.

9. Supply Fittings: ASME A112.18.1.

10. Brass Waste Fittings: ASME A112.18.2.

H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.

2. Brass and Copper Supplies: ASME A112.18.1.

3. Manual-Operation Flushometers: ASSE 1037.

4. Plastic Tubular Fittings: ASTM F 409.

5. Brass Waste Fittings: ASME A112.18.2.

6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

7. Flexible Water Connectors: ASME A112.18.6.

8. Floor Drains: ASME A112.6.3.

9. Off-Floor Fixture Supports: ASME A112.6.1M.

10. Plastic Toilet Seats: ANSI Z124.5.

11. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 WARRANTY:

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures of unit shell.

b. Faulty operation of controls, blowers, pumps, heaters, and timers.

c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Commercial Applications: Three years from date of Substantial Completion.

1.07 EXTRA MATERIALS:

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

3. Flushometer Valve, Repair Kits: Equal to 10percent of amount of each type installed, but no fewer than 12 of each type.

4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

5. Toilet Seats: Equal to 5 percent of amount of each type installed.

6. Filter Cartridges: Two each for the Water Coolers.

PART 2: PRODUCTS

2.01 LAVATORY FAUCETS:

A. Lavatory Faucets

1. Basis-of-Design Manufacturer: TOTO Inc, EcoPower series

2. Available Manufacturers: Subject to compliance with requirements matching the basis-of-design faucet, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Standard Companies, Inc.

   b. Chicago Faucets.

   c. Delta Faucet Company.

   d. Elkay Manufacturing Co.

   e. Kohler Co.

   f. Moen, Inc.

   g. Speakman Company.

3. Description: Sensor operated mixing valve; Coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

   a. Body Material: Commercial, solid brass

   b. Finish: Polished chrome plate

   c. Maximum Flow Rate: 0.5 gpm (1.5 L/min.)

   d. Centers: 4 inches (102 mm) or to fit lavatory.

   e. Mounting: Deck, exposed

   f. Inlet(s): NPS 3/8 (DN 10) tubing

   g. A compact infrared sensor.

   h. Self-setting detection range

   i. 10-second cycle or 60-second cycle options

   j. Low flow 10-second cycle uses 0.09 gallons per cycle—or 0.5 gallons per minute—64 percent below the baseline of 0.25 gallons per cycle

   k. Thermal mixing Thermostatically maintain water temperaure

2.02 SINK FAUCETS:

A. Sink Faucets,:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Standard Companies, Inc.

   b. Chicago Faucets.

   c. Delta Faucet Company.

   d. Elkay Manufacturing Co.

   e. Kohler Co.

   f. Moen, Inc.

   g. Speakman Company.

2. Description: Kitchen faucet without spray and mop sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook**.** Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

   a. Body Material: Commercial, solid brass

   b. Finish: Polished chrome plate

   c. Maximum Flow Rate: 2.5 gpm (9.5 L/min.), unless otherwise indicated.

   d. Mixing Valve: Single control for kitchen sink, two lever handles for service sink.

   e. Backflow Protection Device for Hose Outlet: Required

   f. Handle(s): Lever for kitchen sink and Cross, four arm for service sink.

   g. Inlet(s): NPS 3/8 (DN 10) tubing with NPS 1/2 (DN 15) male adapter.

   h. Spout Type: Rigid, solid brass with wall brace for service sink and Swivel gooseneck for kitchen sink.

i. Spout Outlet: Aerator for kitchen sink Hose thread for service sink.

j. Vacuum Breaker: Required for service sink.

2.03 LAMINAR-FLOW FAUCET-SPOUT OUTLETS:

A. Laminar-Flow Faucet-Spout Outlets,

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Chronomite Laboratories, Inc.

b. NEOPERL, Inc.

2. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating, laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.04 FLUSHOMETERS:

A. Flushometers:

1. Basis of design flush valves shall be TOTO Inc. products

2. Manufacturers acceptable: Subject to compliance with requirements and matching the performance of basis-of-design flush valves, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Coyne & Delany Co.

b. Delta Faucet Company.

c. Sloan Valve Company.

d. Zurn Plumbing Products Group; Commercial Brass Operation.

3. Description: Flushometer for urinal and water-closet-type fixtures shall be brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts. Sensor-operated TOTO High-

Efficiency EcoPower series flush valves shall be hydropower self-generating type, without the need of external electrical power supply or batteries,

a. Inlet Size: NPS 3/4 (DN 20) for urinal, NPS 1 (DN 25) for water closet.

b. Water usage: 1/8 gal./flush (0.475 L/flush) for urinals, 1.28 gal./flush (4.8L/flush) for water closet.

2.05 TOILET SEATS:

A. Toilet Seats,

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.

b. Bemis Manufacturing Company.

c. Church Seats.

d. Kohler Co.

e. Olsonite Corp.

2. Description: Toilet seat for water-closet-type fixture.

a. Material: Molded, solid plastic with antimicrobial agent.

b. Configuration: Open front without cover.

c. Size: Elongated.

d. Hinge Type: SC, self-sustaining, check

e. Class: Heavy-duty commercial.

f. Color: White.

2.06 PROTECTIVE SHIELDING GUARDS:

A. Protective Shielding Pipe Covers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be

incorporated into the Work include, but are not limited to, the following:

a. Engineered Brass Co.

b. McGuire Manufacturing Co., Inc.

c. TCI Products.

d. TRUEBRO, Inc.

e. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.07 FIXTURE SUPPORTS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Josam Company.

2. MIFAB Manufacturing Inc.

3. Smith, Jay R. Mfg. Co.

4. Tyler Pipe; Wade Div.

5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.

6. Zurn Plumbing Products Group; Specification Drainage Operation.

2.08 WATER CLOSETS:

A. Water Closets, P-1:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.

b. Briggs Plumbing Products, Inc.

c. Crane Plumbing, L.L.C./Fiat Products.

d. Eljer.

e. Kohler Co.

2. Description: Floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.

a. Style: Flushometer valve.

i. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.

ii. Height: Standard.

iii. Design Consumption: 1.28 gal./flush (4.85 L/flush)

iv. Color: White

B. Water Closets, P-1A:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies

b. Crane Plumbing, L.L.C./Fiat Products.

c. Eljer.

d. Kohler Co.

2. Description Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer-valve operation.

a. Style: Flushometer valve.

i. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.

ii. Height: Accessible.

iii. Design Consumption: 1.28gal./flush (4.85 L/flush)

iv. Color: White

2.09 URINALS:

A. Urinals, P-2 & P-2A:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Standard Companies, Inc.

   b. Briggs Plumbing Products, Inc.

   c. Crane Plumbing, L.L.C./Fiat Products.

   d. Eljer.

   e. Kohler Co.

2. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.

   a. Type: Siphon jet, Washout with extended shields.

   b. Strainer or Trapway: Separate removable strainer with integral trap.

   c. Design Consumption: 1/8 gal./flush (0.475 L/flush).

   d. Color: White

   e. Supply Spud Size: NPS 3/4 (DN 20)

   f. Outlet Size: NPS 1-1/2 (DN 40)

   g. Mounting Height: P-2 standard height, and P-2A at ADA compliant height. See Architectural details for exact height from floor.

2.10 LAVATORIES:

A. Lavatories, P-3 and P-3A:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. American Standard Companies, Inc.

b. Briggs Plumbing Products, Inc.

c. Crane Plumbing, L.L.C./Fiat Products.

d. Kohler Co.

2. Description: Counter-mounting , vitreous-china fixture.

a. Type: Self-rimming.

b. Oval Lavatory Size: 20 by 17 inches (508 by 432 mm.

c. Faucet Hole Punching: Three holes, 2-inch (51-mm) centers.

d. Faucet Hole Location: Top.

e. Color: White.

f. Supplies: NPS 3/8 (DN 10) chrome-plated copper with stops.

g. Drain: Grid

h. Drain Piping: NPS 1-1/4 by NPS 1-1/2 (DN 32 by DN 40) chrome-plated, cast-brass P-trap; NPS 1-1/2 (DN 40), thick tubular brass waste to wall; and wall escutcheon.

2.11 WASH FOUNTAINS

A. Wash Fountains, P-9:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acorn Engineering Company.

b. Bradley Corporation.

c. Intersan Manufacturing Company.

2. Description: Accessible, wall mounted design, wash-up fixture.

a. Arrangement: Wash-up stations facing central spray head.

b. Receptor Material: Precast terrazzo on base.

c. Receptor Color or Finish: Architect/ Owner to select from manufacturer's available standard.

d. Size: 54-inch (1370-mm) diameter.

e. Number of Stations: Two.

f. Control: sensor actuation with thermostatic valve and check stops or field-installed check valves.

g. Mounting: Wall-mounted with wall bracket.

h. Supplies: NPS 3/4 (DN 20) copper tubing with ball, gate, or globe valves.

i. Drain: Grid with 3" tailpiece.

j. Drain Piping: NPS 3 (DN 72) P-trap, waste to wall, and wall flange.

2.12 KITCHEN/PANTRY SINKS:

A. Kitchenette Sinks, P-4:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Eljer.

b. Kohler Co.

c. Dayton Products, Inc.

d. Elkay Manufacturing Co.

e. Just Manufacturing Company.

2. Description: One -bowl, residential, counter-mounting, stainless-steel kitchen sink.

a. Overall Dimensions: 20" X 22". Coordinate with Architectural drawings.

b. Metal Thickness: 0.050 inch (1.3 mm).

c. Bowl:

i. Dimensions: 7" deep.

ii. Drain: 3-1/2-inch (89-mm) grid with offset waste

1) Location: Centered in bowl.

d. Supplies: NPS 1/2 (DN 15) chrome-plated copper with stops.

e. Drain Piping: NPS 1-1/2 (DN 40) chrome-plated, cast-brass P-trap; 0.045-inch- (1.1-mm-) thick tubular brass waste to wall; and wall escutcheon(s).

2.13 SERVICE SINKS:

A. Mop sinks, P-7:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acorn Engineering

b. Crane Plumbing, L.L.C./Fiat Products.

c. Florestone Products, Inc,

d. Stern-Williams Co, Inc.

2. Description: Terrazzo, floor mounted.

a. Standard: IAPMO PS 99.

b. Shape: Square.

c. Nominal Size: 36 by 36 inches (915 by 915 mm).

d. Height: 6 inches (150 mm).

e. Rim Guard: Front and sides not flush to wall.

f. Color: Architect to select.

g. Drain: Grid with NPS 3 (DN 80) outlet.

2.14 EMERGENCY FIXTURES

A. Eyewash Equipment, P-8

1. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:

a. Bradley Corporation.

b. Chicago Faucets.

c. Encon Safety Products.

d. Guardian Equipment Co.

e. Haws Corporation.

f. Lab Safety Supply Inc.

g. Speakman Company.

h. WaterSaver Faucet Co.

2. Description: Plumbed, accessible, wall-mounting eyewash equipment with receptor and wall bracket.

a. Capacity: Deliver potable water at rate not less than 0.4 gpm (1.5 L/min.) for at least 15 minutes.

b. Supply Piping: NPS 1/2 (DN 15) chrome-plated brass or stainless steel with flow regulator and stay-open control valve.

c. Control-Valve Actuator: Paddle.

d. Spray-Head Assembly: Two receptor-mounted spray heads, with chained pop-up dust caps.

e. Receptor: Chrome-plated brass or stainless-steel bowl.

B. Emergency Showers with Eyewash Combination units, P-8A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Safety (Acorn Engineering Company.)

b. Bradley Corporation.

c. Chicago Faucets.

d. Encon Safety Products.

e. Guardian Equipment Co.

f. Haws Corporation.

g. Speakman Company.

h. WaterSaver Faucet Co.

2. Shower Description: Plumbed, single-shower-head horizontal, wall-mounting emergency shower.

a. Capacity: Deliver potable water at rate not less than 20 gpm (76 L/min.) for at least 15 minutes.

b. Supply Piping: NPS 1 (DN 25) chrome plated or stainless steel with flow regulator and stay-open control valve.

c. Control-Valve Actuator: Pull chain.

d. Shower Head: 8-inch (200-mm) minimum diameter, chrome-plated brass or stainless steel.

3. Eyewash Unit:

a. Capacity: Not less than 0.4 gpm (1.5 L/min.) for at least 15 minutes.

b. Supply Piping: NPS 1/2 (DN 15) with flow regulator and stay-open control valve.

c. Control-Valve Actuator: Paddle.

d. Spray-Head Assembly: Two receptor-mounted spray heads, with chained pop-up dust caps.

e. Receptor: Chrome-plated brass or stainless-steel bowl.

f. Mounting: Attached shower pedestal.

2.15 PRESSURE WATER COOLERS

A. Pressure Water Coolers, P-5: Wall mounted, dual height: one standard, another wheelchair accessible.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Co.

b. Halsey Taylor.

c. Haws Corporation.

d. Tri Palm International, LLC; Oasis Brand.

e. Filtrine

2. Cabinet: Bi-level with two attached cabinets, all stainless steel.

3. Bubbler: One, with adjustable stream regulator, located on each cabinet deck.

4. Control: Push bar.

5. Drain: Grid with NPS 1-1/4 (DN 32) tailpiece.

6. Supply: NPS 3/8 (DN 10) with shutoff valve.

7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.

8. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.

9. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

10. Capacities and Characteristics:

a. Cooled Water: 8 gph (0.0084 L/s).

b. Ambient-Air Temperature: 90 deg F (32 deg C).

c. Inlet-Water Temperature: 80 deg F (27 deg C).

d. Cooled-Water Temperature: 50 deg F (10 deg C).

e. Electrical Characteristics:

i. Volts: 120-V ac.

ii. Phase: Single.

iii. Hertz: 60.

11. Support: ASME A112.6.1M, Type I water-cooler carrier.

PART 3: EXECUTION

3.01 EXAMINATION:

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

2. Use carrier supports without waste fitting for fixtures with tubular waste piping.

3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

D. Install counter-mounting fixtures in and attached to casework.

E. Install fixtures level and plumb according to roughing-in drawings.

F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 15 Section

"Valves."

G. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

H. Install flushometer valves for with sensors mounted such that the manual puch button is easily accessible. Install other actuators in locations that are easy for people with disabilities to reach.

I. Install toilet seats on water closets.

J. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

K. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

L. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

M. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

N. Set service basins in leveling bed of cement grout. Delete paragraph below if sealants are specified in Division 7 Section "Joint Sealants."

O. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Architectural Joint Sealants."

3.03 CONNECTIONS:

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL:

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING:

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

3.06 CLEANING:

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.

2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION:

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

PART 4: MEASUREMENT AND PAYMENT

4.01 PLUMBING FIXTURES

A. Plumbing Fixtures will not be measured for payment.

B. Plumbing Fixtures will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15480

DOMESTIC WATER HEATERS

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following domestic water heaters:

1. Commercial, high-efficiency, gas water heaters.

2. Compression tanks.

3. Water heater accessories.

1.03 SUBMITTALS:

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Product Certificates: For each type of commercial water heater, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For fuel-fired water heaters to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE:

A. Source Limitations: Obtain same type of domestic water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water heaters and are based on the specific

system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.05 COORDINATION:

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.06 WARRANTY:

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.

b. Faulty operation of controls.

c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): From date of Substantial Completion:

a. Commercial Gas Water Heaters:

i. Storage Tank: Five years.

ii. Controls and Other Components: Five years.

b. Compression Tanks: One year.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

A. In other Part 2 articles where titles below introduce lists, the following

requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 COMMERCIAL GAS WATER HEATERS:

A. Commercial, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

1. Manufacturers:

a. Bradford White Corporation.

b. Laars Heating Systems; Waterpik Technologies, Inc.

c. Lochinvar Corporation.

d. PVI Industries.

e. Rheem Water Heater Div.; Rheem Manufacturing Company.

f. Smith, A. O. Water Products Company.

g. State Industries, Inc.

2. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.

3. Storage-Tank Construction: ASME-code steel with 150-psig (1035-kPa) minimum working-pressure rating.

a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

i. NPS 2 (DN 50) and Smaller: Threaded ends according to ASME B1.20.1.

ii. NPS 2-1/2 (DN 65) and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into

and through tank fittings and outlets.

c. Lining: Glass or Nickel plate complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

4. Factory-Installed, Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.

b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.

c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.

d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.

e. Jacket: Steel with enameled finish.

f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

5. Burner or Heat Exchanger: Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.

6. Temperature Control: Adjustable thermostat.

7. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

8. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.

9. Draft Hood: Draft diverter; complying with ANSI Z21.12.

10. Capacity and Characteristics: See drawings.

2.03 COMPRESSION TANKS:

A. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Manufacturers:

   a. AMTROL Inc.

   b. Armstrong Pumps, Inc.

   c. Smith, A. O.; Aqua-Air Div.

   d. State Industries, Inc.

   e. Taco, Inc.

2. Construction:

   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread.

   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

   c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics:

   a. See drawings.

2.04 WATER HEATER ACCESSORIES:

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than water heater working-pressure rating.

C. Water Heater Stand and Drain-Pan Units: High-density-polyethylene-plastic, 18-inch- (457-mm-) high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 (DN 25) drain outlet with ASME B1.20.1 pipe thread.

D. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

F. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- (172.5-kPa-) maximum outlet pressure, unless otherwise indicated.

G. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

2.05 SOURCE QUALITY CONTROL:

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3: EXECUTION

3.01 WATER HEATER INSTALLATION:

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

2. Concrete base construction requirements are specified in Division 3.

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for hose-end drain valves.

F. Install thermometer on outlet piping of water heaters. Refer to Division 15 Section "Meters and Gages" for thermometers.

G. Install pressure gage(s) on inlet and outlet of commercial water- heater piping. Refer to Division 15 Section "Meters and Gages" for pressure gages.

H. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 15 Section "Plumbing Valves" for general-duty valves and to Division 15 Section "Meters and Gages" for thermometers.

I. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

J. Fill water heaters with water.

K. Charge compression tanks with air.

3.02 CONNECTIONS:

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL:

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

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

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, confirm proper operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.04 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and instantaneous domestic water heaters.

PART 4: MEASUREMENT AND PAYMENT

4.01 DOMESTIC WATER HEATERS

A. Domestic Water Heaters will not be measured for payment.

B. Domestic Water Heaters will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15512

CAST-IRON BOILERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes packaged cast-iron boilers, trim, and accessories for generating hot water with the following configurations and burners:

1. Factory assembled.

2. Sealed-combustion, Oil burner.

1.03 ACTION SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.

3. Wiring Diagrams: Power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that boiler, accessories, and components will withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place

without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control test reports.

C. Field quality-control test reports.

D. Warranty: Special warranty specified in this Section.

E. Other Informational Submittals:

1. Startup service reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For boilers, components, and accessories to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

D. I=B=R Compliance: Boilers shall be tested and rated according to HI's "Rating Procedure for Heating Boilers" and "Testing Standard for Commercial Boilers," with I=B=R emblem on a nameplate affixed to boiler.

E. UL Compliance: Test boilers for compliance with UL 726, "Oil-Fired Boiler Assemblies." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace controls and heat exchangers of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Controls: Two years from date of Substantial Completion.

2. Warranty Period for Heat Exchangers: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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

1. Burnham Hydronics.

2. Smith Cast Iron Boilers.

3. Weil-McLain; a United Dominion Company.

2.02 MANUFACTURED UNITS

A. Description: Factory fabricated and assembled.

1. Cast-iron sections shall be sealed pressure tight and held together with tie rods set on an insulated steel base; including insulated jacket and flue-gas vent connection.

B. Cast-Iron Section Design:

1. Number of Passes: three.

2. Sectional Joints: High-temperature sealant to seal flue-gas passages not in contact with heating medium, tapered cast-iron

push nipples, silicone-coated fiberglass rope gasket fiber roping, and held together with tie rods. compressed into a cast tongue and groove connection around the perimeter of the section, providing a durable, gas tight seal.

3. Drain and blowdown tappings.

4. Return injection tube to equalize water flow to all sections.

5. Crown inspection tappings with brass plugs.

6. Built-in air separator.

C. Combustion Chamber: Equipped with ceramic-fiber target wall refractory insulation and flame observation ports, front and back.

D. Casing:

1. Jacket: Galvanized sheet metal, with snap-in or interlocking closures and powder-coated protective finish.

2. Insulation: Minimum 4 -inch- thick, mineral-fiber insulation surrounding the heat exchanger.

3. Combustion Chamber Access: Refractory lined, hinged, front.

4. Access: For cleaning between cast-iron sections.

5. Draft Hood: Flue canopy and flue connection shall be constructed of stainless steel containing adjustable outlet damper assembly.

6. Insulated base constructed of aluminized steel to permit boiler to be installed on combustible floor.

7. Mounting Frame: Steel rails to mount assembled boiler package on concrete base.

8. Control Cabinet: Sheet metal casing shall cover all controls, gas train, and burner.

E. Draft Diverter: Steel assembly integral with boiler casing.

2.03 BURNER

A. Burner: Welded construction with multivane, stainless-steel, flame-retention diffuser for fuel oil.

B. Blower: Forward-curved centrifugal fan integral to burner, directly driven by motor; with adjustable, dual-blade damper assembly and locking

quadrant to set air-fuel ratio.

1. Motors: Comply with requirements specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

   a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

C. Oil Supply: Control devices and modulating control sequence shall comply with requirements in ASME CSD-1, IRI and UL.

1. Oil Pump: Two-stage, gear-type oil pump integral to and directly driven by blower shall be capable of producing 300-psig (2070-kPa) discharge pressure and 15-inch Hg (50.7-kPa) vacuum.

2. Oil Piping Specialties:

   a. Suction-line, manual, gate valve.

   b. Removable-mesh oil strainer.

   c. 0- to 30-inch Hg (0- to 101.3-kPa) vacuum; 0- to 30-psig (0- to 207-kPa) vacuum-pressure gage.

   d. 0- to 300-psig (0- to 2070-kPa) oil-nozzle pressure gage.

   e. Nozzle-line, solenoid-safety-shutoff oil valve.

D. Pilot: Electric-spark pilot ignition with 100 percent main-valve and pilot-safety shutoff solenoid using UV scanner flame-safety control.

2.04 TRIM

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch- (89-mm-) diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.

F. Drain Valve: Minimum NPS 3/4 (DN 20) hose-end gate valve.

2.05 CONTROLS

A. Refer to Section 15900 "Building Automation Controls" and contract drawings.

B. Controls shall be factory installed and physically mounted on the burner and shall be UL Listed. Boiler control panel shall allow local-remote selection for operations. In the local mode, the boiler leaving water setpoint shall be derived from the boiler control panel. In the remote mode, the boiler leaving water setpoint shall be derived from the BAS.

C. Supply a Boiler Control System to provide safety interlocks and water temperature control. The control system shall be fully integrated into the burner control cabinet and incorporate multiple boiler control logic, inputs, outputs and communication interfaces. The control system shall coordinate the operation of both fully modulating hot water boilers and shall integrate with the BAS for control operation of the boiler pumps. The control system shall control boiler modulation and on/off outputs based on the boiler water supply temperature (from BAS) and an operator-adjusted setpoint. Controller shall be provided with a two-line by sixteen character LCD display. Display automatically presents boiler sequence, alarm, hold and lockout messages. Boiler operating controls shall include the following devices and features:

1. Control transformer.

2. Set-Point Adjust: Set points shall be adjustable.

3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. .

   a. Include automatic, alternating-firing sequence for multiple boilers.

D. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.

2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.

3. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

E. The boiler control system (BCS) shall be provided with a peer-to-peer communications data highway network operating across an RS-485 communications system on each boiler control system. When peer-to-peer communication is enabled the data highway shall allow the connected boilers to exchange signals as required to provide coordinated fully modulating lead/lag functions. It shall not be required to wire individual control signals between boilers. When communication is enabled, the data highway shall allow individual boiler limits, lockout, boiler and system temperatures and firing rate status to be readable at the LCD and water setpoint, boiler firing rate, and start/stop command to be readable and writable. The BCS shall accept a hot water temperature setpoint from the Building Automation System (BAS). The BCS shall provide real time operations feedback from the boiler via the LCD display, including but not limited to burner firing rate, motor speed and damper position, water temperatures and all available alarms and operating parameters.

F. Using PID (proportional-integral-derivative) based control, the remote (actual) system water temperature shall be compared with a setpoint (provided by the BAS) to establish a target boiler firing rate. When the remote system temperature is near the boiler high limit temperature, the boiler supply sensor shall limit the maximum boiler supply temperature to prevents boiler High Limit Trips.

G. When the controller is in remote mode, the control system shall accept a remote temperature setpoint via the Building Automation System (BAS). When the controller is in the local control mode, the control system shall establish the setpoint based on a manual input by the operator.

2.06 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 12 enclosure.

2. Wiring shall be numbered and color-coded to match wiring diagram.

3. Install factory wiring outside of an enclosure in a metal raceway.

4. Field power interface shall be to wire lugs, nonfused disconnect switch.

5. Provide branch power circuit to each motor and to controls with disconnect switch or circuit breaker.

6. Provide each motor with overcurrent protection.

2.07 CAPACITIES AND CHARACTERISTICS

A. See Design Drawings for schedule of capacities and characteristics.

2.08 SOURCE QUALITY CONTROL

A. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

B. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 BOILER INSTALLATION

A. Equipment Mounting: Install boilers on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 03300 "Cast-in-Place Concrete."

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct bases to withstand, without damage to equipment, seismic force required by code.

3. Construct concrete bases 4 inches (100 mm) high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of boiler unless otherwise indicated or unless required for seismic anchor support.

4. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.

5. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

6. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.

7. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

8. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Equipment Mounting: Install boilers on cast-in-place concrete equipment base(s) using elastomeric pads. Comply with requirements for equipment bases specified in Section 03300 "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Install oil-fired boilers according to NFPA 31.

D. Assemble boiler sections in sequence and seal between each section.

E. Assemble and install boiler trim.

F. Install electrical devices furnished with boiler but not specified to be factory mounted.

G. Install control wiring to field-mounted electrical devices.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Connect oil piping full size to burner inlet with shutoff valve and union.

D. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

E. Install piping from safety relief valves to nearest floor drain.

F. Install piping from equipment drain connection to nearest floor drain.

Piping shall be at least full size of connection. Provide an isolation valve if required.

G. Connect breeching full size to boiler outlet. Comply with requirements in Section 15550 "Breechings, Chimneys, and Stacks" for venting materials.

H. Ground equipment according to Section 16060 "Grounding and Bonding."

I. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Burner Test: Adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency.

b. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.

c. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Provide for at least two 1 hour sessions.

PART 4: MEASUREMENT AND PAYMENT

4.01 CAST-IRON BOILERS:

A. Cast-Iron Boilers will not be measured for payment.

B. Cast-Iron Boilers will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15550

BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Listed double-wall vents.

2. Listed, refractory-lined [breechings and] stacks.

B. Related Sections include the following:

1. Division 15 Section 15555 "Draft Control Devices" for induced-draft and mechanical fans and for motorized and barometric dampers.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Building-heating-appliance chimneys.

2. Guy wires and connectors.

B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers and seismic restraints, and location and size of each field connection.

C. Manufacturer Seismic Qualification Certification: Submit certification that factory-fabricated breeching, chimneys, and stacks; accessories; and components will withstand seismic forces defined in Division 15 Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is

based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Breeching, Chimneys, and Stacks: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of anchorage devices on which the certification is based and their installation requirements.

D. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 LISTED BUILDING-HEATING-APPLIANCE CHIMNEYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Heat-Fab, Inc.

2. Metal-Fab, Inc.

3. Schebler Co. (The).

4. Selkirk Inc.; Selkirk Metalbestos and Air Mate.

5. Van-Packer Company, Inc.

B. Description: Double-wall metal vents tested according to UL 103 and rated for 1000 deg F (538 deg C) continuously, or 1700 deg F (926 deg C) for 10 minutes; with neutral or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1-inch (50-mm) annular space filled with high-temperature, ceramic-fiber insulation.

D. Inner Shell: ASTM A 666, Type 304 or Type 316 stainless steel.

E. Outer Jacket: ASTM A 666, Type 304 or Type 316 stainless steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly and constructed of ASTM A 666, Type 304 or Type 316 stainless steel.

1. Termination: Exit cone with drain section incorporated at base of riser, include valved drain pipe to floor drain.

2.02 GUYING AND BRACING MATERIALS

A. Cable: Four stainless steel, stranded wires of the following thickness:

1. Minimum Size: 1/4 inch (6 mm) in diameter.

2. For ID Sizes 4 to 15 Inches (100 to 381 mm): 5/16 inch (8 mm).

3. For ID Sizes 18 to 24 Inches (457 to 610 mm): 3/8 inch (9.5 mm).

B. Pipe: stainless steel, NPS 1-1/4 (DN 32).

C. Angle steel: Stainless steel, 2 by 2 by 0.25 inch (50 by 50 by 6 mm).

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATION

A. Listed Building-Heating-Appliance Chimneys: Dual-fuel boilers, oven vents, water heaters, and exhaust for engines. Fireplaces and other solid-fuel-burning appliances.

3.03 INSTALLATION OF LISTED VENTS AND CHIMNEYS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breechings down in direction of appliance, with valved condensate drain connection at lowest point piped to nearest drain.

E. Lap joints in direction of flow.

3.04 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 BREECHINGS, CHIMNEYS, AND STACKS:

A. Breechings, Chimneys, and Stacks will not be measured for payment.

B. Breechings, Chimneys, and Stacks will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15555

DRAFT CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Barometric dampers.

2. Vent dampers.

1.03 SUBMITTALS

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

B. Shop Drawings: Show fabrication and installation details for dampers. Include plans, elevations, sections, details, and attachments to other work. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, hangers and seismic restraints, and location and size of each field connection.

C. Operation and Maintenance Data: For draft control devices to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of barometric dampers and vent dampers that fail in materials or workmanship within specified warranty period.

1. Failures include failure of the fan due to corrosion.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 BAROMETRIC DAMPERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. EXHAUSTO, Inc.

2. Tec-Air Inc.

3. Tjernlund Products, Inc.

4. Tutco, Inc.; Subsidiary of Smiths Industries.

5. Wing Draft Inducers; Subsidiary of Smiths Industries.

B. Damper Construction: High-temperature- stainless steel damper and housing with stainless-steel breeching connection. Adjustable counterweight with lock. Include knife-edge bearings that do not require lubrication.

2.02 VENT DAMPERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Effikal International Inc.

2. Field Controls L.L.C.; Venting Solutions Company (The).

3. Johnson Controls, Inc.; Controls Group.

B. Damper Construction: Stainless-steel damper blade, shaft, and vent pipe with metal, prelubricated bearings.

1. Electric motor sized to power damper open and closed in approximately 15 seconds in each direction. Power is off when damper is at rest.

2. Comply with ANSI Z21.66.

C. Controls:

1. Control transformer.

2. Keyed wiring harness.

3. Damper end-switch to prove damper is open.

4. Interlock with boiler to permit burner operation when damper is open.

5. Hold-open switch for troubleshooting boiler controls.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Coordinate damper type and location with boiler selection.

B. Install listed components in a manner complying with the listing.

C. Secure barometric dampers to breechings with hardware compatible with connected materials.

D. Locate barometric and motorized vent dampers as close to draft hood collar as possible.

E. Secure barometric and motorized vent dampers to appliances, breechings, or chimneys with hardware compatible with connected materials.

3.02 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

3.03 ADJUSTING

A. Set field-adjustable switches and controls as indicated.

PART 4 - MEASUREMENT AND PAYMENT

4.01 DRAFT CONTROL DEVICES:

A. Draft Control Devices will not be measured for payment.

B. Draft Control Devices will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15671

PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes packaged, refrigerant compressor and condenser units.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Compressor and condenser units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.04 ACTION SUBMITTALS

A. Product Data: For each compressor and condenser unit. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

B. Shop Drawings: For compressor and condenser units. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following

items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which compressor and condenser units will be attached.

2. Liquid and vapor pipe sizes.

3. Refrigerant specialties.

4. Piping including connections, oil traps, and double risers.

5. Compressors.

6. Evaporators.

B. Seismic Qualification Certification: For compressor and condenser units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressor and condenser units to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Standard for Refrigeration Systems."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6, "Heating, Ventilating, and Air-Conditioning."

D. ASME Compliance: Fabricate and label water-cooled compressor and condenser units to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.08 COORDINATION

A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300 "Cast-In-Place Concrete."

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07720 "Roof Accessories."

C. Coordinate location of piping and electrical rough-ins.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of compressor and condenser units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.

b. Condenser coil leak.

2. Warranty Period: Five years from date of Substantial Completion.

3. Warranty Period (Compressor Only): Five years from date of Substantial Completion.

4. Warranty Period (Components Other Than Compressor): Five years from date of Substantial Completion.

5. Warranty Period (Condenser Coil Only): Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 COMPRESSOR AND CONDENSER UNITS, AIR COOLED, 5 TONS or Less

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. McQuay/ Daikin.

2. Trane; a business of American Standard Companies.

3. YORK; a Johnson Controls company.

B. Description: Factory assembled and tested; consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

1. Motor: variable speed digital, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

2. Compressor: Include manual-reset, high-pressure switch and automatic-reset, low-pressure switch.

3. Accumulator: Suction tube.

D. Refrigerant: R-410A.

E. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

F. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection [and ball bearings].

G. Accessories:

1. Crankcase heater.

2. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.

3. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.

4. Filter-dryer.

5. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.

6. Liquid-line solenoid.

7. Low-Ambient Controller: Cycles condenser fan to permit operation down to 0 deg F (minus 18 deg C) with time-delay relay to bypass low-pressure switch.

8. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.

9. PE mouning base.

10. Precharged and insulated suction and liquid tubing.

11. Sound Hood: Wraps around sound attenuation cover for compressor.

12. Thermostatic expansion valve.

13. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.

H. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

I. Capacities and Characteristics:

1. See Design Drawings for schedule of capacities and characteristics.

2.02 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.03 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate compressor and condenser units according to ARI 210/240 or ARI 340/360.

B. Energy Efficiency: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," Section 6, "Heating, Ventilating, and Air-Conditioning."

C. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. Testing Requirements: Factory test sound-power-level ratings according to ARI 270 or ARI 370.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for

compliance with requirements for installation tolerances and other conditions affecting performance of compressor and condenser units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where compressor and condenser units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Install compressor and condenser units on PE mounting base.

C. Install roof-mounting units on equipment supports specified in Section 07720 "Roof Accessories."

D. Vibration Isolation: Mount compressor and condenser units on rubber pads with a minimum deflection of 1/4 inch (6.35 mm). Vibration isolation devices and installation requirements are specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.03 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

B. Connect refrigerant piping to air-cooled compressor and condenser units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Section 15183 "Refrigerant Piping."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies,

and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test. Certify compliance with test parameters.

2. Leak Test: After installation, charge system with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor operation and unit operation, product capability, and compliance with requirements.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

5. Verify proper airflow over coils.

C. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

D. Compressor and condenser units will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Inspect for physical damage to unit casing.

b. Verify that access doors move freely and are weathertight.

c. Clean units and inspect for construction debris.

d. Verify that all bolts and screws are tight.

e. Adjust vibration isolation and flexible connections.

f. Verify that controls are connected and operational.

B. Lubricate bearings on fan motors.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow and air temperature rise over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain compressor and condenser units.

PART 4: MEASUREMENT AND PAYMENT

4.01 PACKAGED COMPRESSOR AND CONDENSER UNITS:

A. Packaged Compressor and Condenser Units will not be measured for payment.

B. Packaged Compressor and Condenser Units will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15725

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Constant-air-volume, single-zone air-handling units.

2. Variable-air-volume, single-zone air-handling units.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Casing panels shall be self-supporting and capable of withstanding 133 percent of internal static pressures indicated, without panel joints exceeding a deflection of L/200 where "L" is the unsupported span length within completed casings.

C. Seismic Performance: Air-handling units shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.04 ACTION SUBMITTALS

A. Product Data: For each air-handling unit indicated.

1. Unit dimensions and weight.

2. Cabinet material, metal thickness, finishes, insulation, and accessories.

3. Fans:

a. Certified fan-performance curves with system operating

conditions indicated.

b. Certified fan-sound power ratings.

c. Fan construction and accessories.

d. Motor ratings, electrical characteristics, and motor accessories.

4. Certified coil-performance ratings with system operating conditions indicated.

5. Dampers, including housings, linkages, and operators.

6. Filters with performance characteristics.

B. Delegated-Design Submittal: For vibration isolation and seismic restraints 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Mechanical-room layout and relationships between components and adjacent structural and mechanical elements.

2. Support location, type, and weight.

3. Field measurements.

B. Seismic Qualification Certificates: For air-handling units, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control reports.

D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-handling units to include in emergency, operation, and maintenance manuals.

1.07 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. Filters: One set for each air-handling unit.

2. Gaskets: One for each unit.

3. Fan Belts and pulleys: One set for each air-handling unit fan sized by balancing contractor after project balancing.

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of air-handling units and components.

C. ARI Certification: Air-handling units and their components shall be factory tested according to ARI 430, "Central-Station Air-Handling Units," and shall be listed and labeled by ARI.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. Comply with NFPA 70.

1.09 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate sizes and locations of structural-steel support members, if any, with actual equipment provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Air Enterprises, Inc.

2. Airtherm; a Mestek company.

3. Mammoth Inc.

4. McQuay International

5. Trane; American Standard Inc.

6. YORK International Corporation.

2.02 UNIT CASINGS

A. General Fabrication Requirements for Double Wall Casings:

1. Forming: Form walls, roofs, and floors with at least two breaks at each joint of minimum 16 ga galvanized steel for interior and exterior casing.

2. Casing Joints: Sheet metal screws or pop rivets.

3. Sealing: Seal all joints with water-resistant sealant.

4. Factory Finish for Steel Casings: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on enamel finish, consisting of prime coat and thermosetting topcoat, Epoxy or Powder-baked enamel.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

B. Casing Insulation and Adhesive:

1. Materials: ASTM C 1071, Type II.

2. Location and Application: Encased between outside and inside casing.

C. Inspection and Access Panels and Access Doors:

1. Panel and Door Fabrication: Formed and reinforced, double-wall and insulated panels of same materials and thicknesses as casing.

2. Inspection and Access Panels:

a. Fasteners: Two or more camlock type for panel lift-out operation. Arrangement shall allow panels to be opened against air-pressure differential.

b. Gasket: Neoprene, applied around entire perimeters of panel frames.

c. Size: Large enough to allow inspection and maintenance of air-handling unit's internal components.

3. Access Doors:

a. Hinges: A minimum of two ball-bearing hinges or stainless-steel piano hinge and two wedge-lever-type latches, operable from inside and outside. Arrange doors to be opened against air-pressure differential.

b. Gasket: Neoprene, applied around entire perimeters of panel frames.

c. Fabricate windows in fan section doors of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.

d. Size: At least 18 inches (450 mm) wide by full height of unit casing up to a maximum height of 60 inches (1500 mm).

4. Locations and Applications:

a. Fan Section: Doors.

b. Access Section: Doors.

c. Coil Section: Inspection and access panel.

d. Damper Section: Doors.

e. Filter Section: Doors large enough to allow periodic removal and installation of filters.

f. Mixing Section: Doors.

g. Humidifier Section: Doors.

5. Service Light: 100-W vaporproof fixture with switched junction box located outside adjacent to door.

a. Locations: Each section accessed with door.

D. Condensate Drain Pans:

1. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.

a. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.

b. Depth: A minimum of 2 inches (50 mm) deep.

2. Formed sections.

3. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

4. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

a. Minimum Connection Size: NPS 1 (DN 25).

5. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

E. Air-Handling-Unit Mounting Frame: Formed galvanized-steel channel or structural channel supports, designed for low deflection, welded with integral lifting lugs.

1. Seismic Fabrication Requirements: Fabricate mounting base and attachment to air-handling unit sections, accessories, and components with reinforcement strong enough to withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment" when air-handling unit frame is anchored to building structure.

2.03 FAN, DRIVE, AND MOTOR SECTION

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

1. Shafts: Designed for continuous operation at maximum-rated fan speed and motor horsepower, and with field-adjustable alignment.

a. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.

b. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

B. Centrifugal Fan Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

1. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

2. Horizontal-Flanged, Split Housing: Bolted construction.

3. Housing for Supply Fan: Attach housing to fan-section casing with metal-edged flexible duct connector.

4. Flexible Connector: Factory fabricated with a fabric strip 5-3/4 inches (146 mm) wide attached to 2 strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized-steel sheet or 0.032-inch- (0.8-mm-) thick aluminum sheets; select metal compatible with casing.

a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

i. Fabric Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

ii. Fabric Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.

iii. Fabric Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

C. Backward-Inclined Airfoil, Centrifugal Fan Wheels: Double-width-double-inlet with smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and

backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

D. Fan Shaft Bearings:

1. Grease-Lubricated, Tapered-Roller Bearings: Self-aligning, pillow-block type with double-locking collars and 2-piece, cast-iron housing with grease lines extended to outside unit and a rated life of 120,000 hours according to ABMA 11.

E. Belt Drives: Factory mounted, with adjustable alignment and belt tensioning, and with 1.5 service factor based on fan motor.

1. Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.

2. Motor Pulleys: Adjustable pitch for use with 10-hp motors and smaller; fixed pitch for use with motors larger than 10 hp. Select pulley size so pitch adjustment is at the middle of adjustment range at fan design conditions.

3. Belts: Oil resistant, nonsparking, and nonstatic; in matched sets for multiple-belt drives.

4. Belt Guards: Comply with requirements specified by OSHA and fabricate according to SMACNA's "HVAC Duct Construction Standards"; 0.1046-inch- (2.7-mm-) thick, 3/4-inch (20-mm) diamond-mesh wire screen, welded to steel angle frame; prime coated.

F. Internal Vibration Isolation and Seismic Control: Fans shall be factory mounted with manufacturer's standard[restrained] vibration isolation mounting devices having a minimum static deflection of 1 inch (25 mm).

1. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment" when fan-mounting frame and air-handling-unit mounting frame are anchored to building structure.

G. Motor: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

3. Mount unit-mounted disconnect switches on exterior of unit.

H. Variable Frequency Controllers:

1. Description: unit supplied free standing or wall mounted external to the unit see Division 16 for requirements of Section 16269 “Variable Frequency Controllers.” If location or installation not defined the drive will be provided as part of Division 16, AHU manufacture to coordinate requirements and connections with Variable Frequency Controllers supplier.

2.04 COIL SECTION

A. General Requirements for Coil Section:

1. Comply with ARI 410.

2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).

3. If required to create even air flow, provide air deflectors and air baffles to balance airflow across coils.

4. Coils shall not act as structural component of unit.

5. Seismic Fabrication Requirements: Fabricate coil section, internal mounting frame and attachment to coils, and other coil section components with reinforcement strong enough to withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment" when coil-mounting frame and air-handling-unit mounting frame are anchored to building structure.

2.05 AIR FILTRATION SECTION

A. General Requirements for Air Filtration Section:

1. Comply with NFPA 90A.

2. Provide minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

3. Provide filter holding frames arranged for flat or angular

orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

B. Disposable Panel Filters:

1. Factory-fabricated, viscous-coated, flat-panel type.

2. Thickness: 2 inches (50 mm).

3. Initial Resistance: 0.1 inches wg (Pa).

4. Recommended Final Resistance: 0.25 inches wg (Pa).

5. Merv (ASHRAE 52.2): 5.

6. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.

7. Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.

C. Extended-Surface, Disposable Panel Filters:

1. Factory-fabricated, dry, extended-surface type.

2. Thickness: 4 inches (100 mm).

3. Initial Resistance: 0.25 inches wg (Pa).

4. Recommended Final Resistance: 0.75 inches wg (Pa).

5. Merv (ASHRAE 52.2): 7.

6. Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.

7. Media-Grid Frame: Nonflammable cardboard.

8. Mounting Frames: Welded, galvanized steel, with gaskets and fasteners, suitable for bolting together into built-up filter banks.

D. Filter Gage:

1. 3-1/2-inch- (90-mm-)diameter, diaphragm-actuated dial in metal case.

2. Vent valves.

3. Black figures on white background.

4. Front recalibration adjustment.

5. 3 percent of full-scale accuracy.

6. Range: 0- to 1.0-inch wg (0 to 250 Pa).

7. Accessories: Static-pressure tips with integral compression fittings, 1/4-inch (6-mm) aluminum tubing, and 2- or 3-way vent valves.

2.06 DAMPERS

A. General Requirements for Dampers: Leakage rate, according to AMCA 500, "Laboratory Methods for Testing Dampers for Rating," shall not exceed 2 percent of air quantity at 2000-fpm (10-m/s) face velocity through damper and 4-inch wg (1000-Pa) pressure differential.

B. Damper Operators: Comply with requirements in Section 15900 "HVAC Instrumentation and Controls."

C. Face-and-Bypass Dampers: Opposed-blade, aluminum dampers with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame and with operating rods connected with a common linkage. Provide blade gaskets and edge seals, and mechanically fasten blades to operating rod.

D. Outdoor- and Return-Air Dampers: Low-leakage, double-skin, airfoil-blade, aluminum dampers with compressible jamb seals and extruded-vinyl blade edge seals in opposed-blade arrangement with cadmium-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 5 cfm/sq. ft. (0.22 L/s per sq. m) at 1-inch wg (250 Pa) and 9 cfm/sq. ft. (0.4 L/s per sq. m) at 4-inch wg (1.0 MPa).

E. Mixing Section: Multiple-blade, air-mixer assembly located immediately downstream of mixing section.

2.07 CAPACITIES AND CHARACTERISTICS

A. Static-Pressure Classifications for Unit Sections 8-inch wg (2000 Pa)

B. See Drawing schedules for capacities and characteristics.

2.08 SOURCE QUALITY CONTROL

A. Fan Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans

according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Fans shall bear AMCA-certified sound ratings seal.

B. Fan Performance Rating: Factory test fan performance for airflow, pressure, power, air density, rotation speed, and efficiency. Rate performance according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating."

C. Water Coils: Factory tested to 300 psig (2070 kPa) according to ARI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-handling unit installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for, hydronic, and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Equipment Mounting: Install air-handling units on concrete bases using restrained spring isolators. Secure units to anchor bolts installed in concrete bases. Comply with requirements for concrete bases specified in Section 03300 "Cast-in-Place Concrete." Comply with requirements for vibration isolation devices specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1 inch (25 mm).

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

3. Install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use setting drawings,

templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Suspended Units: Suspend and brace units from structural-steel support frame using threaded steel rods and spring hangers. Comply with requirements for vibration isolation devices specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

C. Arrange installation of units to provide access space around air-handling units for service and maintenance.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with new, clean filters.

E. Install filter-gage, static-pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum in accessible position. Provide filter gages on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

3.03 CONNECTIONS

A. Comply with requirements for piping specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air-handling unit to allow service and maintenance.

C. Connect piping to air-handling units mounted on vibration isolators with flexible connectors.

D. Connect condensate drain pans using ASTM B 88, Type M (ASTM B 88M, Type C) copper tubing or storm water piping material. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.

E. Hot- and Dual-service heating and cooling piping -Water Piping: Comply with applicable requirements in Section 15181 "Hydronic Piping." Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.

F. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 15820 "Duct Accessories."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Leak Test: After installation, fill water coils with water, and test coils and connections for leaks.

2. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Air-handling unit or components will be considered defective if unit or components do not pass tests and inspections.

E. Prepare test and inspection reports.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Verify that shipping, blocking, and bracing are removed.

3. Verify that unit is secure on mountings and supporting devices and that connections to piping, ducts, and electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers, and switches.

4. Verify proper motor rotation direction, free fan wheel rotation, and smooth bearing operations. Reconnect fan drive system, align belts, and install belt guards.

5. Verify that bearings, pulleys, belts, and other moving parts are lubricated with factory-recommended lubricants.

6. Verify that zone dampers fully open and close for each zone.

7. Verify that outdoor- and return-air mixing dampers open and close,

and maintain minimum outdoor-air setting.

8. Comb coil fins for parallel orientation.

9. Verify that proper thermal-overload protection is installed for electric coils.

10. Install new, clean filters.

11. Verify that manual and automatic volume control and fire and smoke dampers in connected duct systems are in fully open position.

B. Starting procedures for air-handling units include the following:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated rpm. Replace fan and motor pulleys as required to achieve design conditions.

2. Measure and record motor electrical values for voltage and amperage.

3. Manually operate dampers from fully closed to fully open position and record fan performance.

3.06 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 15950 "Testing, Adjusting, and Balancing" for air-handling system testing, adjusting, and balancing.

3.07 CLEANING

A. After completing system installation and testing, adjusting, and balancing air-handling unit and air-distribution systems and after completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, cabinets, dampers, coils, and filter housings, and install new, clean filters.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train. Owner's maintenance personnel to adjust, operate, and maintain air-handling units.

PART 4: MEASUREMENT AND PAYMENT

4.01 MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS:

A. Modular Indoor Central-Station Air-Handling Units will not be measured for payment.

B. Modular Indoor Central-Station Air-Handling Units will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15738

SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.06 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. Filters: One set for each evaporator unit.

2. Fan Belts: One set for each evaporator unit fan.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.08 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.

b. For Parts: One year from date of Substantial Completion.

c. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. McQuay/Diakin.

2. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.

3. Mitsubishi Heavy Industries America, Inc.

4. SANYO North America Corporation; SANYO Fisher Company.

5. Trane; a business of American Standard companies.

6. YORK; a Johnson Controls company.

2.02 INDOOR UNITS (2TONS OR LESS)

A. Fan Cabinet Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

2. Insulation: Faced, glass-fiber duct liner.

3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.

4. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.

5. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

6. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

8. Condensate Drain Pans:

a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

i. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.

ii. Depth: A minimum of 2 inches (50 mm) deep.

b. Single-wall, galvanized-steel sheet.

c. Double-wall, galvanized-steel sheet with space between walls filled with foam insulation and moisture-tight seal.

d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

i. Minimum Connection Size: NPS 1 (DN 25).

e. Pan-Top Surface Coating: Asphaltic waterproofing compound.

f. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

g. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

B. Floor-Mounted, Fan Cabinet Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect.

a. Discharge Grille: Steel with surface-mounted frame.

b. Insulation: Faced, glass-fiber duct liner.

c. Drain Pans: Galvanized steel, with connection for drain; insulated.

2. Air Filtration Section:

a. General Requirements for Air Filtration Section:

i. Comply with NFPA 90A.

ii. Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

iii. Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:

i. Factory-fabricated, viscous-coated, flat-panel type.

ii. Thickness: 1 inch (25 mm).

iii. Merv according to ASHRAE 52.2: 5.

iv. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

C. Wall or Ceiling Mounted, Fan Cabinet Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.

2. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

b. Multitapped, multispeed with internal thermal protection and permanent lubrication.

c. Enclosure Type: Totally enclosed, fan cooled.

d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.

e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

f. Mount unit-mounted disconnect switches on interior of unit.

3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

4. Condensate Drain Pans:

a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

i. Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.

ii. Depth: A minimum of 1 inch (25 mm) deep.

b. Single-wall, high impact polymer sheet.

c. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

i. Minimum Connection Size: NPS 1 (DN 25).

5. Air Filtration Section:

a. General Requirements for Air Filtration Section:

i. Comply with NFPA 90A.

ii. Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.

b. Disposable Panel Filters:

i. Factory-fabricated, viscous-coated, flat-panel type.

ii. Thickness: 1 inch (25 mm).

iii. Merv according to ASHRAE 52.2: 5.

iv. Media: Interlaced glass fibers sprayed with nonflammable adhesive.

2.03 OUTDOOR UNITS (2 TONS OR LESS)

A. Air-Cooled, Compressor-Heat Pump Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

   a. Compressor Type: Scroll.

   b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

   c. Refrigerant Charge R-410A.

   d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.

3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.

4. Fan: Aluminum-propeller type, directly connected to motor.

5. Motor: Permanently lubricated, with integral thermal-overload protection.

6. Low Ambient Kit: Permits operation down to 15 deg F (-7 deg C).

7. Mounting Base: Polyethylene.

2.04 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 15900 "HVAC Instrumentation and Controls".

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction

line with flared fittings at both ends.

D. Drain Hose: For condensate.

E. Outdoor Air: Provided integral connection for hard ducted outdoor air connection

F. Additional Monitoring:

1. Monitor constant and variable motor loads.

2. Monitor variable-frequency-drive operation.

3. Monitor economizer cycle.

4. Monitor cooling load.

5. Monitor air distribution static pressure and ventilation air volumes.

2.05 CAPACITIES AND CHARACTERISTICS

A. See Design Drawings for schedule of capacities and characteristics.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07720 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Install seismic restraints.

E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch (25 mm). See Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 15815 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 15820 "Duct Accessories."

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

PART 4: MEASUREMENT AND PAYMENT

4.01 SPLIT-SYSTEM AIR-CONDITIONING UNITS:

A. Split-System Air-Conditioning Units will not be measured for payment.

B. Split-System Air-Conditioning Units will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15745

WATER-SOURCE HEAT PUMPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following types of water-source heat pumps:

1. Concealed horizontal or vertical units, 6 tons (21 kW) and smaller.

2. Exposed, floor-mounted console units.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the items are shown and coordinated with each other, based on input from installers of the items involved.

B. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.

C. Manufacturer Seismic Qualification Certification: Submit certification that water-source heat pumps, accessories, and components will withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is

based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.

E. Warranty: Special warranty specified in this Section.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water-source heat pumps to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. One set of matched fan belts for each belt-driven fan.

2. One set of filters for each unit.

3. One spare heat-pump motor for each fan size and one spare compressor for each compressor size.

1.07 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Section 01600 "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance:

1. ASHRAE 15.

2. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

E. Comply with NFPA 70.

F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.

G. Comply with safety requirements in UL 1995 for duct-system connections.

1.08 COORDINATION

A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300 "Cast-in-Place Concrete.".

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, refrigeration components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

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

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be

incorporated into the Work include, but are not limited to, manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CONCEALED WATER-SOURCE HEAT PUMPS

A. Available Manufacturers:

1. Addison Products Company.

2. ClimateMaster, Inc.

3. FHP Manufacturing Inc.

4. Hydro-Temp Corporation, Inc.

5. Mammoth Inc.

6. McQuay/Diakin.

7. Trane.

8. WaterFurnace International, Inc.

B. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.

2. Knockouts for electrical and piping connections.

3. Flanged duct connections.

4. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch (13 mm) thick, complies with UL 181.

5. Condensate Drainage: Plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet and complying with ASHRAE 62.1.

a. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

7. Sound Attenuation Package:

   a. Minimum 0.598-inch- (1.5-mm-) thick compressor enclosure and front panel. Minimum 0.0937-inch- (2.38-mm-) thick foam gasket around the compressor and perimeter of end panel.

   b. Sound attenuating blanket over compressor.

   c. Hot-gas muffler.

D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet.

   1. General requirements for motors are specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

   2. Motor: Multispeed, permanently lubricated, ECM motor.

E. Water Circuit:

   1. Refrigerant-to-Water Heat Exchangers:

      a. Coaxial heat exchangers with copper water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig (3102 kPa) on refrigerant side and 400 psig (2758 kPa) on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

   2. Water Regulating Valves: Limit water flow through refrigerant-to-water heat exchanger, and control head pressure on compressor during cooling and heating. Valves shall close when heat-pump compressor is not running.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig (3102 kPa).

G. Refrigerant Circuit Components:

   1. Sealed Refrigerant Circuit: Charge with R-407C or R-410A refrigerant.

   2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

   3. Charging Connections: Service fittings on suction and liquid for charging and testing.

4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.

5. Compressor: Hermetic rotary scroll compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:

   a. Antirecycle timer.

   b. High-pressure cutout.

   c. Low-pressure cutout or loss of charge switch.

   d. Internal thermal-overload protection.

   e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F (2 deg C).

   f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

7. Pipe Insulation: Refrigerant minimum 3/8-inch- (10-mm-) thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.

8. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F (minus 4 to plus 52 deg C).

9. Hot-Gas Reheat Valve: Pilot-operated sliding-type valve with replaceable magnetic coil.

H. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

I. Filters: Disposable, pleated type, 1 inch (25 mm) thick and with a minimum of 90 percent arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value of 7 according to ASHRAE 52.2.

J. Control equipment and sequence of operation are specified in Section 15900 "HVAC Instrumentation and Controls".

K. Controls:

1. Basic Unit Controls:

   a. Low- and high-voltage protection.

   b. Overcurrent protection for compressor and fan motor.

   c. Random time delay, three to ten seconds, start on power up.

   d. Time delay override for servicing.

   e. Control voltage transformer.

2. BAS interface requirements as further described in Section 15900 "HVAC Instrumentation and Controls".

   a. Interface relay for scheduled operation.

   b. Interface relay to provide indication of fault at central workstation.

   c. Provide BAC-net

   d. Interface for central BAS workstation for the following functions:

      i. Set-point adjustment for set points identified in this Section.

      ii. Start/stop and operating status of heat-pump unit.

      iii. Data inquiry to include supply air, room air temperature and humidity, and entering-water temperature.

      iv. Occupied and unoccupied schedules.

L. Electrical Connection: Single electrical connection with fused disconnect.

M. Capacities and Characteristics:

N. See Design Drawings for schedule of capacities and characteristics.

2.03 EXPOSED, CONSOLE WATER-SOURCE HEAT PUMPS

A. Available Manufacturers:

1. Addison Products Company.

2. ClimateMaster, Inc.

3. FHP Manufacturing Inc.

4. Hydro-Temp Corporation, Inc.

5. Mammoth Inc.

6. McQuay International.

7. Trane.

8. WaterFurnace International, Inc.

B. Description: Packaged water-source heat pump with temperature controls; factory assembled, tested, and rated according to ARI-ISO-13256-1.

C. Cabinet and Chassis: Manufacturer's standard- and low-height, flat-top, extended galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.

2. Knockouts for electrical and piping connections.

3. Cabinet Insulation: Glass-fiber liner, 1/2 inch (13 mm) thick, complying with UL 181.

4. Condensate Drainage: Plastic or stainless-steel drain pan with condensate drain piping projecting to unit exterior and complying with ASHRAE 62.1.

5. Discharge Grille: Steel, aluminum, or plastic grille for adjustable discharge air pattern.

6. Color: Selected by Architect from manufacturer's standard color selection.

7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

8. Sound Attenuation Package: Provide one or more of the following.

a. Minimum 0.598-inch- (1.5-mm-) thick compressor enclosure and front panel. Minimum 0.0937-inch (2.38-mm) thick foam gasket around the compressor and perimeter of end panel.

D. Fan: Direct driven, centrifugal, with multispeed motor mounted on a removable fan-motor board.

1. General requirements for motors are specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

2. Motor: Multispeed, permanently lubricated, ECM.

E. Water Circuit:

1. Refrigerant-to-Water Heat Exchanger: Coaxial heat exchanger with copper water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig (3102 kPa) for refrigerant side and 400 psig (2758 kPa) for water side. Mount heat exchange in unit on resilient rubber vibration isolators.

2. Water Regulating Valves: Limit water flow through refrigerant-to-water heat exchanger and control head pressure on compressor during cooling and heating. Valves shall close when heat-pump compressor is not running.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig (3102 kPa).

G. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-407C or R-410A refrigerant.

2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

3. Charging Connections: Service fittings on suction and liquid for charging and testing.

4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.

5. Compressor: Hermetic rotary compressor installed on vibration isolators housed in an acoustically treated enclosure with factory-installed safeties as follows:

a. Antirecycle timer.

b. High-pressure cutout.

c. Low-pressure cutout or loss of charge switch.

d. Internal thermal-overload protection.

e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F (2

deg C).

f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

7. Pipe Insulation: Refrigerant minimum 3/8-inch- (10-mm-) thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes per ASTM E 84.

8. Refrigerant Metering Device:

a. Capillary tube.

b. Thermal expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F (minus 4 to 52 deg C).

9. Hot-Gas Reheat Valve: Pilot-operated sliding-type valve with replaceable magnetic coil.

H. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when unit-mounted humidistat calls for dehumidification.

I. Outdoor-Air Damper: Two-position, motorized outdoor-air damper for fixed minimum intake up to 25 percent of fan capacity.

J. Filters: Disposable, pleated type, 1 inch (25 mm) thick and with a minimum of 90 percent arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value of 7 according to ASHRAE 52.2.

K. Control equipment and sequence of operation are specified in Section 15900 "HVAC Instrumentation and Controls".

L. Controls:

1. Basic Unit Controls:

a. Low- and high-voltage protection.

b. Overcurrent protection for compressor and fan motor.

c. Random time delay, three to ten seconds, start on power up.

d. Time delay override for servicing.

e. Control voltage transformer.

2. BAS interface requirements as further described in Section 15900 "HVAC Instrumentation and Controls".

a. Interface relay for scheduled operation.

b. Interface relay to provide indication of fault at central workstation.

c. Provide BAC-net interface for central BAS workstation for the following functions:

i. Set-point adjustment for set points identified in this Section.

ii. Start/stop and operating status of heat-pump unit.

iii. Data inquiry to include supply air, room air temperature and humidity, and entering-water temperature.

iv. Occupied and unoccupied schedules.

M. Electrical Connection: Single electrical connection with fused disconnect.

N. Capacities and Characteristics:

1. See Design Drawings for schedule of capacities and characteristics.

2.04 HOSE KITS

A. General: Hose kits shall be designed for minimum 400 psig (2758 kPa) working pressure, and operating temperatures from 33 to 211 deg F (0.5 to 99 deg C). Tag hose kits to equipment designations.

B. Hose: Length 24 inches (600 mm). Minimum diameter, equal to water-source heat-pump connection size.

C. Isolation Valves: Two-piece bronze-body ball valves with stainless-steel ball and stem and galvanized-steel lever handle. Provide valve for supply and return. If balancing device is combination shutoff type with memory stop, the isolation valve may be omitted on the return.

D. Strainer: Y-type with blowdown valve in supply connection.

E. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

1. Manual, venturi-type balancing valve.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.

B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Equipment Mounting: Install water-source heat pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases specified in Section 03300 "Cast-in-Place Concrete."

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct bases to withstand, without damage to equipment, seismic force required by code.

3. Construct concrete bases 4 inches (100 mm) high and extend base not less than 6 inches (150 mm) in all directions beyond the maximum dimensions of water-source heat pump unless otherwise indicated or unless required for seismic anchor support.

4. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.

5. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

6. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.

7. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

8. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Unit Support: Install water-source heat pumps level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

3.03 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with unions and shutoff valves or hose kits.

2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Duct installation requirements are specified in other Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Section 15820 "Duct Accessories."

2. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch- (50-mm-) thick, acoustic duct liner.

3. Install normal-weight, 3000 psi (20.7 MPa), compressive-strength (28-day) concrete mix inside roof curb, 4 inches (100 mm) thick. Concrete, formwork, and reinforcement are specified in Section 03300 "Cast-in-Place Concrete.".

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance.

E. Ground equipment according to Section 16060 "Grounding and Bonding."

F. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

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

1. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.

2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions:

3.06 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.07 CLEANING

A. Replace filters used during construction prior to air balance or substantial completion.

B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat

pumps.

PART 4: MEASUREMENT AND PAYMENT

4.01 WATER-SOURCE HEAT PUMPS:

A. Water-Source Heat Pumps will not be measured for payment.

B. Water-Source Heat Pumps will not be paid directly, but will be included in the lump sum bid prices for maintenance building

END OF SECTION

SECTION 15761

AIR COILS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following types of air coils that are not an integral part of air-handling units:

1. Hot-water.

2. Refrigerant.

1.03 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 each air coil. Include rated capacity and pressure drop for each air coil.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

B. Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.

2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 - PRODUCTS

2.01 WATER COILS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aerofin Corporation.

2. Coil Company, LLC.

3. Heatcraft Refrigeration Products LLC; Heat Transfer Division.

4. McQuay/Diakin.

5. Trane.

6. USA Coil & Air.

B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

C. Minimum Working-Pressure/Temperature Ratings: 200 psig (1380 kPa), 325 deg F (163 deg C).

D. Source Quality Control: Factory tested to 300 psig (2070 kPa).

E. Tubes: ASTM B 743 copper, minimum 0.020 inch (0.508 mm) thick.

F. Fins: Aluminum, minimum 0.010 inch (0.254 mm) thick.

G. Headers: Cast iron with cleaning plugs, and drain and air vent tappings.

H. Frames: Galvanized-steel channel frame, minimum 0.064 inch (1.6 mm) thick for slip-in or flanged mounting.

I. Hot-Water Coil Capacities and Characteristics:

1. See Design Drawings for schedule of capacities and characteristics

2.02 REFRIGERANT COILS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aerofin Corporation.

2. Coil Company, LLC.

3. Heatcraft Refrigeration Products LLC; Heat Transfer Division.

4. McQuay/Diakin.

5. Trane.

6. USA Coil & Air.

B. Performance Ratings: Tested and rated according to ARI 410 and ASHRAE 33.

C. Minimum Working-Pressure Rating: 300 psig (2070 kPa).

D. Source Quality Control: Factory tested to 450 psig (3105 kPa).

E. Tubes: ASTM B 743 copper, minimum 0.020 inch (0.508 mm) thick.

F. Fins: Aluminum, minimum 0.010 inch (0.254 mm) thick.

G. Suction and Distributor Piping: ASTM B 88, Type L (ASTM B 88M, Type B) copper tube with brazed joints.

H. Frames: Galvanized-steel channel frame, minimum 0.064 inch (1.6 mm) thick for slip-in or flanged mounting.

I. Capacities and Characteristics:

1. See Design Drawings for schedule of capacities and characteristics.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Install stainless-steel drain pan under each cooling coil.

1. Construct drain pans with connection for drain; insulated and complying with ASHRAE 62.1.

2. Construct drain pans to extend beyond coil length and width and to connect to condensate trap and drainage.

3. Extend drain pan upstream and downstream from coil face.

4. Extend drain pan under coil headers and exposed supply piping.

D. Install moisture eliminators for cooling coils. Extend drain pan under moisture eliminator.

E. Straighten bent fins on air coils.

F. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Section 15900 "HVAC Instrumentation and Controls," and other piping specialties are specified in Section 15181 "Hydronic Piping."

D. Connect refrigerant piping according to Section 15183 "Refrigerant Piping."

PART 4: MEASUREMENT AND PAYMENT

4.01 AIR COILS:

A. Air Coils will not be measured for payment.

B. Air Coils will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15785

AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Fixed-plate sensible heat exchangers.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design vibration isolation and seismic-restraint details, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Seismic Performance: Air-to-air energy recovery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For air-to-air energy recovery equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For air-to-air energy recovery equipment 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.05 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For air-to-air energy recovery equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include in maintenance manuals.

1.07 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. Filters: One set of each type of filter specified.

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ARI Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."

2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air- Cooling and Air-Heating Coils."

C. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

2. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

D. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

E. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators".

1.09 COORDINATION

A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fixed-Plate Total Heat Exchangers: **10** years.

PART 2 - PRODUCTS

2.01 FIXED-PLATE SENSIBLE HEAT EXCHANGERS

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. American Energy Exchange, Inc.

2. Des Champs Technologies.

3. RenewAire LLC.

4. UAS, Inc.; a CLARCOR company.

5. XeteX Inc.

B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Casing: Galvanized steel, with galvanized-steel liner with duct collars.

D. Casing Insulation: 1-inch- (25-mm-) thick, glass fiber.

E. Drain Pan: Same material as casing, with drain connections on exhaust and supply side.

1. Comply with requirements in ASHRAE 62.1.

F. Plates: Evenly spaced and sealed and arranged for counter airflow.

1. Plate Material: Embossed aluminum.

G. Extended-Surface, Disposable Panel Filters:

1. Comply with NFPA 90A.

2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.

3. Factory-fabricated, dry, extended-surface type.

4. Thickness: 4 inches (100 mm).

5. Initial Resistance: 0.15 inches wg.

6. Recommended Final Resistance: 0.5 inches wg.

7. Minimum MERV: 7, according to ASHRAE 52.2.

8. Media: Fibrous material formed into deep-V-shaped pleats and held by self-supporting wire grid.

9. Media-Grid Frame: Nonflammable cardboard.

10. Mounting Frames: Welded, galvanized steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.02 CAPACITIES AND CHARACTERISTICS

A. See floor plans and Schedules for capacities and characteristics.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for electrical services to verify actual locations of connections before installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install fixed-plate heat exchangers so supply and exhaust airstreams flow in opposite directions.

1. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger. Access doors and panels are specified in Section 15820 "Duct Accessories."

B. Install floor-mounted units on 4-inch- (100-mm-) high concrete base.

C. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure air-to-air energy recovery equipment to structural support with anchor bolts.

D. Install units with clearances for service and maintenance.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

F. Pipe drains from drain pans to nearest floor drain; use ASTM B 88, Type L (ASTM B 88M, Type B), drawn-temper copper water tubing with soldered joints, same size as condensate drain connection.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

PART 4: MEASUREMENT AND PAYMENT

4.01 AIR-TO-AIR ENERGY RECOVERY EQUIPMENT UNITS:

A. Air-To-Air Energy Recovery Equipment will not be measured for payment.

B. Air-To-Air Energy Recovery Equipment will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15791

CABINET UNIT HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes cabinet unit heaters with centrifugal fans and hot-water heating coils.

1.03 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include location and size of each field connection.

4. Include details of anchorages and attachments to structure and to supported equipment.

5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.

6. Indicate location and arrangement of piping valves and specialties.

7. Wiring Diagrams: Power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which items are shown and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Certificates: Submit certification that cabinet unit heaters, accessories, and components will withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Include detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit-Heater Filters: Furnish one spare filter for each filter installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Airtherm; a Mestek company.

2. Engineered Air.

3. International Environmental Corporation.

4. McQuay International.

5. Modine.

6. Trane Inc.

7. Vulcan.

8. Sterling.

9. USA Coil & Air.

2.02 DESCRIPTION

A. Factory-assembled and -tested unit complying with AHRI 440.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.03 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

C. Seismic Performance: Cabinet unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified.

2.04 COIL SECTION INSULATION

A. Insulation Materials: ASTM C 1071; surfaces exposed to airstream shall have aluminum-foil facing to prevent erosion of glass fibers.

1. Thickness: 1/2 inch (13 mm).

2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75

deg F (0.037 W/m x K at 24 deg C) mean temperature.

3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.05 CABINETS

A. Material: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.

1. Vertical Unit, Exposed Front Panels: Minimum 0.0677-inch- (1.7-mm-) thick sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.

2. Recessed Flanges: Steel, finished to match cabinet.

3. Control Access Door: Key operated.

4. Base: Minimum 0.0528-inch- (1.35-mm-) thick steel, finished to match cabinet, 4 inches (100 mm) high.

5. Extended Piping Compartment: 8-inch- (200-mm-) wide piping end pocket.

2.06 FILTERS

A. Minimum Arrestance: According to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber Treated with Adhesive: 80 percent arrestance and MERV 5.

2.07 COILS

A. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1378 kPa) and a maximum entering-water temperature of 220 deg F (104 deg C). Include manual air vent and drain.

2.08 CONTROLS

A. Fan and Motor Board: Removable.

1. Fan: Forward curved, high static, double width, centrifugal, directly connected to motor; thermoplastic or painted-steel wheels and aluminum, painted-steel, or galvanized-steel fan scrolls.

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Section 15058 "Common Motor Requirements for HVAC Equipment."

3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

B. Factory, Hot-Water Piping Package: ASTM B 88, Type L (ASTM B 88M, Type B) copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Three-way, modulating control valve. Three-way valve packages shall include bypass line with manually adjustable balance device.

2. Two-Piece, Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

3. Calibrated-Orifice Balancing Valves: Bronze body, ball type, 125-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature; with calibrated orifice or venture, connection for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.

4. Y-Pattern, Hot-Water Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig (860-kPa) minimum working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 (DN 15) threaded pipe and full-port ball valve in strainer drain connection.

5. Wrought-Copper Unions: ASME B16.22.

C. Control devices and operational sequences are specified in Section 15900 "HVAC Instrumentation and Controls".

D. Basic Unit Controls:

1. Control voltage transformer.

2. Unit-mounted thermostat with the following features:

a. Heat-off switch.

b. Fan on-auto switch.

c. Manual fan-speed switch.

d. Adjustable deadband.

e. Exposed set point.

f. Exposed indication.

g. Deg F (Deg C) indication.

3. Data entry and access port.

a. Input data includes room temperature and occupied and unoccupied periods.

b. Output data includes room temperature, supply-air temperature, entering-water temperature, operating mode, and status.

E. Electrical Connection: Factory-wired motors and controls for a single field connection, including fused disconnect.

2.09 CAPACITIES AND CHARACTERISTICS

A. See contract drawings schedules for capacities and characteristics.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 07920 "Architectural Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.03 CONNECTIONS

A. Piping installation requirements are specified in Section 15181 "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of cabinet unit heater. Hydronic specialties are specified in Section 15181 "Hydronic Piping."

F. Ground equipment according to Section 16060 "Grounding and Bonding."

G. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 ADJUSTING

A. Adjust initial temperature set points.

PART 4: MEASUREMENT AND PAYMENT

4.01 CABINET UNIT HEATERS:

A. Cabinet Unit Heaters will not be measured for payment.

B. Cabinet Unit Heaters will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15792

PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes propeller unit heaters with hot-water coils.

1.03 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include location and size of each field connection.

4. Include details of anchorages and attachments to structure and to supported equipment.

5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.

6. Indicate location and arrangement of piping valves and specialties.

7. Indicate location and arrangement of integral controls.

8. Wiring Diagrams: Power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the items are shown and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Certificates: Submit certification that propeller unit heaters, accessories, and components will withstand seismic forces defined in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Include detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Airtherm; a Mestek company.

2. Engineered Air.

3. International Environmental Corporation.

4. McQuay International.

5. Modine.

6. Trane Inc.

7. Vulcan.

8. Sterling.

2.02 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.03 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

C. Seismic Performance: Propeller unit heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified.

2.04 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Discharge Louver: Adjustable fin diffuser for horizontal units.

2.05 COILS

A. General Coil Requirements: Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.

B. Hot-Water Coil: Copper tube, minimum 0.025-inch (0.635-mm) wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch (2.5 mm) and rated for a minimum working pressure of 200 psig (1380 kPa) and a maximum entering-water temperature of 325 deg F (163 deg C), with manual air vent. Test for leaks to 350 psig (2413 kPa)

underwater.

2.06 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated, multispeed. Comply with requirements in Section 15058 "Common Motor Requirements for HVAC Equipment."

C. Electrical Connection: Factory-wired motors and controls for a single field connection, including fused disconnect.

2.07 CONTROLS

A. Control Devices:

1. Unit-mounted, variable fan-speed switch.

2. Unit-mounted thermostat.

2.08 CAPACITIES AND CHARACTERISTICS

A. See contract drawings schedules for capacities and characteristics.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for [piping and]electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Section 15062 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.03 CONNECTIONS

A. Piping installation requirements are specified in Section 15181 "Hydronic Piping" Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to propeller unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Comply with safety requirements in UL 1995.

E. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of propeller unit heater. Hydronic specialties are specified in Section 15181 "Hydronic Piping."

F. Ground equipment according to Section 16060 "Grounding and Bonding."

G. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.05 ADJUSTING

A. Adjust initial temperature set points.

PART 4: MEASUREMENT AND PAYMENT

4.01 PROPELLER UNIT HEATERS:

A. Propeller Unit Heaters will not be measured for payment.

B. Propeller Unit Heaters will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15815

METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.
7. Seismic-restraint devices.

B. Related Sections:

1. Section 15820 "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
2. Section 15950 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing requirements for metal ducts.

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within

limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.

2. Sealants and gaskets.

3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.

2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.

4. Elevation of top of ducts.

5. Dimensions of main duct runs from building grid lines.

6. Fittings.

7. Reinforcement and spacing.

8. Seam and joint construction.

9. Penetrations through fire-rated and other partitions.

10. Equipment installation based on equipment being used on Project.

11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.

2. Joint and seam construction and sealing.

3. Reinforcement details and spacing.

4. Materials, fabrication, assembly, and spacing of hangers and supports.

5. Design Calculations: Calculations, for selecting hangers and supports and seismic restraints.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the items are shown and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible,"

Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. McGill AirFlow LLC.

b. SEMCO Incorporated.

c. Sheet Metal Connectors, Inc.

d. Spiral Manufacturing Co., Inc.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5,

"90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.03 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).

2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Aluminized Steel Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

1. Where galvanized-steel shapes and plates are used to reinforce aluminized steel ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.04 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

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. CertainTeed Corporation; Insulation Group.

b. Johns Manville.

c. Knauf Insulation.

d. Owens Corning.

2. Maximum Thermal Conductivity:

a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.

3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

4. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel, aluminized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).

7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.

8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

   a. Fan discharges.

   b. Intervals of lined duct preceding unlined duct.

   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.

9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.05 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

2. Tape Width: 4 inches (102 mm).

3. Sealant: Modified styrene acrylic.

4. Water resistant.

5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.

7. Service: Indoor and outdoor.

8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), or aluminized steel.

10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.

2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.

4. Water resistant.

5. Mold and mildew resistant.

6. VOC: Maximum 75 g/L (less water).

7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.

8. Service: Indoor or outdoor.

9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), or aluminized steel sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.

3. Grade: NS.

4. Class: 25.

5. Use: O.

6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for10-inch wg (2500-Pa) static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.06 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2. Supports for Aluminized steel Ducts: Aluminized steel or galvanized steel coated with zinc chromate.

2.07 SEISMIC-RESTRAINT DEVICES

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. Cooper B-Line, Inc.; a division of Cooper Industries.

2. Ductmate Industries, Inc.

3. Hilti Corp.

4. Kinetics Noise Control.

5. Mason Industries.

6. Unistrut Corporation; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of the ICC Evaluation Service.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

D. Restraint Cables: ASTM A 603, galvanized -steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod.

F. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge

type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 15820 "Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for

Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.02 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Where ducts extend down below 7’-0” above finished floor provide sheetmetal at least one gauge heavier than required by SMACNA, but no less than 20 Gauge.

C. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

F. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.03 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight

aggregate concretes or for slabs more than 4 inches (100 mm) thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

1. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.

2. Brace a change of direction longer than 12 feet (3.7 m).

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an evaluation service member of the ICC Evaluation Service.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect 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 sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 15820 "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

C. Where duct plenum connects to exterior wall louvers, provide aluminized steel duct for plenum and blank off. Blank-off unused portions of louver and insulate plenum and duct in accordance with Section 15086 “Duct insulation”.

3.07 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09911 "Exterior Painting" and Section 09915 "Interior Painting."

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections, totaling no less than 25 percent of total installed duct area for each designated pressure class and construction type.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

4. Test for leaks before applying external insulation.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.09 DUCT CLEANING

A. Clean duct systems before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 15820 "Duct Accessories" for access panels and doors.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.

4. Coils and related components.

5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.

6. Supply-air ducts, dampers, actuators, and turning vanes.

7. Dedicated exhaust and ventilation components and makeup air systems.

D. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously

during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

A. Air Balance: Comply with requirements in Section 15950 "Testing, Adjusting, and Balancing."

3.11 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel in accordance with the SMACNA duct pressure classification based on the maximum static pressure rating as scheduled for that system on the drawings.:

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel coated with zinc-chromate primer.

2. Aluminized steel Ducts: Aluminized steel or galvanized sheet steel coated with zinc chromate.

C. Liner:

1. Air Ducts: Fibrous glass, Type I 1 inch (25 mm).

D. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct

Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.

c. Mitered Elbows are not acceptable.

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

i. Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 10 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 12 Inches (356 mm) and Larger in Diameter: Standing seam.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Branch: 45-degree entry.

2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.

b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.

c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

PART 4: MEASUREMENT AND PAYMENT

4.01 METAL DUCTS:

A. Metal Ducts will not be measured for payment.

B. Metal Ducts will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15820

DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Smoke dampers.
7. Flange connectors.
8. Turning vanes.
9. Remote damper operators.
10. Duct-mounted access doors.
11. Flexible connectors.
12. Flexible ducts.
13. Duct accessory hardware.
14. Vehicle Exhaust Hose Reels
15. Turbine Ventilators

B. Related Requirements:

1. Section 13852 "Digital, Addressable Fire-Alarm System" for duct-

mounted fire and smoke detectors.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Control-damper installations.

d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

e. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.01 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.02 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).

2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.

2. American Warming and Ventilating; a division of Mestek, Inc.

3. Greenheck Fan Corporation.

4. Nailor Industries Inc.

5. NCA Manufacturing, Inc.

6. Ruskin Company.

7. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 fpm (5.1 m/s).

D. Maximum System Pressure: 1-inch wg (0.25 kPa).

E. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, off-center pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Extruded vinyl, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel.

2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.

2. Counterweights and spring-assist kits for vertical airflow installations.

3. Chain pulls.

4. Screen Mounting: Front mounted in sleeve.

   a. Sleeve Thickness: 20 gage (1.0 mm) minimum.

   b. Sleeve Length: 6 inches (152 mm) minimum.

5. Screen Mounting: Rear mounted.

6. Screen Material: Galvanized steel.

7. Screen Type: Bird.

8. 90-degree stops.

2.04 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.

2. American Warming and Ventilating; a division of Mestek, Inc.

3. Greenheck Fan Corporation.

4. Nailor Industries Inc.

5. NCA Manufacturing, Inc.

6. Ruskin Company.

7. Vent Products Company, Inc.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 1000 fpm (5.1 m/s).

D. Maximum System Pressure: 1-inch wg (0.25 kPa).

E. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, off-center pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum

with sealed edges and parallel action.

1. Balance: Gravity.

2. Off-center pivoted.

G. Blade Seals: Vinyl.

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Galvanized steel.

2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Bronze.

L. Accessories:

1. Flange on intake.

2. Adjustment device to permit setting for varying differential static pressures.

2.05 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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. Air Balance Inc.; a division of Mestek, Inc.

b. American Warming and Ventilating; a division of Mestek, Inc.

c. McGill AirFlow LLC.

d. Nailor Industries Inc.

e. Ruskin Company.

f. Trox USA Inc.

g. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.

4. Frames:

   a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.

   b. Mitered and welded corners.

   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

   a. Multiple or single blade.

   b. Parallel- or opposed-blade design.

   c. Stiffen damper blades for stability.

   d. Galvanized-steel, 0.064 inch (1.62 mm) thick.

6. Blade Axles: Galvanized steel.

7. Bearings:

   a. Oil-impregnated bronze.

   b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

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. Air Balance Inc.; a division of Mestek, Inc.

   b. American Warming and Ventilating; a division of Mestek, Inc.

   c. McGill AirFlow LLC.

d. Nailor Industries Inc.

e. Ruskin Company.

f. Trox USA Inc.

g. Vent Products Company, Inc.

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.

4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.

b. Parallel- or opposed-blade design.

c. Stiffen damper blades for stability.

d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.

6. Blade Axles: Nonferrous metal.

7. Bearings:

a. Molded synthetic.

b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

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. Air Balance Inc.; a division of Mestek, Inc.

b. American Warming and Ventilating; a division of Mestek, Inc.

c. McGill AirFlow LLC.

d. Nailor Industries Inc.

e. Ruskin Company.

f. Vent Products Company, Inc.

2. Comply with AMCA 500-D testing for damper rating.

3. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

4. Suitable for horizontal or vertical applications.

5. Frames:

a. Hat shaped.

b. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.

c. Mitered and welded corners.

d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

a. Multiple or single blade.

b. Opposed-blade design.

c. Stiffen damper blades for stability.

d. Galvanized, roll-formed steel, 0.064 inch (1.62 mm) thick.

7. Blade Axles: Stainless steel.

8. Bearings

a. Oil-impregnated stainless-steel sleeve.

b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.

10. Jamb Seals: Cambered stainless steel.

11. Tie Bars and Brackets: Galvanized steel.

12. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Jackshaft:

1. Size: 0.5-inch (13-mm) diameter.

2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

E. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-(2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut.

2. Include center hole to suit damper operating-rod size.

3. Include elevated platform for insulated duct mounting.

2.06 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.

2. Arrow United Industries; a division of Mestek, Inc.

3. Greenheck Fan Corporation.

4. Nailor Industries Inc.

5. Ruskin Company.

6. Vent Products Company, Inc.

7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa)] static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.138 inch (3.5 mm) or 0.39 inch (9.9 mm) thick, as indicated, and of length to suit application.

2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, rated, fusible links.

2.07 SMOKE DAMPERS

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. Air Balance Inc.; a division of Mestek, Inc.

2. Greenheck Fan Corporation.

3. Nailor Industries Inc.

4. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa)] static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.138 inch (3.5 mm) or 0.39 inch (9.9 mm) thick, as indicated, and of length to suit application.

2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, rated, fusible links.

K. Smoke Detector: provided with Fire Alarm system.

L. Leakage: Class II.

M. Rated pressure and velocity to exceed design airflow conditions.

N. Mounting Sleeve: Factory-installed, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

O. Damper Motors two-position action.

P. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large

enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 15900 "HVAC Instrumentation and Controls."

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).

5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).

7. Electrical Connection: 115 V, single phase, 60 Hz.

Q. Accessories:

1. Auxiliary relays for remote switching

2. Test and reset automatic switch capability.

2.08 FLANGE CONNECTORS

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. Ductmate Industries, Inc.

2. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-forme], factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.09 TURNING VANES

A. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

B. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.10 DUCT-MOUNTED ACCESS DOORS

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. American Warming and Ventilating; a division of Mestek, Inc.

2. Ductmate Industries, Inc.

3. Greenheck Fan Corporation.

4. McGill AirFlow LLC.

5. Nailor Industries Inc.

6. Ventfabrics, Inc.

7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.

b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.

c. Vision panel.

d. Hinges and Latches: 1-by-1-inch (25-by-25-mm)butt or piano hinge and cam latches.

e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam

gaskets.

3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.

b. Access Doors up to 18 Inches (460 mm)] Square: Two hinges and two sash locks.

c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.

d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

2.11 FLEXIBLE CONNECTORS

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. Ductmate Industries, Inc.

2. Ventfabrics, Inc.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).

2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

2.12 FLEXIBLE DUCTS

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. McGill AirFlow LLC.

2. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.

2. Maximum Air Velocity: 4000 fpm (20 m/s).

3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.

2. Maximum Air Velocity: 4000 fpm (20 m/s).

3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.

2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.14 VEHICLE EXHAUST HOSE REELS

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. Car-Mon Products

2. Harvey Co.

B. Hose:

1. Monoxivent Series 7210, or approved equal.

2. Construction: Flexible, three layer construction of special high temperature fabric with custom heat stabilizers, middle layer heat resistant material, and inner ply of stainless steel mesh with heat resistant chromium external helix.

3. Hose shall be flame resistant, with neoprene passing UL 94 VO.

4. Temperature Rating: 2100 degrees F.

5. Hose Length: 32 feet.

6. Hose Diameter: 6 inches (nominal.)

7. EPDM Bus Adapter

8. High Temp hose extension with series A stainless steel adapter for buses with lower exhaust pipes.

B. Hose Reels: Provide motorized exhaust hose reels, retracting hose reels with automatic recoil, lock and latch. Provide 120 volt reel motor with 4 button up/down control pendent on 10 foot cord. U/L listed control box with reversing starter, microprocessor and limit control and overload protection. Single power connection and complete factoring assembly and wiring.

1. H-SO-P Adjustable positioning poles.

2. Mounting bracket for control panel.

2.15 TURBINE VENTILATORS

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. Empire Air Vent Inc.

2. Lomanco Vents, Inc.

3. Air Vent, Inc.

B. Materials:

1. Aluminum blades

2. Aluminum bracing

3. Self-lubricating bearing assembly

C. Construction: External braced ribbed blade assembly

D. Size: 4"

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Connect ducts to duct silencers [with flexible duct connectors] [rigidly].

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Upstream and downstream from duct filters.

3. At outdoor-air intakes and mixed-air plenums.

4. At drain pans and seals.

5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.

6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.

7. Control devices requiring inspection.

8. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).

2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).

3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).

4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).

5. Body Access: 25 by 14 inches (635 by 355 mm).

6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

L. Label access doors according to Section 15077 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Connect diffusers or light troffer boots to ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

P. Connect flexible ducts to metal ducts with draw bands.

Q. Install duct test holes where required for testing and balancing purposes.

R. Secure turbine ventilators on top vapor relief stacks above roof in accordance with manufacturer's recommendations and sealed with silicone mastic.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.

4. Inspect turning vanes for proper and secure installation.

5. Operate remote damper operators to verify full range of movement of operator and damper.

PART 4: MEASUREMENT AND PAYMENT

4.01 DUCT ACCESSORIES:

A. Duct Accessories will not be measured for payment.

B. Duct Accessories will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15838

FANS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Utility set fans.
2. Centrifugal roof ventilators.
3. Ceiling-mounted ventilators.
4. In-line centrifugal fans.
5. Propeller fans.
6. Vehicle Exhaust fans

1.03 PERFORMANCE REQUIREMENTS

A. Operating Limits: Classify according to AMCA 99.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

6. Roof curbs.

7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For unit hangars and supports 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the items are shown and coordinated with each other, using input from Installers of the items involved.

B. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.07 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. Belts and Pulleys: One set for each belt-driven unit selected by Testing and Balancing contractor after testing.

1.08 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. AMCA compliance in first paragraph below is an optional requirement and not necessarily available from all manufacturers.

C. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

D. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.09 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.01 UTILITY SET FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following]:

1. Aerovent; a division of Twin City Fan Companes, Ltd.
2. Acme.
3. American Coolair Corporation.
4. Carnes Company.
5. Greenheck.
6. Loren Cook Company.
7. PennBarry.
8. Trane; a business of American Standard Companies.

B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.

1. Housing Discharge Arrangement: Adjustable to eight standard positions.

C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Materials: Aluminum.

2. Blade Type: Backward inclined.

3. Spark-Resistant Construction: AMCA 99, Type A.

D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{50} of 200,000 hours

1. Extend grease fitting to accessible location outside of unit.

F. Belt Drives:

1. Factory mounted, with final alignment and belt adjustment made after installation

2. Service Factor Based on Fan Motor Size: 1.5.

3. Motor Pulleys: Adjustable pitch for use with motors through 10 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

5. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Accessories:

1. Inlet and Outlet: Flanged.

2. Companion Flanges: Rolled flanges for duct connections of same material as housing.

3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame

installed on fan discharge.

4. Access Door: Gasketed door in scroll with latch-type handles.

5. Drain Connections: NPS 3/4 (DN 20) threaded coupling drain connection installed at lowest point of housing.

6. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.

7. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

H. Capacities and Characteristics:

1. See contract drawings schedules for capacities and characteristics..

2. Vibration Isolators:

a. Type: Restrained spring isolators.

b. Static Deflection: 1.0 inches.

3. Spark Arrestance Class: A.

2.02 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corporation.

2. Aerovent; a division of Twin City Fan Companies, Ltd.

3. American Coolair Corporation.

4. Carnes Company.

5. Greenheck Fan Corporation.

6. JencoFan.

7. Loren Cook Company.

8. PennBarry.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle or extruded-aluminum, rectangular top; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

2. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.

2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

4. Pulleys: Cast-iron, adjustable-pitch motor pulley.

5. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.

4. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch-(40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Built-in raised cant and mounting flange.

2. Overall Height: 16 inches (400 mm).

3. Sound Curb: Curb with sound-absorbing insulation.

4. Pitch Mounting: Manufacture curb for roof slope.

5. Metal Liner: Galvanized steel.

G. Capacities and Characteristics:

1. See contract drawings schedules for capacities and characteristics.

2.03 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Coolair Corporation.

2. Carnes Company.

3. Greenheck Fan Corporation.

4. JencoFan.

5. Loren Cook Company.

6. PennBarry.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.

3. Filter: Washable aluminum to fit between fan and grille.

4. Isolation: Rubber-in-shear vibration isolators.

G. Capacities and Characteristics:

1. See contract drawings schedules for capacities and characteristics..

2.04 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corporation.

2. American Coolair Corporation.

3. Carnes Company.

4. Greenheck Fan Corporation.

5. JencoFan.

6. Loren Cook Company.

7. PennBarry.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing[; with wheel, inlet cone, and motor on swing-out service door].

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

2. Companion Flanges: For inlet and outlet duct connections.

3. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.

4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

G. Capacities and Characteristics:

1. See contract drawings schedules for capacities and characteristics.

2. Vibration Isolators:

a. Type: Elastomeric hangers.

b. Static Deflection: 1 inch (25 mm).

3. Spark Arrestance Class: A.

2.05 PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing Corporation.

2. Aerovent; a division of Twin City Fan Companies, Ltd.

3. American Coolair Corporation.

4. Carnes Company.

5. JencoFan.

6. Loren Cook Company.

7. PennBarry.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring with baked-enamel finish coat applied after assembly.

C. Steel Fan Wheels: Formed-steel blades riveted to heavy-gage steel spider bolted to cast-iron hub.

D. Fan Wheel: Replaceable, extruded-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

E. Fan Drive:

1. Resiliently mounted to housing.

2. Statically and dynamically balanced.

3. Selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

4. Extend grease fitting to accessible location outside of unit.

5. Service Factor Based on Fan Motor Size: 1.4.

6. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

7. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

   a. Ball-Bearing Rating Life: ABMA 9, L_{10} of 100,000 hours.

8. Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.

9. Motor Pulleys: Adjustable pitch for use with motors through 10 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

10. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

11. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

F. Accessories:

1. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.

2. Wall Sleeve: Galvanized steel to match fan and accessory size.

3. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

4. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.

G. Capacities and Characteristics:

1. See contract drawings schedules for capacities and characteristics.

2. Vibration Isolators:

   a. Type: Restrained spring isolators.

   b. Static Deflection: 1 inch (25 mm).

2.06 VEHICLE EXHAUST FANS

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. Car-Mon Products
2. Greenheck
3. Harvey Co.

B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.

1. Housing Discharge Arrangement: As called for on the drawings.

2. All surfaces of housing and fan shall be completely painted with an acid resistant, air-dry phenolic resinous coating

C. Fan Wheels: Single-width, single inlet; cold rolled 12 guage steel and spun-steel inlet cone, with hub keyed to shaft.

1. Blade Materials: Aluminum.

2. Blade Type: Backward inclined.

3. Spark-Resistant Construction: AMCA 99, Type A.

D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

E. Shaft Bearings: Prelubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L_{50} of 200,000 hours

1. Extend grease fitting to accessible location outside of unit.

F. Belt Drives:

1. Factory mounted, with final alignment and belt adjustment made after installation

2. Service Factor Based on Fan Motor Size: 1.5.

3. Motor Pulleys: Adjustable pitch. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

5. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

G. Accessories:

1. Inlet and Outlet: Flanged.

2. Companion Flanges: Rolled flanges for duct connections of same material as housing.

3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.

4. Access Door: Gasketed door in scroll with latch-type handles.

5. Drain Connections: NPS 3/4 (DN 20) threaded coupling drain connection installed at lowest point of housing.

6. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.

7. Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.

H. Capacities and Characteristics:

1. See contract drawings schedules for capacities and characteristics..

2. Vibration Isolators:

a. Type: Restrained spring isolators.

b. Static Deflection: 1.0 inches.

3. Spark Arrestance Class: A.

2.06 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.07 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for

Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts or restrained spring isolators having a static deflection of 1 inch (25 mm) . Vibration- and seismic-control devices are specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounted units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300 "Cast-in-Place Concrete."

D. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 07720 "Roof Accessories" for installation of roof curbs.

E. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

F. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Section 15074 "Vibration and Seismic Controls for HVAC Piping and Equipment."

G. Install units with clearances for service and maintenance.

H. Label units according to requirements specified in Section 15077 "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 15820 "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 16060 "Grounding and Bonding."

D. Connect wiring according to Section 16120 "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.

6. Adjust damper linkages for proper damper operation.

7. Verify lubrication for bearings and other moving parts.

8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.

10. Shut unit down and reconnect automatic temperature-control operators.

11. Remove and replace malfunctioning units and retest as specified

above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 15950 "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

PART 4: MEASUREMENT AND PAYMENT

4.01 POWER VENTILATORS:

A. Power Ventilators will not be measured for payment.

B. Power Ventilators will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 15855

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Perforated diffusers.
3. Linear slot diffusers.
4. Drum Louvers
5. Fixed face registers and grilles.

B. Related Sections:

1. Section 10210 "Wall Louvers" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 15820 "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the items are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.01 CEILING REGISTERS, DIFFUSERS & GRILLES

A. Square Ceiling Diffusers D1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anemostat Products; a Mestek company.

   b. Carnes.

   c. Hart & Cooley Inc.

   d. Krueger.

   e. METALAIRE, Inc.

   f. Nailor Industries Inc.

   g. Price Industries.

   h. Titus.

   i. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.

3. Material: Steel.

4. Finish: Baked enamel, white.

5. Face Size: 24 by 24 inches (600 by 600 mm).

6. Face Style: Four cone.

7. Mounting: Surface or T-bar coordinate with ceiling type.

8. Pattern: Fixed.

9. Dampers: Radial opposed blade.

10. Accessories:

a. Equalizing grid.

b. Plaster ring.

c. Safety chain.

d. Wire guard.

e. Sectorizing baffles.

f. Operating rod extension.

B. Perforated Return R1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anemostat Products; a Mestek company.

b. Carnes.

c. Hart & Cooley Inc.

d. Krueger.

e. METALAIRE, Inc.

f. Nailor Industries Inc.

g. Price Industries.

h. Titus.

i. Tuttle & Bailey.

2. Devices shall be specifically designed for variable-air-volume flows.

3. Material: Steel backpan and pattern controllers, with steel face.

4. Finish: Baked enamel, white.

5. Face Size: 24 by 24 inches (600 by 600 mm).

6. Duct Inlet: Square.

7. Face Style: Drop extended.

8. Mounting: Surface or T-bar coordinate with ceiling type.

9. Pattern Controller: Four louvered deflector patches.

10. Dampers: Opposed blade.

11. Accessories:

    a. Equalizing grid.

    b. Plaster ring as needed.

C. Linear Slot Diffuser D2:

1. Manufacturers:

    a. Anemostat; a Mestek Company.

    b. Carnes.

    c. Hart & Cooley, Inc.; Hart & Cooley Div.

    d. Krueger.

    e. METALAIRE, Inc.; Metal Industries Inc.

    f. Nailor Industries of Texas Inc.

    g. Price Industries.

    h. Titus.

2. Material - Shell: Aluminum insulated.

3. Material - Pattern Controller and Tees: Aluminum.

4. Finish - Face and Shell: Baked enamel, black.

5. Finish - Pattern Controller: Baked enamel, black.

6. Finish - Tees: Baked enamel, white.

7. Slot Width: 3/4 inch (19 mm.

8. Number of Slots: As noted on Drawings.

9. Length: As noted on Drawings.

10. Accessories: Frame type as required for mounting.

D. Drum Louver: High Capacity – Long Throw D3:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anemostat Products; a Mestek company.

b. Carnes.

c. Hart & Cooley Inc.

d. Krueger.

e. METALAIRE, Inc.

f. Nailor Industries Inc.

g. Price Industries.

h. Titus.

i. Tuttle & Bailey.

2. Airflow Principle: Extended distance for high airflow rates.

3. Material: Aluminum, heavy gage extruded.

4. Finish: White baked acrylic.

5. Border: 1-1/4-inch (32-mm) width with countersunk screw holes.

6. Gasket between drum and border.

7. Body: Designed for direct mount in round ductwork.

8. Mounting: Surface to duct.

9. Accessories:

a. Opposed-blade steel damper or air scoop.

b. Duct-mounting collars with countersunk screw holes.

E. Fixed Face Register R2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anemostat Products; a Mestek company.

b. Carnes.

c. Hart & Cooley Inc.

d. Krueger.

e. Nailor Industries Inc.

f. Price Industries.

g. Titus.

h. Tuttle & Bailey.

2. Material: Aluminum standard weight, for mounting of any portion of unit below 5 feet above finished floor extra heavy duty.

3. Finish: Baked enamel, white.

4. Face Arrangement: 1/2-by-1/2-by-1/2-inch (13-by-13-by-13-mm) grid core.

5. Core Construction: Integral.

6. Frame1 inch (25 mm) wide.

7. Mounting Frame: Surface for wall and duct, t-bar for tile ceiling.

8. Damper Type: Adjustable opposed blade.

2.02 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

PART 4: MEASUREMENT AND PAYMENT

4.01 DIFFUSERS, REGISTERS, AND GRILLES:

A. Diffusers, Registers, and Grilles will not be measured for payment.

B. Diffusers, Registers, and Grilles will not be paid directly, but will be included in the lump sum bid prices for the maintenance building.

END OF SECTION

SECTION 15900

HVAC INSTRUMENTATION AND CONTROLS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

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

B. The system shall be an extension of an existing Schneider I/A Series Network 8000 and Enterprise Network Controller system furnished and installed by Pritchett Controls. All controls must be tied into the Schneider I/A Series Energy Management System's Enterprise Server located in the MTA Bush Street Facilities Building.

1.02 SUMMARY

A. This Section includes the Building Management System (BMS) control equipment for HVAC systems and components

1.03 DEFINITIONS

A. Standard

1. ASHRAE: American Society Heating, Refrigeration, Air Conditioning Engineers

2. AHU: Air Handling Unit

3. BACnet: Building Automation Controls Network

4. BMS: Building Management System

5. DDC: Direct Digital Control

6. EIA: Electronic Industries Alliance

7. GUI: Graphical User Interface

8. HVAC: Heating, Ventilation, and Air Conditioning

9. IEEE: Institute Electrical Electronic Engineers

10. MER: Mechanical Equipment Room

11. PID: Proportional, Integral, Derivative

12. VAV: Variable Air Volume Box

B. Communications and Protocols

1. ARP: Address Resolution Protocol
2. CORBA: Common Object Request Broker Architecture
3. CSMA/CD: Carrier Sense Multiple Access/Collision Detect
4. DDE: Dynamic Data Exchange
5. FTT: Free Topology Tranceivers
6. HRDB: Hierarchical Real-Time Database
7. HTTP: Hyper Text Transfer Protocol
8. IIOP: Internet Inter-ORB Protocol
9. LAN: Local Area Network
10. MS/TP: Master Slave Token Passing
11. ODBC: Open DataBase Connectivity
12. ORB: Obect Request Broker
13. SNVT: Standard Network Variable Types
14. SQL: Structured Query Language
15. UDP: User Datagram Protocol
16. XML: exTensible Markup Language

C. Controllers

1. AAC: Advanced Application Controller
2. AHDC: Air Handler Digital Controller
3. ASC: Application Specific Controller
4. ASC: Application Specific Controller
5. ASD: Application Specific Device
6. CAC: Custom Application Controller

7. GCM: Global Control Module

8. LCM: Local Control Module

9. LNC: LON Network Controller

10. MN-FLO: Micronet 2000 Pressure Independent VAV Controller:

11. MSDC: Mechanical System Digital Controller

12. MZ-II: MICROZONE II Direct Digital Controller

13. NIM: Network Interface Module

14. UDC: Unitary Digital Controller

15. UEC: Unitary Equipment Controller

16. UNC: Universal Network Controller

D. Tools and Software

1. BPES: BACnet Portable Engineering Station

2. VAVDC: Variable Air Volume Digital Controller

3. CCDT: Configuration, Commissioning and Diagnostic Tool

4. CIM: Control Interface Module

5. HHOT: Hand Held Operators Tool

6. LPES: LON Portable Engineering Station

7. PES: Portable Engineering Station

8. POT: Portable Operator's Terminal

9. PSI: Personal System Interface

1.04 SYSTEM DESCRIPTION

A. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC). The controls will operate with the existing Schneider I/A Series Enterprise Server and GUI.

B. The Local Area Network (LAN) shall be a Network 8000 ASD controller by Pritchett Controls

C. The system will consist of Network 8000 and the TAC I/A Enterprise Network Controller.

D. The system will consist of an architecture of Network 8000 and/or that utilizes a MS/TP selectable 9.6-76.8 K9600 Baud protocol, as the common communication protocol between all controllers and integral ANSI / ASHRAE™ Standard 135-2004, BACnet functionality to assure interoperability between all system components

E. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation of Mechanical Equipment Room (MER) valves and dampers and electronic actuation of terminal equipment valves and actuators as specified herein. The BMS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel.

F. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of Pritchett Controls. Supervision, calibration and checkout of the system shall be by the employees of Pritchett Controls. The control contractor shall have an in place support facility within 25 miles of the site with factory certified technicians and engineers, spare parts inventory and all necessary test and diagnostic equipment for the installed system, and the control contractor shall have emergency service available.

1.05 INSTALLATION OF PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION.

A. Section 15181 – Hydronic Piping:

1. Temperature Sensor Wells and Sockets.

B. Section 15820 – Ductwork Accessories:

1. Automatic Dampers.

2. Airflow Stations.

3. Terminal Unit Controls.

1.06 PRODUCTS NOT FURNISHED OR INSTALLED BUT INTEGRATED WITH THE WORK OF THIS SECTION.

A. Section 15058 –Variable Frequency Drives.

B. Section 15185 – Hydronic Pumps.

C. Section 15193 – Aboveground Storage Tanks.

D. Section 15195 – Fluid Management System.

E. Section 15512 –Cast-Iron Boilers.

1. Boiler Controls.

F. Section 15671 – Packaged Compressor and Condenser Units.

G. Section 15725 – Modular Indoor Central Station Air Handling Units.

H. Section 15745 – Water Source Heat Pumps.

I. Section 15785 – Air-to-Air Energy Recovery Equipment:

1. Integral Unit Controls.

J. Section 15791 – Cabinet Unit Heaters.

K. Section 15792 – Propeller Unit Heaters.

L. Section 15838 – Fans.

M. Section 16231 – Packaged Engine Generators.

1.07 SUBMITTALS.

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.

2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

3. Written description of sequence of operation.

4. Schedule of dampers including size, leakage, and flow characteristics.

5. Schedule of valves including close-off and flow characteristics.

6. Trunk cable schematic showing programmable control unit locations and trunk data conductors.

7. Listing of connected data points, including connected control unit and input device.

8. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

9. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.

C. Software and Firmware Operational Documentation: Include the following:

1. Engineering, Installation, Operation and Maintenance manuals.

2. Program Software Backup: On a magnetic media or compact disc, complete with data files.

3. Device address list.

4. Licenses, guarantee, and warranty documents for all equipment and systems.

D. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.08 QUALITY ASSURANCE.

A. Bids by wholesalers, distributors, mechanical contractors, ABCS, ACS, and non-franchised contractors shall not be acceptable.

B. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific Controller, Air Handler Digital Controller, Unitary Digital Controller, Variable Air Volume Digital Controller, Variable Air Volume Direct Digital Controller, Unitary Equipment Controller, Advanced Application Controller, Graphical User Interface, damper actuators, and valve actuator assemblies.

C. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the Pritchett Controls – no exceptions.

D. Mechanical equipment manufacturers that are listed as approved to provide DDC type controls may submit a bid with factory mounted controls, and shall also provide a separate bid for their products less all controls, actuators, valve assemblies and sensors, which are specified to be provided by the BMS contractor.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems.".

1.09 PRE-BID SUBMITTAL.

A. Any installing contractors or manufacturers interested in participating as acceptable bidders for this project that are not pre-qualified shall furnish a detailed technical pre-bid submittal to the consulting engineer. All information must be submitted 2 weeks prior to the published bid date to allow the engineer adequate time to review the bidders credentials.

B. The Pre-Bid submittal shall contain the following information as a minimum:

1. A profile of the manufacturer and the local installation and service/organization.

2. Description of how the system meets and achieves all the specified criteria in terms of configuration, operation, and control.

3. System Architecture with single line riser diagram showing all major components (digital controllers, routers, hubs, etc.) that will be required for this project.

4. Procedure for commissioning and time required to startup and commission each of the systems for this project.

5. Contractors approach for the project planning and management.

6. Product Data Sheets for all components, DDC panels, and all accessories listed per the appropriate spec sections herein.

7. Examples of actual graphic screens for other similar projects.

8. Number and types of DDC panels required for this installation.

9. Number and types of spare points provided with the proposed system.

10. Recommended spare parts list for components with list price schedule and discount multiplier.

11. List of 5 similar systems in size, point capacity, total installed value, installed and commissioned by the local office with a list of the installers/manufacturers design team members for each project and the owners contact information.

12. Samples of service offerings and a list of current similar service contracts with contact information.

13. Resumes for the management team and all employees who will be involved with the project design, commissioning, project management, and after installation service. Resumes should include copies of manufacturer's certifications for the proposed product line for each employee.

14. Copy of this Control Specification in its entirety with a check mark beside each paragraph to signify that the manufacturer's equipment and software shall fully conform to the specified requirement. If the requirement cannot be met, indicate the reasons/limitations and the alternative proposed.

15. An interview may be conducted and the bidder will be requested to make a formal presentation concerning the proposed system and possibly provide an installed project tour prior to a final decision.

1.10 DELIVERY, STORAGE AND HANDLING.

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.11 COORDINATION.

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor-Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.

C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

D. Coordinate location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in

Division 3 Section "Cast-in-Place Concrete".

E. Coordinate with the Owner's IT department on locations for UNC's, Ethernet communication cabling and TCP/IP addresses.

1.12 WARRANTY AND MAINTENANCE.

A. All components, system software, and parts furnished and installed by the BMS contractor shall be guaranteed against defects in materials and workmanship for 1 year of substantial completion. Labor to repair, reprogram, or replace these components shall be furnished by the BMS contractor at no charge during normal working hours during the warranty period. Materials furnished but not installed by the BMS contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation. All corrective software modifications made during warranty periods shall be updated on all user documentation and on user and manufacturer archived software disks. The Contractor shall respond to the owner's request for warranty service within 24 standard working hours.

1.13 OWNERSHIP OF PROPRIETARY MATERIAL.

A. The owner shall sign a copy of the manufacturer’s standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to owner as defined by the manufacturer’s license agreement, but shall protect manufacturer’s rights to disclosure of trade secrets contained within such software. All project developed software and documentation shall become the property of the owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

PART 2: PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following pre-qualified manufacturers:

a. TAC I/A by Pritchett Controls

2.02 DDC EQUIPMENT

A. GUI Server is the Pritchett Controls Enterprise Server existing in the MTA Facilities Shop at Bush Street.

1. A local TAC I/A Enterprise Network Controller will communicate to the existing Pritchett Controls Enterprise Network Server.

Input/output capability from operator station for monitoring and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.

B. Control Units General:

1. Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. All field controllers will be Network 8000. Provide a minimum of one separate controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. Each of the following panel types shall meet the following requirements.

2. Controllers shall be suitable for the anticipated ambient conditions.

   a. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non condensing.

   b. Controllers used in conditioned ambient space shall be mounted in dustproof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non condensing.

3. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

4. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

5. Diagnostics: The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification.

6. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an

orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 ft.

7. Automatic staggered restart of field equipment after restoration of power and short cycle protection.

C. TAC I/A Enterprise Network Controllers (ENC)

1. The Enterprise Network Controllers (ENC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the ENC. It shall be capable of executing application control programs to provide:

   a. Calendar functions

   b. Scheduling

   c. Trending

   d. Alarm monitoring and routing

   e. Time synchronization by means of an Atomic Clock Internet site including automatic synchronization

   f. Integration of LonWorks controller data and BACnet controller data

   g. Network Management functions for all LonWorks, BACnet and Network 8000 based devices

2. The Enterprise Network Controller Type 2 must provide the following hardware features as a minimum:

   a. One Ethernet Port – 10/100 Mbps

   b. Two RS-232 ports

   c. Four RS-485 ports electrically isolated

   d. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector

   e. Power supply 24 VAC or 24 VDC

   f. Battery Backup

   g. Real-time clock

h. Processor @ 200 MHz or greater

i. 64 Mb flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)

j. 128 Mb Ram or greater

3. The Enterprise Network Controller with on board I/O must provide the following hardware features as a minimum:

a. One Ethernet Port – 10/100 Mbps

b. One RS-232 ports

c. One RS-485 port

d. One LonWorks Interface Port – 78KB FTT-10A with Weidmuller connector

e. Power supply 120 VAC

f. Battery Backup

g. Real-time clock

h. Processor @ 200 MHz or greater

i. Java Virtual Machine

j. Browser support for operator interface

k. 32 Mb flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)

l. 64 Mb Ram or greater

m. ENC shall have on board I/O as follows:

i. Digital Outputs

1) Minimum of 4 digital outputs

2) Form C SPDT

3) Rated for 24 VAC/VDC @ 2 amps resistive

4) LED indication for each digital output

ii. Universal Inputs

1) Minimum of 6 universal inputs

2) 12 bit A/D resolution

3) Dry Contacts

20 Hz maximum frequency

25 ms minimum pulse width

4) On board power supply

20 VDC

80 mA

5) 0-10 Volt

Accuracy +/- 2% span

Self powered

Powered by on board power supply

6) 0-20 mA

Accuracy +/- 2% span

Self powered

Powered by on board power supply

7) 10K Thermistor

10-135 Def F

4. The ENC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the ENC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

5. Event Alarm Notification and Actions

a. The ENC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed

capabilities of equipment or application specific controllers.

b. The ENC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.

c. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:

i. To alarm

ii. Return to normal

iii. To fault

d. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.

e. Provide timed (schedule) routing of alarms by class, object, group, or node.

f. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.

g. Control equipment and network failures shall be treated as alarms and annunciated.

h. Alarms shall be annunciated in any of the following manners as defined by the user:

i. Screen message text

ii. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

1) Day of week

2) Time of day

3) Recipient

iii. Pagers via paging services that initiate a page on receipt of email message

iv. Graphic with flashing alarm object(s)

v. Printed message, routed directly to a dedicated alarm printer

i. The following shall be recorded by the UNC for each alarm (at a minimum):

i. Time and date

ii. Location (building, floor, zone, office number, etc.)

iii. Equipment (air handler #, accessway, etc.)

iv. Acknowledge time, date, and user who issued acknowledgement.

v. Number of occurrences since last acknowledgement.

j. Alarm actions may be initiated by user defined programmable objects created for that purpose.

k. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

l. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.

m. Provide a “query” feature to allow review of specific alarms by user defined parameters.

n. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.

o. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

6. Data Collection and Storage

a. The ENC shall have the ability to collect data for any property of any object and store this data for future use.

b. The data collection shall be performed by log objects, resident in the UNC that shall have, at a minimum, the following configurable properties:

i. Designating the log as interval or deviation.

ii. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.

iii. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.

iv. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.

v. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

7. All log data shall be stored in a relational database in the ENC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.

8. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.

9. All log data shall be available to the user in the following data formats:

a. HTML

b. XML

c. Plain Text

d. Comma or tab separated values

10. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Serverâ, Oracle 8i or Expressâ, Hyperion Solutions™ SQL Server.

11. The ENC shall have the ability to archive its log data either locally (to itself), or remotely to a server or other ENC on the network.

Provide the ability to configure the following archiving properties, at a minimum:

a. Archive on time of day

b. Archive on user-defined number of data stores in the log (buffer size)

c. Archive when log has reached it's user-defined capacity of data stores

d. Provide ability to clear logs once archived

12. AUDIT LOG

a. Provide and maintain an Audit Log that tracks all activities performed on the UNC. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size. Provide the ability to archive the log locally (to the UNC), to another UNC on the network, or to a server. For each log entry, provide the following data:

i. Time and date

ii. User ID

iii. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

13. DATABASE BACKUP AND STORAGE

a. The UNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.

b. Copies of the current database and, at the most recently saved database shall be stored in the UNC. The age of the most recently saved database is dependent on the user-defined database save interval.

c. The UNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

D. All other controllers to be Network 8000 controllers communicating on an ASD bus.

2.03 CONTROL PANELS

A. Local Control Panels: Unitized NEMA 1 cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.

1. Fabricate panels 0.06-inch thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.

2. Interconnections between internal and face-mounted devices pre-wired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL Listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.

3. Provide ON/OFF power switch with over-current protection for control power sources to each local panel.

2.04 SENSORS

A. Electronic Temperature Sensors: Vibration and corrosion resistant for wall, immersion, or duct mounting as required.

1. Resistance Temperature Detectors: Platinum, thermistor, or balco

a. Accuracy: Plus or minus 0.2 percent at calibration point; thermistors shall have a maximum 5 year drift of no more than .225°F maximum error of no more than .36°F

b. Wire: Twisted, shielded-pair cable

c. Insertion Elements in Ducts: Single point, 6 inches long; use where not affected by temperature stratification or where ducts are smaller than 4 sq. ft.

d. Averaging Elements in Ducts: 60 inches, long, flexible for use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 264 inches long, flexible for use where prone to temperature stratification or where ducts are larger than 16 sq. ft; length as required.

e. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.

f. Outside-Air Sensors: Watertight inlet fitting, shielded from

direct sunlight.

g. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: +/- 1 percent of full scale with repeatability of 0.5 percent.

b. Output: 4 to 20 mA, 0-5 vDC, 0-10 vDC.

c. Building Static-Pressure Range: -.1 to .1, -0.25 to 0.25, -.5 to .5, -1.0 to 1.0 IN WC., jumper selectable.

d. Duct Static-Pressure Range: 0 to 1, 0 to 2.5, 0 to 5, 0 to 10 IN WC., jumper adjustable.

3. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; proportional output 4 to 20 mA.

B. Equipment operation sensors as follows:

1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 IN WC.

2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig.

3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.

C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

D. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vapor proof type.

E. Carbon-Monoxide Detectors: Single or multi-channel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 23°F to 130°F, calibrated for 50 and 100 ppm, with maximum 120-second response time to 100-ppm carbon monoxide.

F. Carbon-Dioxide Sensor and Transmitter: Single detectors, using solid-

state infrared sensors, suitable over a temperature range of 23°F to 130°F, calibrated for 0 to 2 percent, with continuous or averaged reading, 4 to 20 mA output, and wall mounted.

G. Refrigerant Detectors: Dual-level detectors, using solid-state sensors, with alarm preset for 300 ppm, alarm indicator light, alarm silence light and button, alarm test light and button, and trouble light. Provide auxiliary relay preset for 150 ppm.

2.05 THERMOSTATS

A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.

1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.

B. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.

C. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.

1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.

2. Dead Band: Maximum 2°F.

D. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.

1. Bulbs in water lines with separate wells of same material as bulb.

2. Bulbs in air ducts with flanges and shields.

3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.

4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.

5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.

6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

E. Fire-Protection Thermostats: UL listed with fixed or adjustable settings to operate at not less than 75°F above normal maximum operating temperature, with the following:

1. Reset: Manual with control circuit arranged to directly shutdown appropriate equipment and provide remote annunciation at the GUI.

F. Room Thermostat Cover Construction:

1. Set-Point Adjustment: Concealed or exposed

2. Set-Point Indication: Concealed or exposed

3. Thermometer: Optional

4. Color: Neutral

5. Orientation: Vertical or horizontal

G. Room thermostat accessories include the following:

1. Insulating Bases: For thermostats located on exterior walls.

2. Thermostat Guards: As specified in tamper prone areas

3. Adjusting Key: As required for calibration and cover screws.

4. Set-Point Adjustment: 1/2-inch diameter, adjustment knob.

H. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.

1. Bulb Length: Minimum 20 feet

2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

I. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.

1. Bulb Length: Minimum 20 feet.

2. Quantity: One thermostat for every 20 sq. ft. of coil surface.

J. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig., and cast housing with position indicator and adjusting knob.

2.06 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action under all environmental conditions (temperature, low power voltage fluctuations, tight seal damper design, maximum air and water flow forces).

1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.

3. Spring-Return Motors for Valves Larger Than NPS 2-1/2": Size for running and breakaway torque of 150 in. x lbf.

4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.

5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

B. Electronic Damper and Valve Actuators: Direct-coupled type non-hydraulic designed for minimum 100,000 full-stroke cycles at rated torque. The actuator shall have rating of not less than twice the thrust needed for actual operation of the damper or valve

1. Coupling: V-bolt and V-shaped, toothed cradle.

2. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

3. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.

4. Actuators shall have the ability to be tandem mounted.

5. All spring-return actuators shall have a manual override. Complete manual override shall take no more than 10 turns.

6. Power Requirements (Two-Position Spring Return): 24V ac or dc, Maximum 10VA.

7. Power Requirements (Modulating): Maximum 15 VA at 24V ac.

8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.

9. Temperature Rating: -22°F to 140ºF.

10. Run Time: 200 seconds open, 40 seconds closed.

11. All actuators shall have a 5-year warranty.

12. Valves:

    a. Size for torque required for valve close-off at maximum pump differential pressure (regardless of water loop system pressures).

    b. Valve and Actuators shall come from the factory fully assembled.

    c. Spring Return Manual Override shall come with a 10 Degree Valve Preload to assure tight close off.

13. Dampers:

    a. Size for running torque calculated as follows:

        i. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.

        ii. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.

        iii. Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. damper.

        iv. Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. of damper.

        v. Dampers with 2 to 3 Inches wg. of Pressure Drop or Face Velocities of 1000 to 2500 FPM Multiply the minimum full-stroke cycles above by 1.5.

vi. Dampers with 3 to 4 Inches wg. of Pressure Drop or Face Velocities of 2500 to 3000 FPM Multiply the minimum full-stroke cycles above by 2.0.

b. Spring Return Manual Override actuators shall have a factory set 5 Degree Damper Preload.

2.07 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Globe Valves NPS 2” and Smaller: Bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure. Valves shall have allowable media temperature of 20°F to 281°F to assure that the valve packing will have a long life (valves with narrower allowable media temperatures have no reserve packing capability for long term watertight seal.)

C. Globe Valves NPS 2-1/2” and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc. 2-way valves shall have a rangeability if at least 100:1.

D. Hydronic system globe valves shall have the following characteristics :

1. Rating: Class 125 for service at 125 psig. and 250°F operating conditions.

2. Internal Construction: Replaceable plugs and seats of stainless steel or brass.

a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.

b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.

3. Sizing: 3 psig. maximum pressure drop at design flow rate.

4. Temperature Requirements: Valve and actuator assembly shall be able to operate in ambient temperatures of -22°F to 140°F.

5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.

6. Product Life: Valve and actuator assembly shall be rated for a minimum of 200,000 cycles and tested for close off prior to delivery.

E. Control Ball Valves NPS 3” and smaller (NPS 2” for 3-way valves): Forged brass body (CuZn39Pb2), chrome plated brass ball and blowout proof stem and EPDM o-rings with minimum 600 psig. rating. Valve shall contain glass filled ball insert capable of providing equal percentage flow. Valves shall have allowable media temperature of -20°F to 250°F.

1. Rating: No less than 360 psig. at 250°F operating conditions.

2. Rangeability: 2-way valves shall have a rangeability of at least 75:1

3. Medium: Valves shall be used with hot water or cold water with up to 50% glycol.

4. Temperature Requirements: Valve and actuator assembly shall be able to operate in ambient temperatures of -22°F to 140°F.

5. Sizing:

a. Minimum 100 psig. close off on 2 way valves and 70 psig. on three way valves

b. Maximum differential shall be 35 psig. to ensure quiet operation.

6. Flow Characteristics: 2 way valves shall have equal percentage characteristics. 3 way valves shall have an equal percentage characteristic through the control port and a linear characteristic through the bypass port.

7. Product Life: Valve and actuator assembly shall be rated for a minimum of 200,000 cycles and tested for close off prior to delivery.

F. Butterfly Valves: 200 psig. maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.

1. Body Style: Wafer, Lug, or Groove

2. Disc Type: Nickel-plated ductile iron, Aluminum bronze, Elastomer-coated ductile iron, Epoxy-coated ductile iron.

3. Sizing: 1 psig. maximum pressure drop at design flow rate.

G. Terminal Unit Control Valves: 360 psig. forged yellow brass body, nickel plated brass ball, with optimizer insert for modulating applications, blow-out resistant stem, two or three-port as indicated, and threaded ends for chilled or hot water, up to 50% glycol solutions. Actuators shall be as noted above with 5 year warranty. Spring return is required all terminal equipment that has an outside air source. All non-spring return valves must have manual override ability built in to the actuator.

1. Rating: ANSI class IV, maximum static pressure of 250 psig., minimum fluid temperature of 20ºF. and maximum of 250ºF operating conditions.

2. Sizing: 4 psig. maximum pressure drop at design flow rate or twice the load pressure drop, whichever is more.

3. Flow Characteristics: Two-way and three-valves shall have equal percentage characteristics.

2.08 DAMPERS

A. Dampers: AMCA-rated, parallel, opposed blade designs; 0.1084 inch minimum, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.0635 inch galvanized steel with maximum blade width of .8 inches.

1. Blades shall be secured to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: -40°F to 200°F

3. For standard applications, include optional closed-cell neoprene edging.

4. For low-leakage applications, use parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4 inches wg. when the damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.09 CONTROL CABLE

A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 16 Section "Control/Signal Transmission Media.

PART 3: EXECUTION

3.01 EXAMINATION

A. Verify that conditioned power supply is available to control units and operator workstation.

B. Verify that duct, pipe, and equipment mounted devices and wiring are installed before proceeding with installation.

3.02 INSTALLATION

A. Install equipment level and plumb.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve sequence of operation specified.

D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install guards or tamper proof enclosures on thermostats in the following locations:

1. Entrances.

2. Public areas.

3. Where indicated.

F. Install automatic dampers according to Division 15 Section "Duct Accessories.

G. Install damper actuators on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

H. Install labels and nameplates to identify control components according to Division 15 Section "Basic Mechanical Materials and Methods."

I. Install labels and nameplates to identify control components according to Division 15 Section "Mechanical Identification."

J. Install hydronic instrument wells, valves, and other accessories according to Division 15 Section "Hydronic Piping."

K. Install refrigerant instrument wells, valves, and other accessories according to Division 15 Section "Refrigerant Piping."

L. Install duct volume-control dampers according to Division 15 Sections specifying air ducts.

M. Install electronic and fiber-optic cables according to Division 16 Section "Control/Signal Transmission Media."

3.03 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

B. Install building wire and cable according to Division 16 Section "Conductors and Cables."

C. Install signal and communication cable according to Division 16 Section "Control/Signal Transmission Media."

1. All wiring to be done in rigid conduit.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Install piping adjacent to machine to allow service and maintenance.

B. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.05 GRAPHIC USER INTERFACE

A. Home Screen: The home screen of the BAS shall be a menu allowing the user to select to view a floorplan of the building. Or individual systems being monitored. Monitored systems shall be arranged as follows:

1. Mechanical

   a. Heating water system.

      i. Waste Oil Boiler.

      ii. Oil Fired Boilers.

      iii. Primary Pumps.

      iv. Secondary Pumps.

   b. Makeup air system.

      i. Makeup Air Units.

      ii. Heat Exchangers.

   c. Ground source heat pump system.

      i. Ground Source Heat Pumps

      ii. Ground Loop hydronic pumps.

   d. Ductless split units.

      i. Air Cooled Condensing Units.

      ii. Evaporators.

   e. Heating and ventilating units.

   f. Air handling units.

   g. Unit heaters.

   h. Exhaust fans.

2. Shop Services

   a. Air Compressors

   b. Sanitary Pumps

c. Oil pumps

d. Antifreeze pumps

e. Oil Storage Tanks

f. Antifreeze Storage Tanks

g. Hose Reels

B. Systems: Each of the individual system screens will include a graphic of the entire system with a schematic diagram of all associated equipment. Individual equipment screens shall be available from the systems screens.

C. Individual Equipment: Each piece of equipment will have a dedicated screen with all pertinent information and controllable points indicated.

3.06 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Leak Test: After installation, fill system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.

4. Pressure test control for air piping:

a. Pressure test control air piping at 30 psig. or 1.5 times the operating pressure for 24 hours, with maximum 5 psig. loss.

b. Pressure test high-pressure control air piping at 150 psig. and low-pressure control air piping at 30 psig. for 2 hours, with maximum 1 psig.

5. Calibration and test electric/electronic thermostats by disconnecting input sensors and stimulating operation with compatible signal generator.

B. Replace damaged or malfunctioning controls and equipment.

1. Start, test, and adjust control systems.

2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.

3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

C. Verify DDC as follows:

1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.

2. Verify operation of operator workstation.

3. Verify local control units including self-diagnostics.

3.07 TRAINING

A. Provide a minimum of 40 hours of on-site or classroom training throughout the contract period for personnel designated by the Owner. Each session shall be a minimum of four hours in length and must be coordinated with the building Owner. Train the designated staff of Owners Representative and Owner to enable them to:

1. Proficiently operate the system

2. Understand control system architecture and configuration

3. Understand DDC system components

4. Understand system operation, including DDC system control and optimizing routines (algorithms)

5. Operate the workstation and peripherals

6. Log on and off the system

7. Access graphics, point reports, and logs

8. Adjust and change system set points, time schedules, and holiday schedules

9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals

10. Understand system drawings, and Operation and Maintenance manual

11. Understand the job layout and location of control components

12. Access data from DDC controllers

13. Operate portable operators terminals

PART 4: MEASUREMENT AND PAYMENT

4.01 HVAC INSTRUMENTATION AND CONTROLS:

A. HVAC Instrumentation and Controls will not be measured for payment.

B. HVAC Instrumentation and Controls will not be paid directly, but will be included in the lump sum bid prices for maintenance building

END OF SECTION

SECTION 15950

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

b. Variable-air-volume systems.

2. Balancing Hydronic Piping Systems:

a. Constant-flow hydronic systems.

b. Variable-flow hydronic systems.

c. Primary-secondary hydronic systems.

1.03 DEFINITIONS:

A. AABC: Associated Air Balance Council.

B. TAB: Testing, adjusting, and balancing.

C. TABB: Testing, Adjusting, and Balancing Bureau.

D. TAB Specialist: An entity engaged to perform TAB Work.

1.04 INFORMATIONAL SUBMITTALS:

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as

specified in Part 3.

C. Strategies and Procedures Plan: Within 30 Insert number> days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Instrument calibration reports, to include the following:

1. Instrument type and make.

2. Serial number.

3. Application.

4. Dates of use.

5. Dates of calibration.

1.05 QUALITY ASSURANCE:

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC.

2. TAB Technician: Employee of the TAB contractor and who is certified by AABC as a TAB technician.

B. TAB Conference: Meet with Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items:

a. The Contract Documents examination report.

b. The TAB plan.

c. Coordination and cooperation of trades and subcontractors.

d. Coordination of documentation and communication flow.

C. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to

prepare certified TAB reports.

2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard AABC TAB contractor's forms approved by Commissioning Authority.

E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.06 COORDINATION:

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

A. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 15815 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

J. Examine terminal units, , and verify that they are accessible and their controls are connected and functioning.

K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine system pumps to ensure absence of entrained air in the suction piping.

O. Examine operating safety interlocks and controls on HVAC equipment.

P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION:

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.

2. Hydronic systems are filled, clean, and free of air.

3. Automatic temperature-control systems are operational.

4. Equipment and duct access doors are securely closed.

5. Balance, smoke, and fire dampers are open.

6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING:

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.

2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 15820 "Duct Accessories."

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 15086 "Duct Insulation," Section 15087 "HVAC Equipment Insulation," and Section 15088 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS:

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 15815 "Metal Ducts."

3.05 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS:

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

   a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.

   b. Measure static pressure directly at the fan outlet or through the flexible connection.

   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

   a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.

5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-

handling-unit performance.

7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.

3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS:

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at

maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

A. Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-ventilation load.

2. Check all diffusers and registers as specified above for Constant Volume air systems. Measure total system airflow. Adjust to within indicated airflow.

3. Remeasure the return/exhaust airflow to the fan while operating at maximum return/exhaust airflow and minimum outdoor airflow.

a. Adjust the fan and balance the return/exhaust-air ducts and inlets the same as described for constant-volume air systems.

4. Record final fan-performance data.

3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS:

A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.

2. Check liquid level in expansion tank.

3. Check makeup water-station pressure gage for adequate pressure for highest vent.

4. Check flow-control valves for specified sequence of operation, and set at indicated flow.

5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is

positive-displacement type unless several terminal valves are kept open.

6. Set system controls so automatic valves are wide open to heat exchangers.

7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.08 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS:

A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Commissioning Authority and comply with requirements in Section 15185 "Hydronic Pumps."

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

a. Monitor motor performance during procedures and do not operate motors in overload conditions.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 10 percent of design.

B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.

C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.

D. Set calibrated balancing valves, if installed, at calculated presettings.

E. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.

J. Check settings and operation of each safety valve. Record settings.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS:

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS:

A. Balance the primary circuit flow first and then balance the secondary circuits.

3.11 PROCEDURES FOR HEAT EXCHANGERS:

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Check settings and operation of safety and relief valves. Record settings.

3.12 PROCEDURES FOR MOTORS:

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.

2. Motor horsepower rating.

3. Motor rpm.

4. Efficiency rating.

5. Nameplate and measured voltage, each phase.

6. Nameplate and measured amperage, each phase.

7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.13 PROCEDURES FOR CONDENSING UNITS:

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.14 PROCEDURES FOR BOILERS:

A. Hydronic Boilers: Measure and record entering- and leaving-water temperatures and water flow.

3.15 PROCEDURES FOR HEAT-TRANSFER COILS:

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.16 TOLERANCES:

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.

3.17 REPORTING:

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and

additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare [monthly] progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 FINAL REPORT:

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.

2. Fan curves.

3. Manufacturers' test data.

4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB contractor.

3. Project name.

4. Project location.

5. Architect's name and address.

6. Engineer's name and address.

7. Contractor's name and address.

8. Report date.

9. Signature of TAB supervisor who certifies the report.

10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:

    a. Indicated versus final performance.

    b. Notable characteristics of systems.

    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Data for terminal units, including manufacturer's name, type, size, and fittings.

14. Notes to explain why certain final data in the body of reports vary from indicated values.

15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.

    b. Conditions of filters.

    c. Cooling coil, wet- and dry-bulb conditions.

    d. Face and bypass damper settings at coils.

    e. Fan drive settings including settings and percentage of maximum pitch diameter.

    f. Inlet vane settings for variable-air-volume systems.

    g. Settings for supply-air, static-pressure controller.

    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.

2. Water flow rates.

3. Duct, outlet, and inlet sizes.

4. Pipe and valve sizes and locations.

5. Terminal units.

6. Balancing stations.

7. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.

b. Location.

c. Make and type.

d. Model number and unit size.

e. Manufacturer's serial number.

f. Unit arrangement and class.

g. Discharge arrangement.

h. Sheave make, size in inches (mm), and bore.

i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

j. Number, make, and size of belts.

k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches (mm), and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).

b. Total system static pressure in inches wg (Pa).

c. Fan rpm.

d. Discharge static pressure in inches wg (Pa).

e. Filter static-pressure differential in inches wg (Pa).

f. Preheat-coil static-pressure differential in inches wg (Pa).

g. Cooling-coil static-pressure differential in inches wg (Pa).

h. Heating-coil static-pressure differential in inches wg (Pa).

i. Outdoor airflow in cfm (L/s).

j. Return airflow in cfm (L/s).

k. Exhaust airflow in cfm (L/s).

l. Outdoor-air damper position.

m. Return-air damper position.

n. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.

b. Location.

c. Coil type.

d. Number of rows.

e. Fin spacing in fins per inch (mm) o.c.

f. Make and model number.

g. Face area in sq. ft. (sq. m).

h. Tube size in NPS (DN).

i. Tube and fin materials.

j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Air flow rate in cfm (L/s).

b. Average face velocity in fpm (m/s).

c. Air pressure drop in inches wg (Pa).

d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).

e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).

f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).

g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).

h. Water flow rate in gpm (L/s).

i. Water pressure differential in feet of head or psig (kPa).

j. Entering-water temperature in deg F (deg C).

k. Leaving-water temperature in deg F (deg C).

l. Refrigerant expansion valve and refrigerant types.

m. Refrigerant suction pressure in psig (kPa).

n. Refrigerant suction temperature in deg F (deg C).

G. Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.

b. Location.

c. Make and type.

d. Model number and unit size.

e. Manufacturer's serial number.

f. Fuel type in input data.

g. Output capacity in Btu/h (kW).

h. Ignition type.

i. Burner-control types.

j. Motor horsepower and rpm.

k. Motor volts, phase, and hertz.

l. Motor full-load amperage and service factor.

m. Sheave make, size in inches (mm), and bore.

n. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).

b. Entering-air temperature in deg F (deg C).

c. Leaving-air temperature in deg F (deg C).

d. Air temperature differential in deg F (deg C).

e. Entering-air static pressure in inches wg (Pa).

f. Leaving-air static pressure in inches wg (Pa).

g. Air static-pressure differential in inches wg (Pa).

h. Low-fire fuel input in Btu/h (kW).

i. High-fire fuel input in Btu/h (kW).

j. Manifold pressure in psig (kPa).

k. High-temperature-limit setting in deg F (deg C).

l. Operating set point in Btu/h (kW).

m. Motor voltage at each connection.

n. Motor amperage for each phase.

o. Heating value of fuel in Btu/h (kW).

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.

b. Location.

c. Make and type.

d. Model number and size.

e. Manufacturer's serial number.

f. Arrangement and class.

g. Sheave make, size in inches (mm), and bore.

h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and rpm.

c. Volts, phase, and hertz.

d. Full-load amperage and service factor.

e. Sheave make, size in inches (mm), and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).

b. Total system static pressure in inches wg (Pa).

c. Fan rpm.

d. Discharge static pressure in inches wg (Pa).

e. Suction static pressure in inches wg (Pa).

I. Round, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.

b. Location and zone.

c. Traverse air temperature in deg F (deg C).

d. Duct static pressure in inches wg (Pa).

e. Duct size in inches (mm).

f. Duct area in sq. ft. (sq. m).

g. Indicated air flow rate in cfm (L/s).

h. Indicated velocity in fpm (m/s).

i. Actual air flow rate in cfm (L/s).

j. Actual average velocity in fpm (m/s).

k. Barometric pressure in psig (Pa).

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

a. Unit identification.

b. Location.

c. Service.

d. Make and size.

e. Model number and serial number.

f. Water flow rate in gpm (L/s).

g. Water pressure differential in feet of head or psig (kPa).

h. Pump rpm.

i. Impeller diameter in inches (mm).

j. Motor make and frame size.

k. Motor horsepower and rpm.

l. Voltage at each connection.

m. Amperage for each phase.

n. Full-load amperage and service factor.

o. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig (kPa).

b. Pump shutoff pressure in feet of head or psig (kPa).

c. Actual impeller size in inches (mm).

d. Full-open flow rate in gpm (L/s).

e. Full-open pressure in feet of head or psig (kPa).

f. Final discharge pressure in feet of head or psig (kPa).

g. Final suction pressure in feet of head or psig (kPa).

h. Final total pressure in feet of head or psig (kPa).

i. Final water flow rate in gpm (L/s).

j. Voltage at each connection.

k. Amperage for each phase.

K. Instrument Calibration Reports:

1. Report Data:

   a. Instrument type and make.

   b. Serial number.

   c. Application.

   d. Dates of use.

   e. Dates of calibration.

3.19 INSPECTIONS:

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.

2. Check the following for each system:

   a. Measure airflow of at least 10 percent of air outlets.

   b. Measure water flow of at least 5 percent of terminals.

   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.

   d. Verify that balancing devices are marked with final balance position.

   e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Authority.

2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.

3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded

or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.20 ADDITIONAL TESTS:

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

PART 4: MEASUREMENT AND PAYMENT

4.01 TESTING, ADJUSTING, AND BALANCING:

A. Testing, Adjusting, and Balancing will not be measured for payment.

B. Testing, Adjusting, and Balancing will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16055

OVERCURRENT PROTECTIVE DEVICE COORDINATION AND ARC-FLASH STUDY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.

B. Contractor shall provide over current protective devices and electrical equipment required by the coordination-study report at no additional cost.

1.03 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.

1. Coordination-study input data, including completed computer program input data sheets.

2. Study and Equipment Evaluation Reports.

3. Coordination-Study Report.

4. Arc-flash study input data, including completed computer program input data sheets.

5. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is

satisfactory.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For coordination-study specialist.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

C. Product certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1554 and NFPA 70E.

1.05 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Arc-Flash Study Specialist Qualifications: Professional engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

E. Comply with IEEE 399 for general study procedures.

PART 2 - PRODUCTS

2.01 COMPUTER SOFTWARE DEVELOPERS

A. Computer Software Developers: Subject to compliance with requirements, provide products by the following:

1. ETAP

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

a. Arcing faults.

b. Simultaneous faults.

c. Explicit negative sequence.

d. Mutual coupling in zero sequence.

2.03 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 16075 "Electrical Identification." Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.

2. Nominal voltage.

3. Flash protection boundary.

4. Hazard risk category.

5. Incident energy.

6. Working distance.

7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Impedance of utility service entrance.

3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a. Circuit-breaker and fuse-current ratings and types.

b. Relays and associated power and current transformer ratings and ratios.

c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.

d. Generator kilovolt amperes, size, voltage, and source impedance.

e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.

f. Busway ampacity and impedance.

g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

   a. Special load considerations, including starting inrush currents and frequent starting and stopping.

   b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

   c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

   d. Generator thermal-damage curve.

   e. Ratings, types, and settings of utility company's overcurrent protective devices.

   f. Special overcurrent protective device settings or types stipulated by utility company.

   g. Time-current-characteristic curves of devices indicated to be coordinated.

   h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

   i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

   j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.03 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

   1. Switchgear and switchboard bus.

   2. Medium-voltage controller.

   3. Motor-control center.

4. Distribution panelboard.

5. Branch circuit panelboard.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.

1. Transformers:

a. ANSI C57.12.10.

b. ANSI C57.12.22.

c. ANSI C57.12.40.

d. IEEE C57.12.00.

e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.

3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.

4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

2. For devices and equipment rated for asymmetrical fault current,

apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.04 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 141 recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the

maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.

b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.

d. Fuse-current rating and type.

e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.

b. Voltage and current ratio for curves.

c. Three-phase and single-phase damage points for each transformer.

d. No damage, melting, and clearing curves for fuses.

e. Cable damage curves.

f. Transformer inrush points.

g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

3.05 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.

C. Calculate maximum and minimum contributions of fault-current size.

1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.

2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.

F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.

2. When the line terminals of the circuit breaker are separate from the

work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.06 LABELING

A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations per the latest MTA standards:

1. Motor-control center.

2. Low-voltage switchboard.

3. Switchgear.

4. Medium-voltage switch.

5. Control panel.

3.07 APPLICATION OF WARNING LABELS

A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

3.08 DEMONSTRATION

A. Engage the Arc-Flash Study Specialist to train Owner's maintenance personnel in the potential arc-flash hazards associated with working on energized equipment and the significance of the arc-flash warning labels.

PART 4: MEASUREMENT AND PAYMENT

4.01 OVERCURRENT PROTECTIVE DEVICE COORDINATION:

A. Overcurrent protective device coordination will not be measured for payment.

B. Overcurrent protective device coordination will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes grounding systems and equipment, plus the following special applications:

1. Ground bonding common with lightning protection system.

1.03 ACTION SUBMITTALS

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

1.04 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.

2. Ground rings.

3. Grounding for sensitive electronic equipment.

B. Qualification Data: For qualified testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS.

a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

b. Include recommended testing intervals.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes

spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.02 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.03 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel 3/4 inch in diameter by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.

1. Bury at least 30 inches (750 mm) below grade.

2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors and as otherwise indicated.

3. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod and grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.03 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding

conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

F. Metal Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.04 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 12 inches (305 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least three rods spaced at least two-rod lengths from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers

and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

G. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column , extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.

2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

3.05 LABELING

A. Comply with requirements in Section 16075 "Electrical Identification" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

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

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to

1000 kVA: 5 ohms.

3. Panelboards Serving Electronic Equipment: 1 ohm(s).

4. Switchboards and Pad-Mounted Equipment: 5 ohms.

5. Manhole Grounds: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

PART 4: MEASUREMENT AND PAYMENT

4.01 GROUND RODS:

A. Ground rods will be measured for at the contract unit price bid per each.

B. Ground rods will be paid per each complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 #2/0 BARE COPPER WIRE

A. #2/0 Bare copper wire will not be measured for payment.

B. #2/0 Bare copper wire will not be paid for directly, but will be included in the lump sum bid price for Maintenance Building.

END OF SECTION

SECTION 16073

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Equipment supports.

1.06 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.07 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.08 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07720 "Roof Accessories."

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.; a division of Cooper Industries.

c. ERICO International Corporation.

d. GS Metals Corp.

e. Thomas & Betts Corporation.

f. Unistrut; Tyco International, Ltd.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

i. Hilti Inc.

ii. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

iii. MKT Fastening, LLC.

iv. Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      i. Cooper B-Line, Inc.; a division of Cooper Industries.

      ii. Empire Tool and Manufacturing Co., Inc.

      iii. Hilti Inc.

      iv. ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.

      v. MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05500 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To New Concrete: Bolt to concrete inserts.

2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

3. To Existing Concrete: Expansion anchor fasteners.

4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

6. To Light Steel: Sheet metal screws.

7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05500 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03300 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 09915 "Interior Painting" painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

PART 4: MEASUREMENT AND PAYMENT

4.01 HANGARS AND SUPPORTS FOR ELECTRICAL SYSTEMS:

A. Hangers and Supports for Electrical Systems will not be measured for payment.

B. Hangers and Supports for Electrical Systems will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.03 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.04 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.05 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

E. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.02 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.03 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.04 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil-(0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.

C. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.05 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.06 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.07 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.08 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.09 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.10 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).

5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

K. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.02 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 Identify with self-adhesive vinyl label. Install labels at 10-foot (3-m) maximum intervals.

C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

2. Power.

3. UPS.

D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in

vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

   a. Color shall be factory applied.

   b. Colors for 208/120-V Circuits:

      i. Phase A: Black.

      ii. Phase B: Red.

      iii. Phase C: Blue.

   c. Colors for 480/277-V Circuits:

      i. Phase A: Brown.

      ii. Phase B: Orange.

      iii. Phase C: Yellow.

   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

E. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Metal-backed, butyrate warning signs.

1. Comply with 29 CFR 1910.145.

2. Identify system voltage with black letters on an orange background.

3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

a. Power transfer switches.

b. Controls with external control power connections.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.

c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchboards.

e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

f. Emergency system boxes and enclosures.

g. Motor-control centers.

h. Enclosed switches.

i. Enclosed circuit breakers.

j. Enclosed controllers.

k. Variable-speed controllers.

l. Push-button stations.

m. Power transfer equipment.

n. Contactors.

o. Remote-controlled switches, dimmer modules, and control devices.

p. Monitoring and control equipment.

q. UPS equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 ELECTRICAL IDENTIFICATION:

A. Electrical Identification will not be measured for payment.

B. Electrical Identification will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16091

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.

2. Sleeve-seal systems.

3. Sleeve-seal fittings.

4. Grout.

5. Silicone sealants.

B. Related Requirements:

1. Section 07841 "Through-Penetration Firestop Systems" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. LEED Submittals:

1. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit EQ 4: For sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic

Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 2 - PRODUCTS

2.01 SLEEVES

A. Wall Sleeves:

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

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.

b. CALPICO, Inc.

c. Metraflex Company (The).

d. Pipeline Seal and Insulator, Inc.

e. Proco Products, Inc.

2. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel .

4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products and Systems, Inc.

b. CALPICO, Inc.

c. Metraflex Company (The).

d. Pipeline Seal and Insulator, Inc.

e. Proco Products, Inc.

2.04 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.01 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07920 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

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

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

PART 4: MEASUREMENT AND PAYMENT

4.01 SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING:

A. Sleeves and Sleeve Seals for Electrical Raceways and Cabling will not be measured for payment.

B. Sleeves and Sleeve Seals for Electrical Raceways and Cabling will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16120

CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 16717 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 DEFINITIONS

A. VFC: Variable frequency controller.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:

1. Alpha Wire.

2. Belden Inc.

3. Encore Wire Corporation.

4. General Cable Technologies Corporation.

5. Southwire Incorporated.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for THHN-2-THWN-2, Type XHHW-2 and Type USE

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC with ground wire.

E. VFC Cable:

1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.

2. Retain one shield option in first subparagraph below.

3. Type TC-ER with oversized crosslinked polyethylene insulation, [spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire] [dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires], and sunlight- and oil-resistant outer PVC jacket.

4. Comply with UL requirements for cables in [direct burial] [Classes I and II, Division 2 hazardous **location**] applications.

2.02 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Encore Wire Corporation.

2. General Cable Technologies Corporation.

3. Southwire Company.

B. Class 1 Control Circuits: Stranded copper, Type XHHW-2, in raceway, complying with UL 44.

2.03 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.04 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except Variable Frequency Controller VFC cable, which shall be extra flexible stranded.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

E. Feeders in Cable Tray: Type THHN-2-THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

H. Branch Circuits in Cable Tray: Type THHN-2-THWN-2, single conductors in raceway.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 16130 "Raceways and Boxes" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 16073 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 16136 "Cable Trays" prior to installing conductors and cables.

3.04 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 16075 "Electrical Identification."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 16091 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07841 "Through-Penetration Firestop Systems."

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding critical equipment and services for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.

   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

C. Test and Inspection Reports: Prepare a written report to record the following:

   1. Procedures used.

   2. Results that comply with requirements.

   3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Cables will be considered defective if they do not pass tests and inspections.

PART 4: MEASUREMENT AND PAYMENT

4.01 CONDUCTORS AND CABLES:

A. Conductors and cables will not be measured for payment.

B. Conductors and cables will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16130

RACEWAYS AND BOXES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.

2. Nonmetal conduits, tubing, and fittings.

3. Metal wireways and auxiliary gutters.

4. Boxes, enclosures, and cabinets.

B. Related Requirements:

1. Section 02584 "Underground Ducts and Utility Structures" for exterior ductbanks, manholes, and underground utility construction.

2. Section 16711 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

3. Section 16712 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.03 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.

2. Anamet Electrical, Inc.

3. Electri-Flex Company.

4. O-Z/Gedney; a brand of EGS Electrical Group.

5. Picoma Industries, a subsidiary of Mueller Water Products, Inc.

6. Republic Conduit.

7. Robroy Industries.

8. Southwire Company.

9. Thomas & Betts Corporation.

10. Western Tube and Conduit Corporation.

11. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:

a. Material: Steel.

b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CANTEX Inc.

2. Condux International, Inc.

3. Electri-Flex Company.

4. Kraloy.

5. Lamson & Sessions; Carlon Electrical Products.

6. RACO; a Hubbell company.

7. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.03 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.

2. Hoffman; a Pentair company.

3. Mono-Systems, Inc.

4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Prime coated, ready for field painting.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mono-Systems, Inc.

b. Panduit Corp.

c. Wiremold / Legrand.

2.05 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.

2. Cooper Technologies Company; Cooper Crouse-Hinds.

3. EGS/Appleton Electric.

4. Erickson Electrical Equipment Company.

5. FSR Inc.

6. Hoffman; a Pentair company.

7. Hubbell Incorporated; Killark Division.

8. Kraloy.

9. Milbank Manufacturing Co.

10. Mono-Systems, Inc.

11. O-Z/Gedney; a brand of EGS Electrical Group.

12. RACO; a Hubbell Company.

13. Robroy Industries.

14. Spring City Electrical Manufacturing Company.

15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.

16. Thomas & Betts Corporation.

17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of

same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

K. Gangable boxes are prohibited.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: EMT.

3. Underground Conduit: RNC, Type EPC-40-PVC, concrete encased.

4. Connection to Vibrating Equipment (Including Transformers and

Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: GRC Raceway locations include the following:

a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: GRC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install surface raceways only where indicated on Drawings.

F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 16073 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

O. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

P. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

Q. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm)radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

R. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following

changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Where otherwise required by NFPA 70.

T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

U. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and

piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

Z. Locate boxes so that cover or plate will not span different building finishes.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 02317

"Excavation and Fill" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 02317 "Excavation and Fill."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 02317 "Excavation and Fill."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

5. Underground Warning Tape: Comply with requirements in Section 16075 "Electrical Identification."

3.04 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 16091 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.05 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

3.06 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

PART 4: MEASUREMENT AND PAYMENT

4.01 RACEWAYS AND BOXES:

A. Raceways and boxes will not be measured for payment.

B. Raceways and boxes will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16136

CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Ladder cable trays.

2. Trough cable trays.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of cable tray.

1. Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.

1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

C. Delegated-Design Submittal: For seismic restraints.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.

2. Design Calculations: Calculate requirements for selecting seismic restraints.

3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.

2. Vertical and horizontal offsets and transitions.

3. Clearances for access above and to side of cable trays.

4. Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

B. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, to design cable tray supports and seismic bracing.

B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."

2. Component Importance Factor: 1.5.

C. Thermal Movements: Allow for thermal movements from ambient and

surface temperature changes in cable tray installed outdoors.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 GENERAL REQUIREMENTS FOR CABLE TRAYS

A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.

1. Source Limitations: Obtain cable trays and components from single manufacturer.

B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.

C. Structural Performance: See articles for individual cable tray types for specific values for the following parameters:

1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.

2. Concentrated Load: A load applied at midpoint of span and centerline of tray.

3. Load and Safety Factors: Applicable to both side rails and rung capacities.

2.03 LADDER CABLE TRAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.

2. Chalfant Manufacturing Company.

3. Cooper B-Line, Inc.

4. Mono-Systems, Inc.

5. MP Husky.

6. Niedax-Kleinhuis USA, Inc.

B. Description:

1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.

2. Rung Spacing: 6 inches (150 mm) o.c.

3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.

4. Minimum Cable-Bearing Surface for Rungs: 7/8-inch (22-mm) width with radius edges.

5. No portion of the rungs shall protrude below the bottom plane of side rails.

6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.

7. Minimum Usable Load Depth: 6 inches (150 mm).

8. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.

9. Width: 18 inches (450 mm) unless otherwise indicated on Drawings.

10. Fitting Minimum Radius: 36 inches (900 mm).

11. Class Designation: Comply with NEMA VE 1, Class 12B.

12. Splicing Assemblies: Bolted type using serrated flange locknuts.

13. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316.

14. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

2.04 TROUGH CABLE TRAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a Tyco International Ltd. Co.

2. Chalfant Manufacturing Company.

3. Cooper B-Line, Inc.

4. Mono-Systems, Inc.

5. MP Husky.

6. Niedax-Kleinhuis USA, Inc.

B. Description:

1. Configuration: Two longitudinal members (side rails) with a solid sheet over rungs exposed on the interior of the trough, or corrugated sheet with both edges welded to the side rails.

2. Rung Spacing: Rungs or corrugations shall be spaced a maximum of 6 inches (150 mm) o.c. and have a minimum flat bearing surface of 2 inches (50 mm).

3. Radius-Fitting Rung Spacing: 9 inches (225 mm) at center of tray's width.

4. Structural Performance: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a200-lb (90-kg) concentrated load, when tested according to NEMA VE 1.

5. Minimum Usable Load Depth: 6 inches (150 mm).

6. Straight Section Lengths: 10 feet (3 m) except where shorter lengths are required to facilitate tray assembly.

7. Width: 18 inches (450 mm) unless otherwise indicated on Drawings.

8. Fitting Minimum Radius: 36 inches (900 mm).

9. Class Designation: Comply with NEMA VE 1, Class 12B.

10. Splicing Assemblies: Bolted type using serrated flange locknuts.

11. Splicing Assembly Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

12. Hardware and Fasteners: ASTM F 593 and ASTM F 594 stainless steel, Type 316.

2.05 MATERIALS AND FINISHES

A. Steel:

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.

2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.

3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.

4. Finish: Mill galvanized before fabrication.

   a. Standard: Comply with ASTM A 653/A 653M, G90 (Z275).

   b. Hardware: Galvanized, ASTM B 633.

5. Finish: Hot-dip galvanized after fabrication.

   a. Standard: Comply with ASTM A 123/A 123M, Class B2.

   b. Hardware: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

6. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.

B. Stainless Steel:

1. Materials: Low-carbon, passivated, stainless steel, Type 304L or Type 316L, ASTM F 593 and ASTM F 594.

2. Hardware for Stainless-Steel Cable Tray Used Outdoors: Stainless steel, Type 316, ASTM F 593 and ASTM F 594.

2.06 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Covers: Solid 2-in-3 pitch type made of same materials and with same finishes as cable tray.

C. Barrier Strips: Same materials and finishes as for cable tray.

D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

2.07 WARNING SIGNS

A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."

B. Comply with requirements for fasteners in Section 16075 "Electrical Identification."

2.08 SOURCE QUALITY CONTROL

A. Testing: Test and inspect cable trays according to NEMA FG 1.

PART 3 - EXECUTION

3.01 CABLE TRAY INSTALLATION

A. Install cable trays according to NEMA FG 1.

B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.

C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.

D. Remove burrs and sharp edges from cable trays.

E. Join aluminum cable tray with splice plates; use four square neck-carriage bolts and locknuts.

F. Fasten cable tray supports to building structure and install seismic restraints.

G. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

H. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.

I. Support bus assembly to prevent twisting from eccentric loading.

J. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.

K. Locate and install supports according to NEMA FG 1 Do not install more than one cable tray splice between supports.

L. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.

M. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1. Space connectors and set gaps according to applicable

standard.

N. Make changes in direction and elevation using manufacturer's recommended fittings.

O. Make cable tray connections using manufacturer's recommended fittings.

P. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

Q. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

R. Install cable trays with enough workspace to permit access for installing cables.

S. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

T. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.

U. Clamp covers on cable trays installed outdoors with heavy-duty clamps.

V. Install warning signs in visible locations on or near cable trays after cable tray installation.

3.02 CABLE TRAY GROUNDING

A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 16060 "Grounding and Bonding."

B. Cable trays with communications cable shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

C. Cable trays with control conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.

D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.

E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

3.03 CABLE INSTALLATION

A. Install cables only when each cable tray run has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. Fasten cables on vertical runs to cable trays every 18 inches (450 mm).

D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 72 inches (1800 mm).

E. Tie MI cables down every 36 inches (900 mm) where required to provide a 2-hour fire rating and every 72 inches (1800 mm) elsewhere.

F. In existing construction, remove inactive or dead cables from cable trays.

3.04 CONNECTIONS

A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.

B. Connect pathways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

3.05 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.

2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.

3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.

4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.

5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.

6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.

7. Check for improperly sized or installed bonding jumpers.

8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.

9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.

B. Prepare test and inspection reports.

3.06 PROTECTION

A. Protect installed cable trays and cables.

1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.

2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.

3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

PART 4: MEASUREMENT AND PAYMENT

4.01 CABLE TRAYS FOR COMMUNICATIONS (6”D X 18”W):

A. 6”D x 18”W cable trays will not be measured for payment.

B. 6”D x 18”W cable trays will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Weather-resistant receptacles.
4. Snap switches and wall-box dimmers.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.
7. Pendant cord-connector devices.
8. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.06 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.08 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. Service/Power Poles: One for every 10, but no fewer than one.

2. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.

3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with the requirements in this Section.

2.03 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; 5351 (single), CR5362 (duplex).

b. Hubbell; HBL5351 (single), HBL5352 (duplex).

c. Leviton; 5891 (single), 5352 (duplex).

d. Pass & Seymour; 5361 (single), 5362 (duplex).

B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Products: Subject to compliance with requirements, provide one of

the following:

a. Cooper; IG5362RN.

b. Hubbell; IG5362.

c. Leviton; 5362-IG.

d. Pass & Seymour; IG5362.

2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.04 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.

2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.

3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; VGF20.

b. Hubbell; GFR5352L.

c. Pass & Seymour; 2095.

d. Leviton; 7590.

C. Tamper-Resistant GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hubbell; GFTR20.

b. Pass & Seymour; 2095TR.

2.05 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Crouse-Hinds.

b. EGS/Appleton Electric.

c. Killark; Division of Hubbell Inc.

2.06 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Cooper; CWL520R.

b. Hubbell; HBL2310.

c. Leviton; 2310.

d. Pass & Seymour; L520-R.

2. Description:

a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.07 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.

2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.

3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.08 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Single Pole:

i. Cooper; AH1221.

ii. Hubbell; HBL1221.

iii. Leviton; 1221-2.

iv. Pass & Seymour; CSB20AC1.

b. Three Way:

i. Cooper; AH1223.

ii. Hubbell; HBL1223.

iii. Leviton; 1223-2.

iv. Pass & Seymour; CSB20AC3.

c. Four Way:

i. Cooper; AH1224.

ii. Hubbell; HBL1224.

iii. Leviton; 1224-2.

iv. Pass & Seymour; CSB20AC4.

2.09 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.10 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.

3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.11 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 16717 "Communications Horizontal Cabling."

2.12 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.

2. Pass & Seymour/Legrand.

3. Square D/Schneider Electric.

4. Thomas & Betts Corporation.

5. Wiremold/Legrand.

B. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

2. Comply with UL 514 scrub water exclusion requirements.

3. Service-Outlet Assembly: Flush type with two duplex receptacle and space for two RJ-45 jacks complying with requirements in Section 16717 "Communications Horizontal Cabling."

4. Size: Selected to fit nominal 4-inch (75-mm) cored holes in floor and matched to floor thickness.

5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

6. Closure Plug: Arranged to close unused 4-inch (100-mm) cored openings and reestablish fire rating of floor.

7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, four-pair data cables that comply with requirements in Section 16717 "Communications Horizontal Cabling."

2.13 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Brown unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency Power System: Red.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.

b. Straighten conductors that remain and remove corrosion and foreign matter.

c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.

2. Verify that dimmers used for fan speed control are listed for that application.

3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in

the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section 16075 "Electrical Identification."

B. Identify each receptacle with source panelboard and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault

current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 4: MEASUREMENT AND PAYMENT

4.01 DUPLEX RECEPTACLES:

A. Duplex receptacles will be measured for at the contract unit price bid per each.

B. Duplex receptacles will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 GFCI RECEPTACLES:

A. GFCI Receptacles will be measured for at the contract unit price bid per each.

B. GFCI receptacles will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.03 TOGGLE SWITCHES:

A. Toggle switches will be measured for at the contract unit price bid per each.

B. Toggle switches will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16145

LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy sensors.
5. Outdoor motion sensors.
6. Lighting contactors.

B. Related Requirements:

1. Section 16140 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.01 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. Invensys Controls.

4. Leviton Mfg. Company Inc.

5. NSi Industries LLC; TORK Products.

6. Tyco Electronics; ALR Brand.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency,

2. Contact Configuration: SPST.

3. Contact Rating: 20-A ballast load, 120-/240-V ac.

4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.

5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.

6. Astronomic Time: All channels.

7. Automatic daylight savings time changeover.

8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

C. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Contact Configuration: SPST.

3. Contact Rating: 20-A ballast load, 120-/240-V ac.

4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.

5. Astronomic time dial.

6. Eight-Day Program: Uniquely programmable for each weekday and holidays.

7. Skip-a-day mode.

8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.02 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. NSi Industries LLC; TORK Products.

4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.

3. Time Delay: Fifteen second minimum, to prevent false operation.

4. Surge Protection: Metal-oxide varistor.

5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

C. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.

3. Time Delay: Thirty-second minimum, to prevent false operation.

4. Lightning Arrester: Air-gap type.

5. Mounting: Twist lock complying with NEMA C136.10, with base.

2.03 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.

2. Eaton Corporation.

3. Hubbell Building Automation, Inc.

4. Leviton Mfg. Company Inc.

5. Lithonia Lighting; Acuity Lighting Group, Inc.

6. NSi Industries LLC; TORK Products.

7. Sensor Switch, Inc.

8. Tyco Electronics; ALR Brand.

9. Watt Stopper.

B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing

agency, and marked for intended location and application.

2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.

4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.

6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.

7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.

8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.

9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.

10. Test Mode: User selectable, overriding programmed time delay to allow settings check.

11. Control Load Status: User selectable to confirm that load wiring is correct.

12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.04 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.

2. Hubbell Building Automation, Inc.

3. Leviton Mfg. Company Inc.

4. Lithonia Lighting; Acuity Lighting Group, Inc.

5. Watt Stopper.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).

b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.

b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.

3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.

4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).

2.05 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Bryant Electric; a Hubbell company.

2. Cooper Industries, Inc.

3. Hubbell Building Automation, Inc.

4. Leviton Mfg. Company Inc.

5. Lightolier Controls.

6. Lithonia Lighting; Acuity Lighting Group, Inc.

7. Lutron Electronics Co., Inc.

8. NSi Industries LLC; TORK Products.

9. RAB Lighting.

10. Sensor Switch, Inc.

11. Square D; a brand of Schneider Electric.

12. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. Mounting:

a. Sensor: Suitable for mounting in any position on a standard outlet box.

b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

7. Bypass Switch: Override the "on" function in case of sensor failure.

8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).

2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy .

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.06 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Bryant Electric; a Hubbell company.

2. Cooper Industries, Inc.

3. Hubbell Building Automation, Inc.

4. Leviton Mfg. Company Inc.

5. Lightolier Controls.

6. Lithonia Lighting; Acuity Lighting Group, Inc.

7. Lutron Electronics Co., Inc.

8. NSi Industries LLC; TORK Products.

9. RAB Lighting.

10. Sensor Switch, Inc.

11. Square D; a brand of Schneider Electric.

12. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).

1. Sensing Technology: Dual technology - PIR and ultrasonic.

2. Switch Type: SP.

3. Voltage: Match the circuit voltage; passive-infrared type.

4. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

5. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

6. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.

7. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.07 HIGH-BAY OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Hubbell Building Automation, Inc.

B. General Description: Solid-state unit. The unit is designed to operate with the lamp and ballasts indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights

to half-power that is adjustable over a minimum range of 1 to 16 minutes.

3. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.

4. Operating Ambient Conditions: 32 to 149 deg F (0 to 65 deg C).

5. Mounting: Threaded pipe.

6. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

7. Detector Technology: PIR.

8. Power and dimming control from the lighting fixture ballast that has been modified to include the dimming capacitor and MyzerPORT option.

C. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet (3.7 to 15.2 m).

D. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

2.08 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Allen-Bradley/Rockwell Automation.

2. ASCO Power Technologies, LP; a division of Emerson Electric Co.

3. Eaton Corporation.

4. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.

5. Square D; a brand of Schneider Electric.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and

high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).

2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.

3. Enclosure: Comply with NEMA 250.

4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status.

2. Control: On-off operation.

2.09 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 16120 "Conductors and Cables."

B. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 16120 "Conductors and Cables."

PART 3 - EXECUTION

3.01 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.02 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.03 WIRING INSTALLATION

A. Wiring Method: Comply with Section 16120 "Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.04 IDENTIFICATION

A. Identify components and power and control wiring according to Section 16075 "Electrical Identification."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Perform the following tests and inspections:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.06 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.07 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems where used for this ProjectTrain Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

PART 4: MEASUREMENT AND PAYMENT

4.01 LIGHTING CONTROL DEVICES:

A. Lighting Control Devices will not be measured for payment.

B. Lighting Control Devices will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16211

ELECTRICITY METERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes equipment for electricity metering by utility company.

1.03 DEFINITIONS

A. KY Pulse: Term used by the metering industry to describe a method of measuring consumption of electricity that is based on a relay opening and closing in response to the rotation of the disk in the meter.

B. PC: Personal computer.

1.04 ACTION SUBMITTALS

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

B. Shop Drawings: For electricity-metering equipment.

1. Dimensioned plans and sections or elevation layouts.

2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 01780 "Closeout," include the following:

1. Application and operating software documentation.

2. Software licenses.

3. Software service agreement.

4. Hard copies of manufacturer's operating specifications, design user's guides for software and hardware, and PDF files on CD-ROM of the hard-copy Submittal.

1.07 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.09 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.10 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.

2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

1.11 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two

years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade his computer equipment if necessary.

PART 2 - PRODUCTS

2.01 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

C. Install modular meter center according to NECA 400 switchboard installation requirements.

3.02 IDENTIFICATION

A. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.

2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with

occupant's name.

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.

2. Turn off circuits supplied by metered feeder and secure them in off condition.

3. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.

4. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 4: MEASUREMENT AND PAYMENT

4.01 ELECTRICITY METERING:

A. Electricity Metering will not be measured for payment.

B. Electricity metering will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16231

PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes packaged engine-generator sets for emergency power supply with the following features:

1. Diesel engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Performance requirements for sensitive loads.
5. Load banks.

B. Related Sections include the following:

1. Section 16415 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.03 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. LP: Liquid petroleum.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.

2. Time-current characteristic curves for generator protective device. The generator breaker shall coordinate with the generator damage curve and the generator electrical distribution system.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

4. Wiring Diagrams: Power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, manufacturer and testing agency.

B. Source quality-control test reports.

1. Certified summary of prototype-unit test report.

2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.

3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.

4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

5. Report of sound generation.

6. Report of exhaust emissions showing compliance with applicable regulations.

7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

C. Field quality-control test reports.

D. Warranty: Special warranty specified in this Section.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.

2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.

3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 50 (81km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is

a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 99.

J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

K. Comply with UL 2200.

L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.09 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without

Construction Manager's written permission.

B. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: Minus 15 to plus 40 deg C.

2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to 500feet.

1.10 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.12 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar; Engine Div.

2. Generac Power Systems, Inc.

3. Kohler Co.; Generator Division.

4. Magnetek, Inc.

5. Onan/Cummins Power Generation; Industrial Business Group.

6. Spectrum Detroit Diesel.

2.02 ENGINE-GENERATOR SET

A. Factory-assembled and -tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

C. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated on the drawings.

2. Output Connections: Three-phase, four wire.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.

3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: Less than 5 percent variation

for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.

6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

8. Start Time: Comply with NFPA 110, Type 10, system requirements.

E. Generator-Set Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

   a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.

3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

   a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

2.03 ENGINE

A. Fuel: Fuel oil, Grade DF-2, off road diesel fuel.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm (11.4 m/s).

D. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:

1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.

a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.

b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.

2. Sound level measured at a distance of 10 feet (3 m) from exhaust discharge after installation is complete shall be 85 dBA or less.

J. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

K. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.

7. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.

8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.04 FUEL OIL STORAGE

A. The generator fuel oil storage tank will be provided per Specification Section 15193 “Above Ground Storage Tanks”.

1. The storage tank will be equipped with double wall leak detection. Leak detection will be provided per Specification Section 15192 “Facility Fuel-Oil Piping”.

2.05 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter.

2. AC ammeter.

3. AC frequency meter.

4. DC voltmeter (alternator battery charging).

5. Engine-coolant temperature gage.

6. Engine lubricating-oil pressure gage.

7. Running-time meter.

8. Ammeter-voltmeter, phase-selector switch(es).

9. Generator-voltage adjusting rheostat.

10. Fuel tank derangement alarm.

11. Fuel tank high-level shutdown of fuel supply alarm.

12. Start-stop switch.

13. Overspeed shutdown device.

14. Coolant high-temperature shutdown device.

15. Coolant low-level shutdown device.

16. Oil low-pressure shutdown device.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Section 16215 "Electrical Power Monitoring and Control."

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

1. Overcrank shutdown.

2. Coolant low-temperature alarm.

3. Control switch not in auto position.

4. Battery-charger malfunction alarm.

5. Battery low-voltage alarm.

6. Engine high-temperature shutdown.

7. Lube-oil, low-pressure shutdown.

8. Overspeed shutdown.

9. Remote emergency-stop shutdown.

10. Engine high-temperature prealarm.

11. Lube-oil, low-pressure prealarm.

12. Fuel tank, low-fuel level.

13. Low coolant level.

G. Remote Alarm Annunciator: Comply with NFPA 99. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.06 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Provide three Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489 500 amps, see plans for breaker quantity and sizes.

1. Tripping Characteristic: Designed specifically for generator protection.

2. Trip Rating: Matched to generator rating.

3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.

4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.07 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H or Class F.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Instrument Transformers: Mounted within generator enclosure.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.08 LOAD BANK

A. Description: Permanent, skid mounted remote-controlled, forced-air-cooled, resistive unit capable of providing a balanced 3-phase, delta-connected load to generator set at 50 percent rated-system capacity, at 80 percent power factor, lagging. Unit may be composed of separate resistive and reactive load banks controlled by a common control panel. Unit shall

be capable of selective control of load in 25 percent steps and with minimum step changes of approximately 5 and 10 percent available.

B. Resistive Load Elements: Corrosion-resistant chromium alloy with ceramic and steel supports. Elements shall be double insulated and designed for repetitive on-off cycling. Elements shall be mounted in removable aluminized-steel heater cases.

C. Load-Bank Heat Dissipation: Integral fan with totally enclosed motor shall provide uniform cooling airflow through load elements. Airflow and coil operating current shall be such that, at maximum load, with ambient temperature at the upper end of specified range, load-bank elements operate at not more than 50 percent of maximum continuous temperature rating of resistance elements.

D. Load Element Switching: Remote-controlled contactors switch groups of load elements. Contactor coils are rated 120 V. Contactors shall be located in a separate NEMA 250, Type 3R enclosure within load-bank enclosure, accessible from exterior through hinged doors with tumbler locks.

E. Contactor Enclosures: Heated by thermostatically controlled strip heaters to prevent condensation.

F. Protective Devices: Power input circuits to load banks shall be fused, and fuses shall be selected to coordinate with generator circuit breaker. Fuse blocks shall be located in contactor enclosure. Cooling airflow and overtemperature sensors shall automatically shut down and lock out load bank until manually reset. Safety interlocks on access panels and doors shall disconnect load power, control, and heater circuits. Fan motor shall be separately protected by overload and short-circuit devices. Short-circuit devices shall be noninterchangeable fuses with 200,000-A interrupting capacity.

G. Control Sequence: Control panel may be preset for adjustable single-step loading of generator during automatic exercising.

2.09 MOTORS

A. General requirements for motors are specified in Section 15058 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in electrical Sections.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene.

2. Durometer Rating: 45.

3. Number of Layers: Two.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters and

with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.

2. Full load run for 2 hours.

3. Maximum power.

4. Voltage regulation.

5. Transient and steady-state governing.

6. Single-step load pickup.

7. Safety shutdown.

8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing

connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Section 15181 "Hydronic Piping."

1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Section 15181 "Hydronic Piping."

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect cooling-system water piping to engine-generator set and with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Diesel storage tanks, tank accessories, piping, valves, and specialties for fuel systems are specified in Section 15192 "Facility Fuel-Oil Piping."

F. Ground equipment according to Section 16060 "Grounding and Bonding."

G. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 IDENTIFICATION

A. Identify system components according to Section 15077 "Identification for

HVAC Piping and Equipment" and Section 16075 "Electrical Identification."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.

3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.

c. Verify acceptance of charge for each element of the battery after discharge.

d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator

system before and during system operation. Check for air, exhaust, and fluid leaks.

6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg (120 kPa). Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.

7. Exhaust Emissions Test: Comply with applicable government test criteria.

8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

9. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

10. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Section 01780 "Closeout."

PART 4: MEASUREMENT AND PAYMENT

4.01 EMERGENCY POWER DISTRIBUTION:

A. Emergency power distribution will not be measured for payment.

B. Emergency power distribution will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16264

STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Three-phase, on-line, double-conversion, static-type, UPS units with the following features:

a. Surge suppression.

b. Input harmonics reduction.

c. Rectifier-charger.

d. Inverter.

e. Static bypass transfer switch.

f. Battery and battery disconnect device.

g. Internal maintenance bypass/isolation switch.

h. Remote UPS monitoring provisions.

i. Remote monitoring.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. LCD: Liquid-crystal display.

C. LED: Light-emitting diode.

D. PC: Personal computer.

E. THD: Total harmonic distortion.

F. UPS: Uninterruptible power supply.

1.04 PERFORMANCE REQUIREMENTS

A. Seismic Performance: UPS shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include data on features, components, ratings, and performance.

B. Shop Drawings: For UPS. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.

2. Wiring Diagrams: For power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For UPS equipment, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: For each product, from manufacturer.

D. Factory Test Reports: Comply with specified requirements.

E. Field quality-control reports.

F. Performance Test Reports: Indicate test results compared with specified

performance requirements, and provide justification and resolution of differences if values do not agree.

G. Warranties: Sample of special warranties.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals.

1.08 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. Fuses: One for every 10 of each type and rating, but no fewer than one of each.

2. Cabinet Ventilation Filters: One complete set(s).

1.09 QUALITY ASSURANCE

A. Power Quality Specialist Qualifications: A registered professional electrical engineer or engineering technician, currently certified by the National Institute for Certification in Engineering Technologies, NICET Level 4, minimum, experienced in performance testing UPS installations and in performing power quality surveys similar to that required in "Performance Testing" Article.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. UL Compliance: Listed and labeled under UL 1778 by an NRTL.

E. NFPA Compliance: Mark UPS components as suitable for installation in computer rooms according to NFPA 75.

1.10 WARRANTY

A. Special Battery Warranties: Specified form in which manufacturer and Installer agree to repair or replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.

1. Warranted Cycle Life for Flooded Batteries: Equal to or greater than that represented in manufacturer's published table, including figures corresponding to the following, based on annual average battery temperature of 77 deg F (25 deg C):

Discharge Rate	Discharge Duration	Discharge End Voltage	Cycle Life
8 hours	8 hours	1.75	40 cycles
1 hour	1 hour	1.75	80 cycles
15 minutes	45 seconds	1.67	2700 cycles

B. Special UPS Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within special warranty period.

1. Special Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 OPERATIONAL REQUIREMENTS

A. Automatic operation includes the following:

1. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.

2. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.

3. If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.

4. When power is restored at the normal supply terminals of the system, controls automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger then supplies power to the load through the inverter and simultaneously recharges the battery.

5. If the battery becomes discharged and normal supply is available,

the rectifier-charger charges the battery. On reaching full charge, the rectifier-charger automatically shifts to float-charge mode.

6. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch switches the load to the normal ac supply circuit without disturbance or interruption.

7. If a fault occurs in the system supplied by the UPS, and current flows in excess of the overload rating of the UPS system, the static bypass transfer switch operates to bypass the fault current to the normal ac supply circuit for fault clearing.

8. When the fault has cleared, the static bypass transfer switch returns the load to the UPS system.

9. If the battery is disconnected, the UPS continues to supply power to the load with no degradation of its regulation of voltage and frequency of the output bus.

B. Manual operation includes the following:

1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.

2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

C. Maintenance Bypass/Isolation Switch Operation: Switch is interlocked so it cannot be operated unless the static bypass transfer switch is in the bypass mode. Device provides manual selection among the three conditions in subparagraphs below without interrupting supply to the load during switching:

1. Full Isolation: Load is supplied, bypassing the UPS. Normal UPS ac input circuit, static bypass transfer switch, and UPS load terminals are completely disconnected from external circuits.

2. Maintenance Bypass: Load is supplied, bypassing the UPS. UPS ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.

3. Normal: Normal UPS ac supply terminals are energized and the load is supplied through either the static bypass transfer switch and the UPS rectifier-charger and inverter, or the battery and the inverter.

D. Environmental Conditions: The UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance.

1. Ambient Temperature for Electronic Components: 32 to 104 deg F (0 to 40 deg C).

2. Ambient Temperature for Battery: 41 to 95 deg F (5 to 35 deg C).

3. Relative Humidity: 0 to 95 percent, noncondensing.

4. Altitude: Sea level to 4000 feet (1220 m).

2.02 PERFORMANCE REQUIREMENTS

A. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a load crest factor of 3.0, under the following conditions or combinations of the following conditions:

1. Inverter is switched to battery source.

2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.

3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.

4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.

5. Load is 50 percent unbalanced continuously.

B. Minimum Duration of Supply: If battery is sole energy source supplying rated full UPS load current at 80 percent power factor, duration of supply is 15 minutes.

C. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 10, minus 15 percent from nominal voltage.

D. Overall UPS Efficiency: Equal to or greater than 90 percent at 100 percent load, 70 percent at 75 percent load, and 48 percent at 50 percent load.

E. Maximum Acoustical Noise: 20 dB, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 10’

from nearest surface of component enclosure.

F. Maximum Energizing Inrush Current: Six times the full-load current.

G. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent over the full range of battery voltage.

H. Output Frequency: 60 Hz, plus or minus 0.5 percent over the full range of input voltage, load, and battery voltage.

I. Limitation of harmonic distortion of input current to the UPS shall be as follows:

1. Description: Either a tuned harmonic filter or an arrangement of rectifier-charger circuits shall limit THD to 5 percent, maximum, at rated full UPS load current, for power sources with X/R ratio between 2 and 30.

J. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for 100 percent rated nonlinear load current with a load crest factor of 3.0.

K. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.

L. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 100 ms:

1. 50 Percent: Plus or minus 5 percent.

2. 100 Percent: Plus or minus 5 percent.

3. Loss of AC Input Power: Plus or minus 1 percent.

4. Restoration of AC Input Power: Plus or minus 1 percent.

M. Input Power Factor: A minimum of 0.85 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current.

N. EMI Emissions: Comply with FCC Rules and Regulations and with 47 CFR 15 for Class A equipment.

2.03 UPS SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Powerware Division.

2. General Electric

3. Liebert Corporation; a division of Emerson.

4. MGE UPS SYSTEMS.

5. Mitsubishi Electric Automation, Inc.

6. Toshiba Corporation; Industrial Systems.

B. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.

C. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.

D. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.

E. Surge Suppression: Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch, and maintenance bypass/isolation switch. Protect rectifier-charger, inverter, controls, and output components.

1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category B.

2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41.1 and IEEE C62.41.2. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 40-Hz, 180 percent voltage surges described in IEEE C62.41.1 and IEEE C62.41.2.

F. Maintainability Features: Mount rectifier-charger and inverter sections and the static bypass transfer switch on modular plug-ins, readily accessible for maintenance.

G. Capacity Upgrade Capability: Arrange wiring, controls, and modular

component plug-in provisions to permit future 25 percent increase in UPS capacity.

H. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.

2.04 RECTIFIER-CHARGER

A. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.

B. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.

C. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.

1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.

D. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life.

2.05 INVERTER

A. Description: Pulse-width modulated, with sinusoidal output.

B. Description: Pulse-width modulated, with sinusoidal output. Include a bypass phase synchronization window adjustment to optimize compatibility with local engine-generator-set power source.

2.06 STATIC BYPASS TRANSFER SWITCH

A. Description: Solid-state switching device providing uninterrupted transfer. A contactor or electrically operated circuit breaker automatically provides electrical isolation for the switch.

B. Switch Rating: Continuous duty at the rated full UPS load current, minimum.

2.07 BATTERY

A. Description: Valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch.

1. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

2. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. C&D Technologies, Inc.; Standby Power Division.

2. Eaton Corporation; Powerware Division.

3. EnerSys.

4. Panasonic Corporation of North America; Panasonic Industrial Company.

2.08 CONTROLS AND INDICATIONS

A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.

B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.

C. Indications: Plain-language messages on a digital LCD or LED.

1. Quantitative indications shall include the following:

a. Input voltage, each phase, line to line.

b. Input current, each phase, line to line.

c. Bypass input voltage, each phase, line to line.

d. Bypass input frequency.

e. System output voltage, each phase, line to line.

f. System output current, each phase.

g. System output frequency.

h. DC bus voltage.

i. Battery current and direction (charge/discharge).

j. Elapsed time discharging battery.

2. Basic status condition indications shall include the following:

a. Normal operation.

b. Load-on bypass.

c. Load-on battery.

d. Inverter off.

e. Alarm condition.

3. Alarm indications shall include the following:

a. Bypass ac input overvoltage or undervoltage.

b. Bypass ac input overfrequency or underfrequency.

c. Bypass ac input and inverter out of synchronization.

d. Bypass ac input wrong-phase rotation.

e. Bypass ac input single-phase condition.

f. Bypass ac input filter fuse blown.

g. Internal frequency standard in use.

h. Battery system alarm.

i. Control power failure.

j. Fan failure.

k. UPS overload.

l. Battery-charging control faulty.

m. Input overvoltage or undervoltage.

n. Input transformer overtemperature.

o. Input circuit breaker tripped.

p. Input wrong-phase rotation.

q. Input single-phase condition.

r. Approaching end of battery operation.

s. Battery undervoltage shutdown.

t. Maximum battery voltage.

u. Inverter fuse blown.

v. Inverter transformer overtemperature.

w. Inverter overtemperature.

x. Static bypass transfer switch overtemperature.

y. Inverter power supply fault.

z. Inverter transistors out of saturation.

aa. Identification of faulty inverter section/leg.

bb. Inverter output overvoltage or undervoltage.

cc. UPS overload shutdown.

dd. Inverter current sensor fault.

ee. Inverter output contactor open.

ff. Inverter current limit.

4. Controls shall include the following:

a. Inverter on-off.

b. UPS start.

c. Battery test.

d. Alarm silence/reset.

e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

1. UPS on battery.

2. UPS on-line.

3. UPS load-on bypass.

4. UPS in alarm condition.

5. UPS off (maintenance bypass closed).

E. Emergency Power Off Switch: Capable of local operation and operation by means of activation by external dry contacts.

2.09 MAINTENANCE BYPASS/ISOLATION SWITCH

A. Description: Manually operated switch or arrangement of switching devices with mechanically actuated contact mechanism arranged to route the flow of power to the load around the rectifier-charger, inverter, and static bypass transfer switch.

1. Switch shall be electrically and mechanically interlocked to prevent interrupting power to the load when switching to bypass mode.

2. Switch shall electrically isolate other UPS components to permit safe servicing.

B. Comply with NEMA PB 2 and UL 891.

C. Switch Rating: Continuous duty at rated full UPS load current.

D. Mounting Provisions: Internal to system cabinet.

E. Key interlock requires unlocking maintenance bypass/isolation switch before switching from normal position with key that is released only when the UPS is bypassed by the static bypass transfer switch. Lock is designed specifically for mechanical and electrical component interlocking.

2.10 OUTPUT DISTRIBUTION SECTION

A. Panelboards: Comply with Section 16442 "Panelboards" except provide assembly integral to UPS cabinet.

2.11 MONITORING BY REMOTE STATUS AND ALARM PANEL

A. Description: Labeled LEDs on panel faceplate indicate five basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.

1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

2.12 MONITORING BY REMOTE COMPUTER

A. Description: Communication module in unit control panel provides

capability for remote monitoring of status, parameters, and alarms specified in "Controls and Indications" Article. The remote computer and the connecting signal wiring are not included in this Section. Include the following features:

1. Connectors and network interface units or modems for data transmission via RS-232 link.

2. Software designed for control and monitoring of UPS functions and to provide on-screen explanations, interpretations, diagnosis, action guidance, and instructions for use of monitoring indications and development of meaningful reports. Permit storage and analysis of power-line transient records. Designs for Windows applications, software, and computer are not included in this Section.

3. Software and Hardware: Compatible with that specified in Section 16215 "Electrical Power Monitoring and Control."

2.13 BASIC BATTERY MONITORING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Albercorp.

2. BTECH, Inc.

3. Eaton Corporation; Powerware Division.

B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.

C. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 75 deg C occurs within the compartment.

D. Annunciation of Alarms: At UPS control panel.

2.14 BATTERY-CYCLE WARRANTY MONITORING

A. Description: Electronic device, acceptable to battery manufacturer as a basis for warranty action, for monitoring of charge-discharge cycle history of batteries covered by cycle-life warranties.

B. Performance: Automatically measures and records each discharge event, classifies it according to duration category, and totals discharges according to warranty criteria, displaying remaining warranted battery life on front panel display.

C. Additional monitoring functions and features shall include the following:

1. Measuring and Recording: Total voltage at battery terminals; initiates alarm for excursions outside the proper float-voltage level.

2. Monitors: Ambient temperature at battery; initiates alarm if temperature deviates from normally acceptable range.

3. Keypad on Device Front Panel: Provides access to monitored data using front panel display.

4. Alarm Contacts: Arranged to initiate local alarm for abnormal battery voltage or temperature.

5. Memory: Stores recorded data in nonvolatile electronic memory.

6. RS-232 Port: Permits downloading of data to a portable PC.

7. Modem: Makes measurements and recorded data accessible to a remote PC via telephone line. Computer is not specified in this Section.

2.15 SOURCE QUALITY CONTROL

A. Factory test complete UPS system before shipment. Use actual batteries that are part of final installation. Include the following:

1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.

2. Full-load test.

3. Transient-load response test.

4. Overload test.

5. Power failure test.

B. Observation of Test: Give 14 days' advance notice of tests and provide opportunity for Owner's representative to observe tests at Owner's choice.

C. Report test results. Include the following data:

1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.

2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of

actual observations during test.

3. List of instruments and equipment used in factory tests.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the UPS.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Equipment Mounting: Install UPS on concrete base. Comply with requirements for concrete base specified in Section 03300 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

C. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.

3.03 GROUNDING

A. Separately Derived Systems: If not part of a listed power supply for a data-processing room, comply with NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer.

3.04 IDENTIFICATION

A. Identify components and wiring according to Section 16075 "Electrical Identification."

1. Identify each battery cell individually.

3.05 BATTERY EQUALIZATION

A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Comply with manufacturer's written instructions.

2. Inspect interiors of enclosures, including the following:

a. Integrity of mechanical and electrical connections.

b. Component type and labeling verification.

c. Ratings of installed components.

3. Inspect batteries and chargers according to requirements in NETA Acceptance Testing Specifications.

4. Test manual and automatic operational features and system protective and alarm functions.

5. Test communication of status and alarms to remote monitoring equipment.

6. Load the system using a variable-load bank to simulate kilovolt

amperes, kilowatts, and power factor of loads for unit's rating. Use instruments calibrated within the previous six months according to NIST standards.

a. Simulate malfunctions to verify protective device operation.

b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.

c. Test harmonic content of input and output current less than 25, 50, and 100 percent of rated loads.

d. Test output voltage under specified transient-load conditions.

e. Test efficiency at 50, 75, and 100 percent of rated loads.

f. Test remote status and alarm panel functions.

g. Test battery-monitoring system functions.

E. Seismic-restraint tests and inspections shall include the following:

1. Inspect type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.

2. Test mounting and anchorage devices according to requirements in Section 16074 "Vibration and Seismic Controls for Electrical Systems."

F. The UPS system will be considered defective if it does not pass tests and inspections.

G. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

H. Prepare test and inspection reports.

3.07 PERFORMANCE TESTING

A. Engage the services of a qualified power quality specialist to perform tests and activities indicated for each UPS system.

B. Monitoring and Testing Schedule: Perform monitoring and testing in four 10-day periods, each in a different season of the year.

1. Schedule monitoring and testing activity with Owner, through Architect, with at least 14 days' advance notice.

2. Schedule monitoring and testing after Substantial Completion, when the UPS is supplying power to its intended load.

C. Monitoring and Testing Instruments: Three-phase, recording, power monitors. Instruments shall provide continuous simultaneous monitoring of electrical parameters at UPS input terminals and at input terminals of loads served by the UPS. Instruments shall monitor, measure, and graph voltage current and frequency simultaneously and provide full-graphic recordings of the values of those parameters before and during power-line disturbances that cause the values to deviate from normal beyond the adjustable threshold values. Instruments shall be capable of recording either on paper or on magnetic media and have a minimum accuracy of plus or minus 2 percent for electrical parameters. Parameters to be monitored include the following:

1. Current: Each phase and neutral and grounding conductors.

2. Voltage: Phase to phase, phase to neutral, phase to ground, and neutral to ground.

3. Frequency transients.

4. Voltage swells and sags.

5. Voltage Impulses: Phase to phase, phase to neutral, phase to ground, and neutral to ground.

6. High-frequency noise.

7. Radio-frequency interference.

8. THD of the above currents and voltages.

9. Harmonic content of currents and voltages above.

D. Monitoring and Testing Procedures for Each Test Period:

1. Exploratory Period: For the first two days of the first scheduled monitoring and testing period, make recordings at various circuit locations and with various parameter-threshold and sampling-interval settings. Make these measurements with the objective of identifying optimum UPS, power system, load, and instrumentation setup conditions for subsequent test and monitoring operations.

2. Remainder of Test Period: Perform continuous monitoring of at

least two circuit locations selected on the basis of data obtained during exploratory period.

a. Set thresholds and sampling intervals for recording data at values selected to optimize data on performance of the UPS for values indicated, and to highlight the need to adjust, repair, or modify the UPS, distribution system, or load component that may influence its performance or that may require better power quality.

b. Perform load and UPS power source switching and operate the UPS on generator power during portions of test period according to directions of Owner's power quality specialist.

c. Operate the UPS and its loads in each mode of operation permitted by UPS controls and by the power distribution system design.

d. Using loads and devices available as part of the facility's installed systems and equipment, create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients. Maintain normal operating loads in operation on system to maximum extent possible during tests.

e. Make adjustments and repairs to UPS, distribution, and load equipment to correct deficiencies disclosed by monitoring and testing and repeat appropriate monitoring and testing to verify success of corrective action.

E. Monitoring and Testing Assistance by Contractor:

1. Open UPS and electrical distribution and load equipment and wiring enclosures to make monitoring and testing points accessible for temporary monitoring probe and sensor placement and removal as requested.

2. Observe monitoring and testing operations; ensure that UPS and distribution and load equipment warranties are not compromised.

3. Perform switching and control of various UPS units, electrical distribution systems, and load components as directed by power quality specialist. Specialist shall design this portion of monitoring and testing operations to expose the UPS to various operating environments, conditions, and events while response is observed, electrical parameters are monitored, and system and equipment deficiencies are identified.

4. Make repairs and adjustments to the UPS and to electrical distribution system and load components, and retest and repeat monitoring as needed to verify validity of results and correction of deficiencies.

5. Engage the services of the UPS manufacturer's factory-authorized service representative periodically during performance testing operations for repairs, adjustments, and consultations.

F. Documentation: Record test point and sensor locations, instrument settings, and circuit and load conditions for each monitoring summary and power disturbance recording. Coordinate simultaneous recordings made on UPS input and load circuits.

G. Analysis of Recorded Data and Report: Review and analyze test observations and recorded data and submit a detailed written report. Include the following in report:

1. Description of corrective actions performed during monitoring and survey work and their results.

2. Recommendations for further action to provide optimum performance by the UPS and appropriate power quality for non-UPS loads. Include a statement of priority ranking and a cost estimate for each recommendation that involves system or equipment revisions.

3. Copies of monitoring summary graphics and graphics illustrating harmonic content of significant voltages and currents.

4. Copies of graphics of power disturbance recordings that illustrate findings, conclusions, and recommendations.

5. Recommendations for operating, adjusting, or revising UPS controls.

6. Recommendation for alterations to the UPS installation.

7. Recommendations for adjusting or revising generator-set or automatic transfer switch installations or their controls.

8. Recommendations for power distribution system revisions.

9. Recommendations for adjusting or revising electrical loads, their connections, or controls.

H. Interim and Final Reports: Provide an interim report at the end of each test period and a final comprehensive report at the end of final test and

analysis period.

3.08 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the UPS.

B. A minimum of eight hours of training will be required to train the Owner's maintenance personnel.

PART 4: MEASUREMENT AND PAYMENT

4.01 12KW UPS:

A. 12KW UPSs will be measured for at the contract unit price bid per each.

B. 12KW UPSs will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16269

VARIABLE FREQUENCY CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.03 DEFINITIONS

A. BAS: Building automation system.

B. CE: Conformite Europeene (European Compliance).

C. CPT: Control power transformer.

D. EMI: Electromagnetic interference.

E. IGBT: Insulated-gate bipolar transistor.

F. LAN: Local area network.

G. LED: Light-emitting diode.

H. MCP: Motor-circuit protector.

I. NC: Normally closed.

J. NO: Normally open.

K. OCPD: Overcurrent protective device.

L. PCC: Point of common coupling.

M. PID: Control action, proportional plus integral plus derivative.

N. PWM: Pulse-width modulated.

O. RFI: Radio-frequency interference.

P. TDD: Total demand (harmonic current) distortion.

Q. THD(V): Total harmonic voltage demand.

R. VFC: Variable-frequency motor controller.

1.04 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Credit EA 5: For continuous metering equipment for energy consumption.

C. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Factory-installed devices.

c. Enclosure types and details.

d. Nameplate legends.

e. Short-circuit current (withstand) rating of enclosed unit.

f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.

g. Specified modifications.

2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show

support locations, type of support, and weight on each support. Indicate field measurements.

B. Provide documentation showing the coordination of the VFCs with HVAC Manufacturer mechanical equipment and specifications.

C. Qualification Data: For qualified testing agency.

D. Seismic Qualification Certificates: For VFCs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

E. Product Certificates: For each VFC, from manufacturer.

F. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.

G. Source quality-control reports.

H. Field quality-control reports.

I. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

J. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.

2. Manufacturer's written instructions for setting field-adjustable overload relays.

3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.

4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Indicating Lights: Two of each type and color installed.

4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.09 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and

install temporary electric heating, with at least 250 W per controller.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).

2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)

3. Humidity: Less than 95 percent (noncondensing).

4. Altitude: Not exceeding 3300 feet (1005 m).

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical systems.

2. Indicate method of providing temporary electrical service.

3. Do not proceed with interruption of electrical systems without Construction Manager's written permission.

4. Comply with NFPA 70E.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.11 COORDINATION

A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:

1. Torque, speed, and horsepower requirements of the load.

2. Ratings and characteristics of supply circuit and required control sequence.

3. Ambient and environmental conditions of installation location.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB.

2. Baldor Electric Company.

3. Danfoss Inc.; Danfoss Drives Div.

4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

5. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

6. Rockwell Automation, Inc.; Allen-Bradley Brand.

7. Siemens Energy & Automation, Inc.

8. Square D; a brand of Schneider Electric.

9. Toshiba International Corporation.

10. Yaskawa Electric America, Inc; Drives Division.

B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

C. Application: Constant torque.

D. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral

disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."

2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."

3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

F. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

G. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.

2. Input AC Voltage Unbalance: Not exceeding 3 percent.

3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.

4. Minimum Efficiency: 97 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.

6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.

7. Ambient Temperature Rating: Not less than 14 deg F (minus 10 deg C) and not exceeding 104 deg F (40 deg C).

8. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C)

9. Humidity Rating: Less than 95 percent (noncondensing).

10. Altitude Rating: Not exceeding 3300 feet (1005 m).

11. Vibration Withstand: Comply with IEC 60068-2-6.

12. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.

13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.

14. Speed Regulation: Plus or minus 5 percent.

15. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.

16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

I. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

2. Signal: Pneumatic.

J. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.

3. Acceleration: 0.1 to 999.9 seconds.

4. Deceleration: 0.1 to 999.9 seconds.

5. Current Limit: 30 to minimum of 150 percent of maximum rating.

6. Insert adjustment and parameters.

K. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

3. Under- and overvoltage trips.

4. Inverter overcurrent trips.

5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.

6. Critical frequency rejection, with three selectable, adjustable deadbands.

7. Instantaneous line-to-line and line-to-ground overcurrent trips.

8. Loss-of-phase protection.

9. Reverse-phase protection.

10. Short-circuit protection.

11. Motor overtemperature fault.

L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

M. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

N. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

O. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

P. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

Q. Integral Input Disconnecting Means and OCPD: NEMA KS 1, fusible switch with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.

2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.

3. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.

4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.

5. NO alarm contact that operates only when circuit breaker has tripped.

2.02 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.

2. Run.

3. Overvoltage.

4. Line fault.

5. Overcurrent.

6. External fault.

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.

2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

C. Historical Logging Information and Displays:

1. Real-time clock with current time and date.

2. Running log of total power versus time.

3. Total run time.

4. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).

2. Motor speed (rpm).

3. Motor status (running, stop, fault).

4. Motor current (amperes).

5. Motor torque (percent).

6. Fault or alarming status (code).

7. PID feedback signal (percent).

8. DC-link voltage (V dc).

9. Set point frequency (Hz).

10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. A minimum of two programmable analog inputs: 0- to 10-V dc.

2. A minimum of six multifunction programmable digital inputs.

3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:

a. 0- to 10-V dc.

b. 4- to 20-mA dc.

c. Potentiometer using up/down digital inputs.

d. Fixed frequencies using digital inputs.

4. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc, which can be configured for any of the following:

a. Output frequency (Hz).

b. Output current (load).

c. DC-link voltage (V dc).

d. Motor torque (percent).

e. Motor speed (rpm).

f. Set point frequency (Hz).

5. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.

b. Set point speed reached.

c. Fault and warning indication (overtemperature or overcurrent).

d. PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: Two.

G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display VFC status and alarms. Allows VFC to be used with an external system within a multidrop LAN configuration; settings retained within VFC's nonvolatile memory.

1. Network Communications Ports: Ethernet and RS-422/485.

2. Embedded BAS Protocols for Network Communications: Modbus/Memobus protocols accessible via the communications

ports.

2.03 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the harmonic analysis study and report, provide input filtering, as required, to limit TDD at input terminals of all VFCs to less than 5 percent and THD(V) to 3 percent.

B. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

2.04 BYPASS SYSTEMS

A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

C. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

1. Bypass Contactor: Load-break, NEMA-rated contactor.

2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.

3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

D. Bypass Contactor Configuration: Full-voltage (across-the-line).

1. NORMAL/BYPASS selector switch.

2. HAND/OFF/AUTO selector switch.

3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.

4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

   b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

   a. CPT Spare Capacity: 100 VA.

6. Overload Relays: NEMA ICS 2.

   a. Bimetallic Overload Relays:

      i. Inverse-time-current characteristic.

      ii. Class 10 tripping characteristic.

      iii. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

      iv. Ambient compensated.

      v. Automatic resetting.

   b. NO isolated overload alarm contact.

   c. External overload reset push button.

2.05 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

   1. Dry and Clean Indoor Locations: Type 1.

   2. Outdoor Locations: Type 3R.

   3. Other Wet or Damp Indoor Locations: Type 4.

4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.05 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Unguarded types; momentary.

b. Pilot Lights: LED types; push to test.

c. Selector Switches: Rotary type.

B. Reversible NC/NO bypass contactor auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Digital Meters:

1. Elapsed-time meter.

2. Kilowatt meter.

3. Kilowatt-hour meter.

F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 4X enclosures installed in unconditioned interior spaces subject to humidity and temperature swings.

H. Cooling Fan and Exhaust System: For NEMA 250, Type 1 ; UL 508 component recognized: Supply fan, with stainless steel intake and exhaust

grills and filters; 120-V ac; obtained from integral CPT.

I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

J. Spare control-wiring terminal blocks; unwired.

2.06 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

1. Test each VFC while connected to its specified motor.

2. Verification of Performance: Rate VFCs according to operation of functions and features specified.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 HARMONIC ANALYSIS STUDY

A. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze possible operating scenarios, including recommendations for VFC input filtering to limit TDD and THD(V) at each VFC to specified levels.

B. Prepare a harmonic analysis study and report complying with IEEE 399 and NETA Acceptance Testing Specification.

3.03 INSTALLATION

A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 16073 "Hangers and Supports for Electrical Systems."

C. Floor-Mounting Controllers: Install VFCs on 4-inch (100-mm) nominal thickness concrete base. Comply with requirements for concrete base specified in Section 03300 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

E. Install fuses in each fusible-switch VFC.

F. Install fuses in control circuits if not factory installed. Comply with requirements in Section 16491 "Fuses."

G. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

H. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

I. Comply with NECA 1.

3.04 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each VFC with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.05 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.

2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.06 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

D. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.

2. Test continuity of each circuit.

3. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).

4. Test each motor for proper phase rotation.

5. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

6. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

7. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. VFCs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that

identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.07 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.08 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges as specified in Section 16055 "Overcurrent Protective Device Coordination."

F. Set field-adjustable pressure switches.

3.09 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Owner's maintenance personnel to adjust, operate, reprogram, and

maintain VFCs.

PART 4: MEASUREMENT AND PAYMENT

4.01 30HP VARIABLE FREQUENCY CONTROLLER:

A. 30HP variable frequency controllers will be measured for at the contract unit price bid per each.

B. 30HP variable frequency controllers will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 40HP VARIABLE FREQUENCY CONTROLLER:

A. 40HP variable frequency controllers will be measured for at the contract unit price bid per each.

B. 40HP variable frequency controllers will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16289

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:

1. Section 16441 "Switchboards" for factory-installed SPDs.

2. Section 16442 "Panelboards" for factory-installed SPDs.

1.03 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.07 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ABB France.

2. Advanced Protection Technologies Inc. (APT).

3. Eaton Corporation.

4. Emerson Electric Co.

5. GE Zenith Controls.

6. LEA International; Protection Technology Group.

7. Leviton Manufacturing Co., Inc.

8. PowerLogics, Inc.

9. Schneider Electric Industries SAS.

10. Siemens Industry, Inc.

2.02 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449, latest edition.

D. MCOV of the SPD shall be at least 125 percent of the nominal system voltage.

2.03 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

A. SPDs: Comply with UL 1449, Type 1.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1

1. SPDs with the following features and accessories:

a. Integral disconnect switch.

b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

c. Indicator light display for protection status.

d. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status

e. Surge counter.

C. Comply with UL 1283.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.

2. Line to Ground: 1200 V for 480Y/277 V, 1200 V for 208Y/120 V.

3. Line to Line: 2000 V for 480Y/277 V. 1000 V for 208Y/120 V.

F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.

2. Line to Ground: 1000 V.

3. Line to Line: 1000 V.

G. SCCR: Equal or exceed 100 kA.

H. Nominal Rating: 20 kA.

2.04 PANEL SUPPRESSORS

A. SPDs: Comply with UL 1449, Type 1.

1. Include LED indicator lights for power and protection status.

2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.

3. Include Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status

B. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

C. Comply with UL 1283.

D. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V,, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.

2. Line to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.

3. Neutral to Ground: 1200 V for 480Y/277 V, 700 V for 208Y/120 V.

4. Line to Line: 2000 V for 480Y/277 V, 1200 V for 208Y/120 V

E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.

2. Line to Ground: 700 V.

3. Neutral to Ground: 700 V.

4. Line to Line: 1200 V.

F. SCCR: Equal or exceed 100 kA.

G. Nominal Current Rating: 20 kA.

2.05 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 250, Type 4X.

2.06 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 16120 "Conductors and Cables."

B. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 16120 "Conductors and Cables."

PART 3 - EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 16120 "Conductors and Cables."

2. Controls: Comply with wiring methods in Section 16120 "Conductors and Cables."

3.02 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.

2. Inspect anchorage, alignment, grounding, and clearances.

3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.03 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.04 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

PART 4: MEASUREMENT AND PAYMENT

4.01 SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS:

A. Surge Protection for Low Voltage Electrical Power Circuits will not be measured for payment.

B. Surge Protection for Low Voltage Electrical Power Circuits will not be paid for directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Fusible switches.

2. Nonfusible switches.

3. Molded-case circuit breakers (MCCBs).

4. Enclosures.

1.03 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and

auxiliary components.

5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Manufacturer's field service report.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.07 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Fuse Pullers: Two for each size and type.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.09 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.01 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

5. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.02 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.

3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally

mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.04 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.

3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.

4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and

components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.03 IDENTIFICATION

A. Comply with requirements in Section 16075 "Electrical Identification."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and

prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

PART 4: MEASUREMENT AND PAYMENT

4.01 60A NON-FUSIBLE SAFETY SWITCH:

A. 60A non-fusible safety switches will be measured for at the contract unit price bid per each.

B. 60A non-fusible safety switches will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 100A NON-FUSIBLE SAFETY SWITCH:

A. 100A non-fusible safety switches will be measured for at the contract unit price bid per each.

B. 100A non-fusible safety switches will be paid per each, complete in place, accepted, which price will be full compensation for all material,

equipment, tools, labor and all work incidental to complete the item as specified.

4.03 100A FUSIBLE SAFETY SWITCH:

A. 100A fusible safety switch will be measured for at the contract unit price bid per each.

B. 100A fusible safety switch will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16415

TRANSFER SWITCHES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.

2. Bypass/isolation switches.

3. Remote annunciation systems.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Field quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items

specified in Section 01782 "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain automatic transfer switches, bypass/isolation switches and remote annunciators through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 110.

H. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03300 "Cast-in-Place Concrete."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar; Engine Div.
2. Emerson; ASCO Power Technologies, LP.
3. Generac Power Systems, Inc.
4. GE Zenith Controls.
5. Kohler Power Systems; Generator Division.
6. Onan/Cummins Power Generation; Industrial Business Group.
7. Russelectric, Inc.
8. Eaton Electrical Inc.; Cutler-Hammer.
9. GE Zenith Controls.
10. Hubbell Industrial Controls, Inc.

2.02 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-

impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

I. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

J. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Section 16075 "Electrical Identification."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

K. Enclosures: General-purpose NEMA 250, Type 12, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.03 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

D. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

E. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. Automatic Closed-Transition Transfer Switches: Include the following functions and characteristics:

1. Fully automatic make-before-break operation.

2. Load transfer without interruption, through momentary interconnection of both power sources not exceeding 100 ms.

3. Initiation of No-Interruption Transfer: Controlled by in-phase monitor and sensors confirming both sources are present and acceptable.

a. Initiation occurs without active control of generator.

b. Controls ensure that closed-transition load transfer closure occurs only when the 2 sources are within plus or minus 5 electrical degrees maximum, and plus or minus 5 percent maximum voltage difference.

4. Failure of power source serving load initiates automatic break-before-make transfer.

H. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and

emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

I. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulate normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency

power source regardless of condition of normal source. Pilot light indicates override status.

10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Provide in ATS-1 only.

    b. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

    c. Push-button programming control with digital display of settings.

    d. Integral battery operation of time switch when normal control power is not available.

2.04 BYPASS/ISOLATION SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

1. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. While isolated, interlocks prevent transfer-switch operation, except for testing or maintenance.

2. Drawout Arrangement for Automatic Transfer Switch: Provide physical separation from live parts and accessibility for testing and

maintenance operations.

3. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.

4. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.

5. Operability: Constructed so load bypass and transfer-switch isolation can be performed by 1 person in no more than 2 operations in 15 seconds or less.

6. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.

7. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

C. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.05 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Switch position.

3. Switch in test mode.

4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.

2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.06 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Section 16073 "Hangers and Supports for Electrical Systems."

B. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

C. Identify components according to Section 16075 "Electrical Identification."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.02 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Section 16060 "Grounding and Bonding."

C. Connect wiring according to Section 16120 "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting

agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.

2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.

   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

   c. Verify that manual transfer warnings are properly placed.

   d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

   b. Simulate loss of phase-to-ground voltage for each phase of normal source.

   c. Verify time-delay settings.

   d. Verify pickup and dropout voltages by data readout or inspection of control settings.

   e. Test bypass/isolation unit functional modes and related

automatic transfer-switch operations.

f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

C. Testing Agency's Tests and Inspections:

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.

d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal

source available.

b. Simulate loss of phase-to-ground voltage for each phase of normal source.

c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.

e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

a. Verify grounding connections and locations and ratings of sensors.

D. Coordinate tests with tests of generator and run them concurrently.

E. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

F. Remove and replace malfunctioning units and retest as specified above.

G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results.

Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Section 01780 "Closeout."

B. Coordinate this training with that for generator equipment.

PART 4: MEASUREMENT AND PAYMENT

4.01 TRANSFER SWITCHES:

A. Transfer Switches will not be measured for payment.

B. Transfer Switches will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16420

ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.

2. Full-voltage magnetic.

B. Related Section:

1. Section 16269 "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.03 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service

spaces around controller enclosures.

1. Show tabulations of the following:

   a. Each installed unit's type and details.

   b. Factory-installed devices.

   c. Nameplate legends.

   d. Short-circuit current rating of integrated unit.

   e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.

   f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

D. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.

2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.

3. Manufacturer's written instructions for setting field-adjustable

overload relays.

4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.07 MATERIALS MAINTENANCE 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. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Indicating Lights: Two of each type and color installed.

4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.

5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NFPA 70.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electrical Systems: Do not interrupt electrical systems in facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than five days in advance of proposed interruption of electrical systems.

2. Indicate method of providing temporary utilities.

3. Do not proceed with interruption of electrical systems without Construction Manager's written permission.

4. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required

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 with concrete.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.01 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide

products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

c. Rockwell Automation, Inc.; Allen-Bradley brand.

d. Siemens Energy & Automation, Inc.

e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Surface mounting.

4. Red running pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

c. Rockwell Automation, Inc.; Allen-Bradley brand.

d. Siemens Energy & Automation, Inc.

e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.

4. Surface mounting.

5. Red running pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break"

toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

   c. Rockwell Automation, Inc.; Allen-Bradley brand.

   d. Siemens Energy & Automation, Inc.

   e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.

4. Surface mounting.

5. Red running pilot light.

6. N.O. auxiliary contact.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

   c. Rockwell Automation, Inc.; Allen-Bradley brand.

   d. Siemens Energy & Automation, Inc.

   e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.

3. Contactor Coils: Pressure-encapsulated type.

   a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

   a. CPT Spare Capacity: 100 VA.

6. Bimetallic Overload Relays:

   a. Inverse-time-current characteristic.

   b. Class 10 tripping characteristic.

   c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

   d. Ambient compensated.

   e. Automatic resetting.

7. N.O., isolated overload alarm contact.

8. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

   b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

   c. Rockwell Automation, Inc.; Allen-Bradley brand.

   d. Siemens Energy & Automation, Inc.

e. Square D; a brand of Schneider Electric.

2. Fusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class R fuses.

b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

4. Nonfusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.

b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

c. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

5. MCP Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

c. Auxiliary contacts "a" and "b" arranged to activate with MCP handle.

d. N.O. alarm contact that operates only when MCP has tripped.

e. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA.

6. MCCB Disconnecting Means:

a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for

low-level overloads and instantaneous magnetic trip element for short circuits.

b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.

e. N.O. alarm contact that operates only when MCCB has tripped.

2.02 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

2. Outdoor Locations: Type 3R.

3. Wash-Down Areas: Type 4X, stainless steel.

4. Other Wet or Damp Indoor Locations: Type 4

5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

6. Hazardous Areas Indicated on Drawings: Type 7.

2.03 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Unguarded types; momentary as indicated.

b. Pilot Lights: LED types; colors as indicated; push to test.

c. Selector Switches: Rotary type.

2. Elapsed Time Meters: Heavy duty with digital readout in

hours; resettable.

3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Cover gaskets for Type 1 enclosures.

G. Terminals for connecting power factor correction capacitors to the load side of overload relays.

H. Spare control wiring terminal blocks, quantity as indicated; unwired.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 16073 "Hangers and Supports for Electrical Systems."

B. Floor-Mounted Controllers: Install enclosed controllers on 4-inch (100-

mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 03300 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch enclosed controller.

E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 16491 "Fuses."

F. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Install power factor correction capacitors. Connect to the load side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

I. Comply with NECA 1.

3.03 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved nameplate.

3. Label each enclosure-mounted control and pilot device.

3.04 CONTROL WIRING INSTALLATION

A. Bundle, train, and support wiring in enclosures.

B. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.

2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test continuity of each circuit.

D. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation.

2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.

3. Test continuity of each circuit.

4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).

5. Test each motor for proper phase rotation.

6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.

   b. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed controllers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start

without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers at 50 percent.

E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

F. Set field-adjustable circuit-breaker trip ranges.

3.07 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.08 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

PART 4: MEASUREMENT AND PAYMENT

4.01 120V, 1-POLE, NEMA 0 COMBINATION STARTER:

A. 120V, 1-pole, NEMA 0 combination starters will be measured, for at the contract unit price bid per each.

B. 120V, 1-pole, NEMA 0 combination starters will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 480V, 3-POLE, NEMA 0 COMBINATION STARTER:

A. 480V, 3-pole, NEMA 0 combination starters will be measured, for at the contract unit price bid per each.

B. 480V, 3-pole, NEMA 0 combination starters will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16441

SWITCHBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.

2. Transient voltage suppression devices.

3. Disconnecting and overcurrent protective devices.

4. Instrumentation.

5. Control power.

6. Accessory components and features.

7. Identification.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Detail short-circuit current rating of switchboards and overcurrent

protective devices.

5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.

6. Detail utility company's metering provisions with indication of approval by utility company.

7. Include evidence of NRTL listing for series rating of installed devices.

8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

10. Include diagram and details of proposed mimic bus.

11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Routine maintenance requirements for switchboards and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.06 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. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.

3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NECA 400.

1.09 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards 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. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).

b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

1.10 COORDINATION

A. Coordinate layout and installation of switchboards 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 with concrete.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.

2. Branch Devices: Panel mounted.

3. Sections front and rear aligned.

C. Nominal System Voltage: 480Y/277 V.

D. Main-Bus Continuous: 2000 A.

E. Indoor Enclosures: Steel, NEMA 250, Type 1.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Barriers: Between adjacent switchboard sections.

H. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

I. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

J. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks

K. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

L. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.

M. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

N. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.

2. Set back from front to clear circuit-breaker removal mechanism.

3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.

4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.

5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

O. Buses and Connections: Three phase, four wire.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated**,** with tin-plated copper feeder circuit-breaker line connections.

2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.

3. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-), or Minimum-size required by UL 891**,** hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

5. Neutral Buses: 100 percent of the ampacity of phase buses, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

P. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

Q. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

R. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.02 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.

2. Fabrication using bolted compression lugs for internal wiring.

3. Integral disconnect switch.

4. Redundant suppression circuits.

5. Redundant replaceable modules.

6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

7. LED indicator lights for power and protection status.

8. Audible alarm, with silencing switch, to indicate when protection has failed.

9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

10. Six-digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with

480Y/277-V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277.

2. Line to Ground: 800 V for 480Y/277.

3. Neutral to Ground: 800 V for 480Y/277.

2.03 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes less than 250 A

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip for breakers 250A frame and larger; or for smaller size breakers where required for selective coordination and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip). Selection of equipment protection shall prevent tripping of main switchboard circuit breaker.

6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.

b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

f. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.04 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, tapped secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.

2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.

3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.

4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems with communications capabilities compatible with the MTA sub-metering system and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.

b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.

c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.

d. Megawatts: Plus or minus 2 percent.

e. Megavars: Plus or minus 2 percent.

f. Power Factor: Plus or minus 2 percent.

g. Frequency: Plus or minus 0.5 percent.

h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.

i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.

j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.05 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.06 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

2.07 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install switchboards and accessories according to NECA 4001.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 03300 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.

2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Comply with NECA 1.

3.03 CONNECTIONS

A. Comply with requirements for terminating cable trays specified in Section 16136 "Cable Trays." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 16075 "Electrical Identification."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 16075 "Electrical Identification."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 16075 "Electrical Identification."

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, and feeder circuit.

2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments and Equipment:

i. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Switchboard will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges **s** specified in Section 16055 "Overcurrent Protective Device Coordination.", to maintain temperature

according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

PART 4: MEASUREMENT AND PAYMENT

4.01 480V, 3-PHASE, 2000A SWITCHBOARDS:

A. 480V, 3-phase, 2000A switchboards will be measured for at the contract unit price bid per each.

B. 480V, 3-phase, 2000A switchboards will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16442

PANELBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Distribution panelboards.

2. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

A. SVR: Suppressed voltage rating.

B. TVSS: Transient voltage surge suppressor.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types and details for types other than NEMA 250, Type 1.

3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.

5. Include evidence of NRTL listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

7. Include wiring diagrams for power, signal, and control wiring.

8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Panelboard Schedules: For installation in panelboards.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.07 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. Keys: Two spares for each type of panelboard cabinet lock.

1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. 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.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.09 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 NECA 407.

1.10 PROJECT CONDITIONS

A. 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. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F (plus 40 deg C).

b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

1.11 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 with concrete.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

b. Outdoor Locations: NEMA 250, Type 3R.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: Same finish as panels and trim.

c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

5. Directory Card: Inside panelboard door, mounted in transparent card holder

B. Incoming Mains Location: bottom.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Main and Neutral Lugs: Mechanical type.

3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.02 DISTRIBUTION PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

2.03 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

F. Panel dimensions: Manufacturer shall provide panel in minimum box size, typically 20” W x 6”D.

2.04 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip, frame size 250A and above; and the following field-adjustable settings:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

4. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).

6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.

b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

e. Communication Capability: Integral communication

module with functions and features compatible with power monitoring and control system specified in Section 16215 "Electrical Power Monitoring and Control."

f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

g. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.

h. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

i. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

j. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.05 PANELBOARD SUPPRESSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Current Technology; a subsidiary of Danahar Corporation.

2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

4. Liebert Corporation.

5. Siemens Energy & Automation, Inc.

6. Square D; a brand of Schneider Electric.

B. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

a. LED indicator lights for power and protection status.

b. Audible alarm, with silencing switch, to indicate when protection has failed.

c. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, bolt-on, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

a. Fuses rated at 200-kA interrupting capacity.

b. Fabrication using bolted compression lugs for internal wiring.

c. Integral disconnect switch.

d. Redundant suppression circuits.

e. Redundant replaceable modules.

f. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

g. LED indicator lights for power and protection status.

h. Audible alarm, with silencing switch, to indicate when protection has failed.

i. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

j. Four-digit, transient-event counter set to totalize transient surges.

2. Peak Single-Impulse Surge Current Rating: 40 kA per mode/80 kA per phase.

3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.

a. Line to Neutral: 70,000A.

b. Line to Ground: 70,000A.

c. Neutral to Ground: 50,000A.

4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

5. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277 and 208Y/120-V, three-phase, four-wire circuits shall be as follows:

a. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120.

b. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

c. Neutral to Ground: 800 V for 480Y/277 and 400 V for 208Y/120.

2.06 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base

specified in Section 03300 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.

2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to panelboards.

5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Install filler plates in unused spaces.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 16075 "Electrical Identification."

B. Create a directory to indicate installed circuits; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 16075 "Electrical Identification."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 16075 "Electrical Identification."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments and Equipment:

i. Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 16055 "Overcurrent Protective Device Coordination."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.

4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.06 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

PART 4 - MEASUREMENT AND PAYMENT

4.01 150 AMP, 3-POLE, 208/120 VAC PANELBOARD:

A. 150 Amp, 3-Pole, 208/120 VAC panelboards will be measured for at the contract unit price bid per each.

B. 150 Amp, 3-Pole, 208/120 VAC panelboards will be paid for per each, complete in place, accepted, which price will be full compensation for all

material, equipment, tools, labor and all work incidental to complete the item as specifed.

4.02 200 AMP, 3-POLE, 480/277 VAC PANELBOARD:

A. 200 Amp, 3-Pole, 480/277 VAC panelboards will be measured for at the contract unit price bid per each.

B. 200 Amp, 3-Pole, 480/277 VAC panelboards will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specifed.

4.03 300 AMP, 3-POLE, 480/277 VAC PANELBOARD:

A. 300 Amp, 3-Pole, 480/277 VAC panelboards will be measured for at the contract unit price bid per each.

B. 300 Amp, 3-Pole, 480/277 VAC panelboards will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specifed.

4.04 400 AMP, 3-POLE, 480/277 VAC PANELBOARD:

A. 400 Amp, 3-Pole, 480/277 VAC panelboards will be measured for at the contract unit price bid per each.

B. 400 Amp, 3-Pole, 480/277 VAC panelboards will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specifed.

4.05 500 AMP, 3-POLE, 480/277 VAC PANELBOARD:

A. 500 Amp, 3-Pole, 480/277 VAC panelboards will be measured for at the contract unit price bid per each.

B. 500 Amp, 3-Pole, 480/277 VAC panelboards will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16461

LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.07 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ACME Electric Corporation; Power Distribution Products Division.

2. Controlled Power Company.

3. Eaton Electrical Inc.; Cutler-Hammer Products.

4. General Electric Company.

5. Hammond Co.; Matra Electric, Inc.

6. Magnetek Power Electronics Group.

7. Micron Industries Corp.

8. Siemens Energy & Automation, Inc.

9. Sola/Hevi-Duty.

10. Square D; Schneider Electric.

2.02 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.

2. Coil Material: Copper.

2.03 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

E. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

F. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.

G. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

H. Insulation Class: 220 deg C, UL-component-recognized insulation system

with a maximum of 150 deg C rise above 40 deg C ambient temperature.

I. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Tested according to NEMA TP 2.

J. Wall Brackets: Manufacturer's standard brackets.

K. Fungus Proofing: Permanent fungicidal treatment for coil and core.

L. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.04 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 16075 "Electrical Identification."

2.05 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 16060 "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 16073 "Hangers and Supports for Electrical Systems."

3.03 CONNECTIONS

A. Ground equipment according to Section 16060 "Grounding and Bonding."

B. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

2. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

F. Test Labeling: On completion of satisfactory testing of each unit, attach a

dated and signed "Satisfactory Test" label to tested component.

3.05 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.06 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

PART 4 - MEASUREMENT AND PAYMENT

4.01 45KVA 480V TO 208/120VAC TRANSFORMER:

A. 45KVA 480V to 208/120VAC Transformer will be measured for at the contract unit price bid per each.

B. 45KVA 480V to 208/120VAC Transformer will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 75KVA 480V TO 208/120VAC TRANSFORMER:

A. 75KVA 480V to 208/120VAC Transformer will be measured for at the contract unit price bid per each.

B. 75KVA 480V to 208/120VAC Transformer will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.03 30KVA 480V TO 208/120VAC TRANSFORMER:

A. 30KVA 480V to 208/120VAC Transformer will be measured for at the contract unit price bid per each.

B. 30KVA 480V to 208/120VAC Transformer will be paid for per each,

complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.04 15KVA 480V TO 208/120VAC TRANSFORMER:

A. 15KVA 480V to 208/120VAC Transformer will be measured for at the contract unit price bid per each.

B. 15KVA 480V to 208/120VAC Transformer will be paid for per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16491

FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits and enclosed switches.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

5. Coordination charts and tables and related data.

6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

4. Coordination charts and tables and related data.

1.05 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.07 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.08 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.

2. Edison Fuse, Inc.

3. Ferraz Shawmut, Inc.

4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class L, time delay.

2. Feeders: Class RK1, time delay.

3. Motor Branch Circuits: Class RK5, time delay.

4. Other Branch Circuits: Class RK1, time delay.

3.03 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.04 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 16075 "Electrical Identification" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

PART 4 - MEASUREMENT AND PAYMENT

4.01 100A FUSE:

A. 100A fuses will be measured for at the contract unit price bid per each.

B. 100A fuses will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16510

INTERIOR LIGHTING

PART 1: GENERAL

1.01 RELATED DOCUMENTS:

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

1.02 SUMMARY:

A. This Section includes the following:

1. Interior lighting fixtures, lamps, and ballasts.

2. Exit signs.

3. Lighting fixture supports.

B. Related Sections include the following:

1. Division 16 Section "Wiring Devices" for manual wall-box dimmers, and switches.

2. Division 16 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, power packs, and multipole lighting relays and contactors.

1.03 DEFINITIONS:

A. BF: Ballast factor.

B. CRI: Color-rendering index.

C. CU: Coefficient of utilization.

D. LER: Luminaire efficacy rating.

E. RCR: Room cavity ratio.

F. Luminaire Complete lighting fixture, including ballast housing

1.04 SUBMITTALS:

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the

following:

1. Physical description of lighting fixture including dimensions.

2. Ballast.

3. Energy-efficiency data.

4. Life, output, and energy-efficiency data for lamps.

5. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. For all fixtures, photometric data shall be certified by a qualified independent testing agency.

B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

C. Submit a certification to certify all products submitted meet “BUY AMERICA” requirements in accordance with 49 CFR Part 661.

D. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Lighting fixtures.

2. Suspended ceiling components.

3. Structural members to which suspension systems for lighting fixtures will be attached.

4. Other items in finished ceiling including the following:

    a. Air outlets and inlets. (supply and return diffusers).

    b. Mechanical ducts.

    c. Speakers.

    d. Sprinklers.

    e. Smoke and fire detectors.

    f. Occupancy sensors.

g. Access panels.

h. Plumbing drops.

i. Any other ceiling mounted devices.

E. Product certificates: For each type of ballast/driver for bi-level and dimmer controlled fixtures, signed by product manufacturer.

F. Samples for Verification: For all LED type interior lighting fixtures, provide one (1) samples of each separate manufacturer and type of luminaire. Each sample shall include the following:

1. Lamps: Specified units installed.

2. Cord and plug in accordance with NEC requirements.

G. Qualification Data: For agencies providing photometric data for lighting fixtures.

H. Field quality-control test reports.

I. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

J. Warranties: Special warranties specified in this Section and other warranties specified in Division 1 specifications.

1.05 QUALITY ASSURANCE:

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.06 COORDINATION:

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition

assemblies. For more details, refer to Coordination Drawings in Part 1 paragraph 1.04-D above.

1.07 WARRANTY:

A. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.

2. Warranty Period for LEED Drivers: Ten years from date of Substantial Completion.

B. Special Warranty for T5 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: Two year(s) from date of Substantial Completion.

1.08 EXTRA MATERIALS:

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least two of each type.

2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

4. Drivers: 1 for every 100 of each type and rating installed. Furnish at least one of each type.

PART 2: PRODUCTS

2.01 MANUFACTURERS:

A. In Lighting Fixture Schedule, the following requirements apply to product selection:

1. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 GENERAL MATERIAL REQUIREMENTS:

A. General Contractor shall coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

B. Ferrous mounting hardware and accessories shall be finished using either a galvanic or phosphate primer/baked paint process to prevent corrosion and discoloration of adjacent materials.

C. Fasteners shall be manufactured of non-magnetic stainless steel or anodized aluminum, except in indoor applications where galvanized steel shall be acceptable.

D. Fixtures shall be free of light leaks and shall be designed to provide sufficient ventilation of lamps and ballasts including vent holes where required.

E. All sheet metal work shall be free from tool marks and dents and shall have accurate angles bent as sharp as compatible with the gauges of the required metal. All intersections and joints shall be formed true and of adequate strength and structural rigidity to prevent any distortion after assembly. All sheet metal shall be free of light leaks. All edges shall be finished so there are no sharp edges exposed. All miters shall be in accurate alignment with abutting intersecting members. Piecing of plates in individual runs in single planes and the use of spliced pieces or filler material to cover defective workmanship shall not be acceptable. Sheet metal work shall be properly fabricated so that planes will not deform (i.e. become concave or convex, due to normal expected ambient and operating conditions).

F. Lampholders shall hold lamps securely against normal vibrations and maintenance handling. Provide solid nickel or nickel-and-silver-plated contacts in lampholders for following types of lamps:

1. Mogul screw base incandescent, metal halide, mercury vapor lamps and high pressure sodium.

2. Tungsten-halogen lamps.

G. Wiring channels and lampholder mountings shall be rigid and accurately made.

H. Reflector Cones:

1. Provide 45° lamp and lamp image cut-off unless otherwise specified. In fixtures where upper reflector is separate from cone, cut-off shall be 45° unless otherwise specified.

2. Plastic materials shall not be used for reflector cones or aperture plates.

3. Fixtures in which reflector cones are riveted or welded to housing or where removal of cone requires pressure to be applied to finished surface of reflector shall not be acceptable.

4. Cone flange shall be formed as an integral part of the cone and shall have identical color and finish as the cone, except as shown. The flange major surface shall be perpendicular to the cone axis. The width of the flange shall adequately cover the ceiling opening without light leaks. No fixture parts (housing, mounting frame, etc.) shall he visible between the ceiling surface and the edge of the cone flange. The same requirement shall be applicable to fixtures where main reflector extends down to the bottom edge of the fixture without a separate cone. In such case, the flange shall be formed as an integral part of the main reflector.

5. Reflector cones shall be manufactured of uniform gauge, not less than 0.032" thick, high purity aluminum Alcoa 3002 alloy free of spin marks or other defects or blemishes caused during manufacturing.

6. The finish of the inner surface of the reflector shall be highly specular as produced under the Alzak process. The reflector shall have an anodic coating of not less than four mils thick. The reflector inner surface shall be free of water spotting and shall maintain a reflectivity ratio of not less than 83% on clear specular finish. The reflector shall have a low iridescence finish free from multiple colors seen from normal viewing angles. Colors shall be derived from dyes supplied by Sandoz Chemical Company or approved equal.

7. The reflecting surface of the cone shall be tested for proper sealing. Test per ASTM B136-63T.

8. Fixtures with Alzak reflector cones, unless otherwise specified, must be furnished by the same manufacturer.

9. Reflector cone retention devices shall not deform cone in any manner whatsoever.

10. Submit a certificate of compliance with Alzak finish requirements with all requests for approval.

I. Lenses:

1. Glass:

a. Flat glass lenses shall be heat tempered borosilicate glass unless otherwise noted.

b. Glass finishes, i.e. sandblasting, etching, polishing shall be performed as described in the fixture description.

2. Acrylic:

a. Lenses shall be of injection molded crystal clear material 100% virgin acrylic (except as indicated in Lighting Fixture Schedule). For lenses with male pattern of pyramids or cones, specified minimum thickness refers to distance from flat surface to base of pyramids (cones), or thickness of undisturbed material. For lenses with female pattern, specified minimum thickness refers to overall thickness of material.

b. Lenses shall fully eliminate lamp images when viewed from all directions within the 45° to 90° angle from vertical when the ratio of lamp spacing to the distance from lamp underside to top of lens does not exceed 1.50. Within the viewing angle from 0° to 45° the ratio of maximum brightness (under a lamp) to minimum brightness (between lamps) shall not exceed 3 to 1.

c. Finishes, i.e. sandblasting, etching, polishing shall be performed as described in the fixture description.

J. Louvers:

1. Parabolic:

a. Louvers shall be continuously bound in channel formed frame, finish and color as specified or as selected.

b. Louver shall provide a minimum visual cut-off to the lamp of 45°.

c. The finish of the inner surface of the reflector shall be highly specular as produced under the Alzak process. The reflector shall have an anodic coating of not less than four mils thick. The reflector inner surface shall be free of water

spotting and shall maintain a reflectivity ratio of not less than 83% on clear specular finish. The reflector shall have a low iridescence finish free from multiple colors seen from normal viewing angles.

2. Flat Blade:

a. Provide flat blade louvers within formed frame, finish and color as specified.

b. Louvers to provide minimum of 45° degree cut-off from lamp image.

c. Blade thickness to minimum 0.125" flat steel.

K. In adjustable fixtures, aiming and positive locking devices shall be provided.

L. Fixtures with an adjustable lamp and using a lamp with an asymmetrical light pattern shall have an aiming stop which can be permanently set so that the lamp shall remain correctly positioned after service or relamping.

2.03 FLUORESCENT FIXTURES:

A. Housing:

1. No. 22 minimum gauge steel, bonderized or equal rust protected, or No. 16 gauge aluminum rigid construction, suitable for continuous row mounting where indicated.

2. Finish: Baked enamel paint finish unless otherwise specified, color as specified or as selected.

B. Reflector: Minimum 85% reflectance.

C. Lightshields:

1. Frames: Provide extruded aluminum frames with mitered comers filled and ground smooth. Provided with concealed hinges and invisible latching.

2. No cross bars shall be permitted over lightshields.

D. Lampholders:

1. Lampholders shall be UL listed, and meet IEC-60400, "International Standard: Lampholders for tubular fluorescent lamps and startholders".

E. For rapid start lamps on single ballasts, provide one (1) grounding lampholder per lamp. Lampholders operating with open circuit voltage in excess of 300 volts shall be safety type and shall open supply circuit when lamp is removed from lampholder.

1. Mount lamps used in rapid start circuits 430mA and below: within 1/2" (half-inch) of grounded metal as long as the lamp.

2. 800mA and l500mA lamps: mount within 1" of grounded metal as long as the lamp.

F. Fluorescent fixtures shall conform to NEMA Standards, including references to fixture dimensions and temperature ratings.

G. Ballasts shall be electronic high power factor (greater than 95%), ballast factor (greater than 95%) and approved by UL (UL 935 listed). Ballasts shall be certified for voltage and number of lamps specified and equipped with internal thermal protectors unless otherwise specified.

1. Ballasts shall have a Crest Factor of less the one and seven tenths.

2. Ballasts for indoor applications shall be "Class P".

3. Provide multi-lamp ballasts where possible including continuous rows of one-lamp fixtures, and one-lamp ballasts only where the fixture layout does not permit the use of multi-lamp ballasts.

4. Ballast shall be a dedicated ballast to operate a specific lamp, i.e., T5 ballasts specifically for a T5 lamp.

5. All ballasts shall operate at the voltage as described in Lighting Fixture Schedule and confirmed on electrical drawings. Ballasts shall operate lamps properly through the following supply voltage ranges:

a. Rated voltage +/- 10%

b. Universal voltage of 108 to 305V on 50 or 60Hz supply

6. Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

7. Frequency shall be 20 kHz or greater except as noted without any discernible flicker (-<3% flicker index).

8. Ballast shall have input current total harmonic distortion not to exceed 10% of the fundamental harmonic (60 Hz).

9. Ballast shall not contain PCB materials.

10. Ballast shall provide transient immunity as recommended by ANSI C62.41-1991 location Category A2.

11. Ballast shall be encapsulated to ensure maximum thermal and structural integrity.

12. Ballast minimum sound ratings:

    a. 265 mA: Class 'A'

    b. 430 mA: Class 'A'

    c. 800 mA: Class 'B'

    d. 1500 mA: Class 'C'

13. All fixtures installed in exterior or unheated interior spaces shall be supplied with ballasts which start lamps down to 0°F unless noted otherwise.

14. Ballasts for T5, T5HO, and CFL lamps shall incorporate auto resetting lamp shutdown circuitry for end of lamp life protection thereby allowing for re-lamping without the need to cycle power.

15. Program Rapid start ballasts shall be used when the lamps are to be frequently turned on/off (with cycles of less than 3 hours). Otherwise ballast shall provide instant starting sequence consistent with ANSI standard C82.11-1993.

16. Ballast shall be manufactured in an ISO 9002 certified facility.

17. Manufacturer shall have minimum 15 years of manufacturing experience.

18. Ballast, unless specified otherwise, shall be same manufacturer and model in each fixture of the same type. Acceptable ballast manufacturers unless otherwise noted are:

    a. Lutron

    b. Advance

    c. Universal Lighting Technologies

    d. Osram/Sylvania

H. Lighting fixtures recessed in a hung ceiling where the space above the hung ceiling is used as a plenum chamber for either supply or return air for

the air conditioning system shall be designed, manufactured and wired to conform to NEC Article 300-22.

2.04 FLUORESCENT LAMPS:

A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.

B. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.

C. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.

D. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.

1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).

2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).

3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).

4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).

5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).

6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).

2.05 SOLID STATE LIGHTING / LIGHT EMITTING DIODE (LED) LAMPS AND LUMINAIRES:

A. General:

1. Luminaire manufacturer shall have a minimum of five (5) years experience in the manufacture and design of LED products and systems and no less than one hundred (100) North American installations.

2. Unless otherwise specified, all LED luminaires and power supplies shall be provided by a similar manufacturer to ensure compatibility.

3. All components, peripheral devices and control software are to be provided by and shall be the responsibility of a single entity. All components shall perform successfully as a complete system and shall operate as described in Lighting Designer's Control Narrative documents.

4. Provide submittals as described in Part 1 above.

5. Follow procedure for submitting samples as described in Part 1 above.

6. Include all components necessary for a complete installation. Provide all power supplies, synchronizers, data cables, and data terminators for a complete working system.

7. All LED sources used in the LED luminaire shall be of proven quality from established and reputable LED manufacturers and shall have been fabricated after 2007. Acceptable LED lamp manufacturers unless otherwise noted are:

   a. Cree, Inc.

   b. Philips Lighting

   c. Nichia Corporation

   d. Norlux

   e. Opto Technology, Inc.

   f. Osram Optronic Semiconductors

B. Replacement and Spares:

1. Manufacturer shall provide written guarantee of the following:

   a. Manufacture will keep record of original bin for each LED module and have replacement modules from the same bin available for three (3) years after date of installation.

   b. Manufacturer will keep an inventory of replacement parts (source assembly, power and control components).

   c. Manufacturer's LED system will not become obsolete for ten (10) years: Manufacturer will provide exact

replacement parts, or provide upgraded parts that are designed to fit into the original luminaire and provide equivalent distribution and lumen output to the original, without any negative consequences.

2. All parts of system shall be replaceable in field. Manufacturer shall provide written guarantee of the following:

   a. Manufacturer has in place a written recycling and re-use program, and will accept returned product and/or components for recycling or re-use.

   b. Manufacturer will properly dispose of non-recyclable components that are deemed harmful to the environment.

   c. System shall carry a full warranty as described in Part 1 above. Manufacturer shall be responsible for cost of labor and cost of shipping, to replace any component of the system that fails within the warranty period as specified in paragraph 1.07.

C. Products and Components - Performance

1. LED luminaires and components shall be UL listed or UL classified.

2. LED luminaires and components shall be PSE marked.

3. All LED luminaires shall be subjected to the following JEDEC Reliability Tests for Lead-free Semiconductors: HTOL, RTOL, LTOL, PTMCL, TMSK, Mechanical Shock, Variable Vibration Frequency, SHR, Autoclave.

4. To ensure luminaire quality, luminaire shall have been tested under accelerated life test conditions including an operating temperature span of 360 degrees F, and cyclic loading up to 60G.

5. All products included in system shall use Mil-Std 810F, Random Vibration 7.698g as a minimum standard. In installations subject to vibration, luminaire shall be installed with vibration isolation hardware to sufficiently dampen vibrations.

6. All LED components shall be mercury and lead-free.

7. All manufacturing processes and materials shall conform to the requirements of the European Union's Restriction on the Use of Hazardous Substances in Electrical and Electronics Equipment (RoHS) Directive, 2002/95/EC.

8. LEDs shall comply with ANSI/NEMA/ANSLG C78.377-2008 - Specifications for the Chromaticity of Solid State Lighting Products. Color shall remain stable throughout the life of the lamp. Color shall match approved sample.

9. LEDs shall comply with IESNA LM-80 - Standards for Lumen Maintenance of LED Lighting Products

10. White LEDs shall have a rated source life of 50,000 hours mimimum under normal operating conditions. RGB LEDs shall have a rated source life of 100,000 hours. LED "rated source life" is defined as the time when a minimum of 70% of initial lumen output remains.

11. Luminaire assembly shall include a method of dissipating heat so as to not degrade life of source, electronic equipment, or lenses. LED luminaire housing shall be designed to transfer heat from the LED board to the outside environment. Luminaire housing shall have no negative impact on life of components.

12. Manufacturer shall supply a range of permissible operating temperatures in which system will perform optimally.

13. High power LED luminaire shall be thermally protected using one or more of the following thermal management techniques: metal core board, gap pad, and/or internal monitoring firmware

14. LEDs shall be adequately protected from moisture or dust in interior applications.

15. For wet and damp use, LED-based luminaire itself shall be sealed, rated, and tested for appropriate environmental conditions, not accomplished by using an additional housing or enclosure. Such protection shall have no negative impact on rated life of source or components, or if so, such reductions shall be explicitly brought to the attention of the architect/engineer.

16. All hardwired connections to LED luminaires shall be reverse polarity protected and provide high voltage protection in the event connections are reversed or shorted during the installation process.

17. The LED luminaire shall be operated at constant and carefully regulated current levels. LEDs shall not be overdriven beyond their specified nominal voltage and current.

18. RGB LED luminaires shall utilize an equal combination of high brightness red, blue and green LEDs, unless otherwise noted, to

provide up to 16.7 million additive RGB colors and shall be capable of at least 8-bit control.

19. Manufacturer shall be able to provide supporting documentation of the product meeting third party regulatory compliance.

20. Manufacturer shall ensure that products undergo and successfully meet appropriate design and manufacturability testing including Design FMEA, Process FMEA, Environmental Engineering Considerations and Laboratory Tests, IEC standards and UL/CE testing.

21. All LED luminaires (100% of each lot) shall undergo a minimum twenty-four (24) hour burn-in during manufacturing, prior to shipping.

22. Manufacturer shall provide Luminaire Efficacy (lm/W), total luminous flux (lumens), luminous intensity (candelas) chromaticity coordinates, CCT and CRI. Optical performance, polar diagrams, and relevant luminance and illuminance photometric data. Provide data in IES file format in accordance with IES LM-79-2008, based on test results from an independent Nationally Recognized Testing Laboratory.

23. Power / data supply shall have the following:

    a. Supply outputs shall have current limiting protection.

    b. Supply shall provide miswiring protection.

    c. Supply shall have power factor correction.

    d. Supply shall provide connections that are conduit-ready or clamp-style connections in the case of low-voltage wiring.

    e. Supply shall come with a housing that meets a minimum IP20 rating for dry location installation unless located in a damp or wet location.

    f. Supply shall be UL listed for Class 1 or Class 2 wiring

D. LED Control and Communication - Performance

1. LED luminaires shall be network controllable via digital control.

2. Constant data transmission rates shall be employed, resulting in the output being independent of distance of cable between power supply and light source within the specified length.

3. LED system shall have a selectable means of external control via a data network.

4. Each LED luminaire and/or node shall have the capability to be set to a unique and individual address. Address shall be selectable through on board switches or by an external hardware or software method.

5. The LED system shall be scalable, with every LED luminaire/address in the system capable of being controlled by a single, centralized controller.

E. Programming Support

1. Provide installation and commissioning support to the electrical contractor as required to achieve a complete and operational system that meets the intent of the Control Narrative.

2.06 EXIT SIGNS:

A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.07 WIRING:

A. Voltage Rating

1. For voltages up to 120 volts fixture wiring shall be rated for 300 volts minimum.

2. For voltages above 120 volts fixture wiring shall be rated for 600 volts minimum.

B. Temperature Rating - Internal to Fixture

1. All wiring shall be code-approved for fixture wiring, and shall comply with the following temperature ratings unless fixture design or local codes require higher temperature wire.

2. Fluorescent

a. Minimum rating between lampholder(s) and internal ballast.

b. Minimum between ballast and separate junction box, or connection within integral wireway.

3. High Intensity Discharge

a. Minimum rating between lampholder(s) and separate junction box or connections with ballast components.

b. Minimum rating between core and coil ballast components and separate junction box.

c. Minimum rating between encased and potted ballast components and separate junction box.

C. Temperature Rating - External to Fixture

1. All flexible cord wiring between fixture components or to electrical receptacle and not in wireways shall have a minimum temperature rating of 105°C.

2. Cord type shall be suitable for application and shall be fitted with proper strain relief and watertight entries where required by application.

D. Splices

1. Splices internal to fixture shall be made within separate splice compartments and shall utilize nylon insulated crimped connections or insulated quick disconnects.

2. Splices to branch circuit wiring in separate junction boxes shall utilize flame retardant thermoplastic caps with fully seated helical metal spring and threaded entry.

E. No internal wiring shall be visible at normal viewing angles, i.e., above 45° from vertical. Use additional wire clamps if necessary. Anticipate increased visibility if fixtures are mounted on or recessed within a sloping surface.

F. Any fixture fed from more than one panel, i.e., for normal and night or emergency operation, shall have separate neutrals to each panel.

G. Furnish code-approved wiring in ceiling cavities forming air plenums.

2.08 LIGHTING FIXTURE SUPPORT COMPONENTS:

A. Comply with Division 16 Section "Hangers and Supports” for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3: EXECUTION

3.01 INSTALLATION:

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches (150 mm) from lighting fixture corners.

2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch (20-mm) metal channels spanning and secured to ceiling tees.

4. Install four independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.

3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 16 Section "Conductors and Cables."

PART 4: MEASUREMENT AND PAYMENT

4.01 TYPE A1 LUMINAIRE:

A. Type A1 luminaires will be measured for at the contract unit price bid per each.

B. Type A1 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.02 TYPE A2 LUMINAIRE:

A. Type A2 luminaires will be measured for at the contract unit price bid per each.

B. Type A2 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.03 TYPE A5 LUMINAIRE:

A. Type A5 luminaires will be measured for at the contract unit price bid per each.

B. Type A5 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.04 TYPE A51 LUMINAIRE:

A. Type A51 luminaires will be measured for at the contract unit price bid per each.

B. Type A51 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.05 TYPE A6 LUMINAIRE:

A. Type A6 luminaires will be measured for at the contract unit price bid per each.

B. Type A6 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.06 TYPE A7 LUMINAIRE:

A. Type A7 luminaires will be measured for at the contract unit price bid per each.

B. Type A7 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.07 TYPE B1 LUMINAIRE:

A. Type B1 luminaires will be measured for at the contract unit price bid per each.

B. Type B1 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.08 TYPE B1A LUMINAIRE:

A. Type B1A luminaires will be measured for at the contract unit price bid per each.

B. Type B1A luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.09 TYPE B1B LUMINAIRE:

A. The B1B luminaires will be measured for all the contract unit price bid per each.

B. Type B1B luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.10 TYPE B2 LUMINAIRE:

A. Type B2 luminaires will be measured for at the contract unit price bid per

each.

B. Type B2 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.11 TYPE B4 LUMINAIRE:

A. Type B4 luminaires will be measured for at the contract unit price bid per each.

B. Type B4 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.12 TYPE B5 LUMINAIRE:

A. Type B5 luminaires will be measured for at the contract unit price bid per each.

B. Type B5 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.13 TYPE C2 LUMINAIRE:

A. Type C2 luminaires will be measured for at the contract unit price bid per each.

B. Type C2 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.14 TYPE C3 LUMINAIRE:

A. Type C3 luminaires will be measured for at the contract unit price bid per each.

B. Type C3 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.15 TYPE C6 LUMINAIRE:

A. Type C6 luminaires will be measured for at the contract unit price bid per each.

B. Type C6 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools,

labor and all work incidental to complete the item as specified.

4.16 TYPE D2 LUMINAIRE:

A. Type D2 luminaires will be measured for at the contract unit price bid per each.

B. Type D2 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.17 TYPE D3 LUMINAIRE:

A. Type D3 luminaires will be measured for at the contract unit price bid per each.

B. Type D3 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.18 TYPE D3E LUMINAIRE:

A. Type D3E luminaires will be measured for at the contract unit price bid per each.

B. Type D3E luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.19 TYPE EL4 LUMINAIRE:

A. Type EL4 luminaires will be measured for at the contract unit price bid per each.

B. Type EL4 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.20 TYPE F LUMINAIRE:

A. Type F luminaires will be measured for at the contract unit price bid per each.

B. Type F luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.21 TYPE G LUMINAIRE:

A. Type G luminaires will be measured for at the contract unit price bid per each.

B. Type G luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.22 TYPE H LUMINAIRE:

C. Type H luminaires will be measured for at the contract unit price bid per each.

D. Type H luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.23 TYPE I LUMINAIRE:

A. Type I luminaire will be measured for at the contract unit price bid per each.

B. Type I luminaires will be paid for each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

TYPE L6 LUMINAIRE:

A. Type L6 luminaires will be measured for at the contract unit price bid per each.

B. Type L6 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.25 TYPE L13 LUMINAIRE:

A. Type L13 luminaires will be measured for at the contract unit price bid per each.

B. Type L13 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.26 TYPE L14 LUMINAIRE:

A. Type L14 luminaires will be measured for at the contract unit price bid per each.

B. Type L14 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.27 TYPE L18 LUMINAIRE:

A. Type L18 luminaires will be measured for at the contract unit price bid per each.

B. Type L18 luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.28 TYPE M LUMINAIRE:

A. Type M luminaires will be measured for at the contract unit price bid per each.

B. Type M luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.29 TYPE UC LUMINAIRE:

A. Type UC luminaires will be measured for at the contract unit price bid per each.

B. Type UC luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.30 TYPE OA LUMINAIRE:

A. Type OA luminaires will be measured for at the contract unit price bid per each.

B. Type OA luminaires will be paid per each, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

4.27 EXIT SIGN:

A. Type Exit Sign will not be measured payment.

B. Type Exit Sign will not be paid for directly, but will be included in the lump sum Maintenance Building.

END OF SECTION

SECTION 16520

EXTERIOR BUILDING LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This Section specifies providing lighting fixtures and mounting hardware for exterior building lighting.,

B. Related Work Specified Elsewhere:

1. Conductors and Cables: Section 16120.

2. Raceways and Boxes: Section 16130.

3. Grounding and Bonding: Section 16060

1.02 QUALITY ASSURANCE:

A. The following Codes, Regulations, Reference Standards and Specifications apply to work included in this Section:

1. Codes and regulations of jurisdictional authorities.

2. Reference Codes and Standards.

a. NFPA 70, National Electrical Code.

b. UL: 57, 62, 496, 508, 542, 935, 1029, 1570. 1598

c. SSPC: SP-6, SP-8, SP-10.

d. ASTM: A36, A53A123, A153, A167, A276, A325, A507, A575, A1011, B26, B85, B137, B209, B221, D635, D1056, D1400, D2240.

e. Applicable AISI, ANSI and NAAMM standards.

f. AASHTO: LTS-2.

B. Each lighting fixture: UL-labeled or listed.

1. HALO 6 Inch LED Module:

a. UL/cUL Damp Location Listed

b. UL/cUL Wet location, Protected Ceiling Listed and IP66 rated with designated trims.

c. RoHS Compliant

d. Non-IC listed

C. Experience:

1. Manufacturer: Select a firm regularly engaged in the manufacture of the products described herein.

2. Furnish products in this work which essentially duplicate products, by the same manufacturer, that have been in satisfactory use of a period of five years prior to the bid opening of this project.

1.03 SUBMITTALS:

A. Submit the following for approval in accordance with SUBMITTALS; Section 01300 and with the additional requirements as specified for each:

1. Shop Drawings:

a. Include photometric curves.

b. Include manufacturer's product specifications and installation instruction

i. Lighting fixtures

2. Wiring diagrams and bill of materials.

3. Mounting details and installation instructions.

4. Samples: One of each type of fixture, as requested or directed by the Administration or the Engineer.

a. Lighting fixtures

5. Documentation:

a. Verification that each fixture is in compliance with applicable codes, regulations, reference standards and specifications for the location at which it is to be used. Indicate requirements that each fixture meets.

b. Calculations:

i. Submit calculations by a professional engineer registered in the State of Maryland certifying that assemblies of foundation, anchor bolts, pole, arms and luminaire will withstand specified wind

pressure, wind speed, stress, deflection, vibration and fatigue.

6. Field Testing:

   a. Submit a detailed plan of the proposed methods of and scheduling of the required field testing at least 30 calendar days before initiating the tests.

   b. Submit certified test reports.

7. Manufacturer's Data:

   a. At least two weeks before start of any shop coating work, submit to the Engineer for approval two each of the following:

      i. Complete data sheets with surface preparation and the coating materials to be used, identified by the manufacturer, brand name, and product number.

8. Substitute Lighting Fixture Submission: Submit the following data for light fixtures substituted for named manufacturers for the engineer's approval.

   a. Manufacturer's catalog cuts indicating type, design, dimensions, mounting arrangement and other industry standard lighting fixture information.

   b. Manufacturer's photometric data, distribution curves, isolux charts, BUG rating, glare factor data and coefficient of utilization.

   c. Submit design using computer program showing the substituted fixture is equivalent to the named fixture, including lighting levels, and average to minimum lighting level ratio of 5 to 1 for the main parking and sidewalk areas. The minimum illumination level within the main parking area and sidewalk shall be 0.5 foot-candles.

9. Certification

   a. Fixture compliance with codes and regulations

   b. Lighting fixtures

10. Operation and maintenance manuals

   a. Lighting fixtures

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Ship each unit securely packaged and labeled for safe handling in shipment and to avoid damage or distortion.

B. Store lighting fixtures and mounting poles in secure and dry storage facility.

1.05 WARRANTY:

A. Lamps: Warrant the life of lamps for periods of two years.

B. Warranties for items in this Section shall begin after final acceptance

PART 2 - PRODUCTS

2.01 PRODUCTS AND MATERIALS:

A. General Requirements for Lighting Fixtures:

1. Interchangeability: Components of same type, size, rating, functional characteristics and make are to be interchangeable.

2. In accordance with UL 57, UL 1598.

3. Materials:

a. Stainless steel:

i. Sheet: ASTM A167, 22 gauge minimum.

ii. Bar: ASTM A276, Type 316.

iii. Finish: AISI Alloy 304, NAAMM Finish No. 4, unless otherwise shown.

b. Aluminum: Alloy as recommended by manufacturer, unless otherwise shown or specified.

i. Sheet and plate: ASTM B209.

ii. Extrusion: ASTM B221, 0.109-inch minimum thickness, unless otherwise shown.

iii. Cast:

1) Die cast: ASTM B85, 0.1875-inch minimum thickness, unless otherwise shown.

2) Sand cast: ASTM B26, 0.1875-inch minimum thickness, unless otherwise shown.

3) Color-anodized cast: Kalcolor Casting Alloy No. 2 or equal.

4. Lamps:

a. In accordance with applicable ANSI, IESNA-80-2008 and LM-79-2008 Standards.

b. Constant current Wall Director LED

i. Wattage: 73 and 140W

ii. Base: Emitter Deck

iii. Rated Life: 100,000 hours and remaining above 85% of original light output minimum

c. Constant current HALO LED

i. Wattage: 14W

ii. Base: Edison screw-base adapter

iii. Rated Life: 50,000 hours at 70% lumen maintenance.

iv. Correlated Color Temperature: 4000K

v. Color Rendering Index: 80 or greater

5. Ballasts/ Drivers:

a. Wall Director LED Luminaire:

i. Electronic Driver with 0-10V dimming interface

ii. Operable on 277-volt, 60 Hertz as necessary, type and rating suitable for associated LED

iii. Driver is rated for 40°F starting

b. HALO 6 Inch LED Module

i. High efficiency driver with power factor greater than 0.90

ii. Input power of 120V at 50/60 Hertz

iii. Integral thermal protection

6. Fixture body and housing: Shape size and material as shown.

7. Reflector: LED MicroEmitter reflectors and secondary integeral specular reflectors providing “0” up light. .

8. Diffusers:

a. Shape and size as shown on plans, type III and type IV light distributions are specified one-piece molded or extruded polycarbonate plastic having the following properties:

i. Interior diffusing with smooth exterior surface.

ii. Self-extinguishing, in accordance with ASTM D635.

iii. No material color change when used with fluorescent lamps.

iv. No apparent yellowing after 500 hours exposure to fluorescent lamp source under conditions similar to those existing in the lighting fixture.

v. No alteration to optical properties of the fixture when finished diffuser treated with anti-static wax.

b. Formed so that the finished piece retains its design contours and dimensions at normal operating temperature.

c. Resistance to shrinking, warping, crazing, cracking, or discoloring, either in service or when stored in the manufacturer’s standard shipping containers under normal conditions.

9. Lenses:

a. General:

i. Glass lense: 3/16-inch flat tempered glass, sealed to lens frame with a silicone gasket and retainer clips.

ii. Lens frame: one piece die cast, low copper (<0.6% Cu) aluminum alloy with integral hinges and stainless steel pins.

iii. Refracted lenses: Heat-resistant annealed clear borosilicate glass, with the following additional requirements:

1) Initial lumen distribution on horizontal plane evenly from zero to 90 degrees: 55 to 60 percent.

2) Minimum efficiency: 85 percent.

b. HALO 6 Inch LED Module

i. Solite glass

10. Fixture wire: Section 16120.

11. Gasket:

a. Keyed gasket: One-piece extruded solid neoprene having type A durometer hardness of 30 plus or minus five when tested in accordance with ASTM D2240.

b. Self-retaining gasket:

i. One-piece, closed-cell sponge neoprene, soft or medium density.

ii. Resistant to aging, heat, ultra-violet light, water, oil, weathering and setting as determined by ASTM D1056, NEMA 12.

iii. Cemented to component with resilient neoprene sealing compound compatible with finish. Adhesive not applied to diffuser.

c. Silicone gasket equal to neoprene, at Contractor's option.

d. Provide gaskets for fixtures located in tunnels having UL labeling for wet locations and able to withstand water hose spray cleaning with 100 PSI water pressure.

12. Hardware:

a. Latches, catches, release mechanism, hinges, screws, bolts, studs, nuts, rivets, washers and springs. Heavy-duty stainless steel or stealth gray, as shown.

b. Latches and catches: Captive type.

c. Operating hardware: Self-retaining type.

13. Construction:

a. Fixture body, reflectors, wiring channels, end caps and castings formed to prevent buckling or distortion.

b. Minimum of two wire clips provided in wiring channel to support wiring.

c. Seams and joints continuously welded and ground smooth.

d. When aluminum is in contact with dissimilar metal, separate contact surfaces with gasket, non-absorptive tape, or coating to prevent corrosion.

14. Finish:

a. Specular anodized coating: 14-stage process for permanently sealed specular or semispecular finish, as shown, in accordance with patented electrolytic process, Alzak or equal.

b. Anodic coating: AA-M22C22A41, minimum coating thickness 0.8 mil, coating weight 35 milligrams per square inch, hot water seal overall, tested in accordance with the following requirements:

i. Coating weight: ASTM B137.

ii. Coating thickness: ASTM B244.

iii. Sealing test: ASTM B136.

iv. Undercutting of anodic film from scored line after exposing to 10 percent salt spray for 1,500 hours, in accordance with ASTM B117: 0.067-inch maximum.

c. Shop painting: Prepare surfaces in accordance with SSPC SP-6. Apply coating of 8.0 mil total DFT as follows:

i. First coat: Inorganic zinc silicate primer appllied with a dry film thickness of 2.5 – 3 mils.

ii. Second coat: High-build epoxy primer applied with a dry film thickness of 4 mils.

iii. Third coat: Aliphatic polyester polyurethane applied with a dry film thickness of 1.5 to 2.5 mils.

d. Color anodized finish: AA-M22-C22A42, minimum coating thickness 0.8 mil, coating weight 35 milligrams per square inch, hot water seal overall, tested in accordance with the following requirements:

i. Coating weight: ASTM B137.

ii. Coating thickness: ASTM B244.

iii. Sealing test: ASTM B136.

e. Stealth Gray TGIC thermoset polyester powder coating: Apply TGIC of a 2.5 mil nominal thicknes applied over titanated zirconium conversion coating. Cure by heat treatment.

f. ASTM 2500 hour salt spray test endurance rating.

15. Mark each fixture and its components in accordance with applicable reference standard.

16. Fasteners: Size and type shown or as approved by the Engineer.

a. Expansion anchors: FS FF-S-325, Group II, Type 3, Class1, stainless steel, Type 303.

b. Toggle bolts: FS FF-B-588C.

c. Powder-actuated: FS FF-P-395B.

2.02 LIGHTING FIXTURE:

A. Building exterior walls - Acceptable Models:

1. Wall Director LED Luminaire, Type III, 277 volt, stealth gray finish, Model No for 140 watt, Type III distribution,WD18-D3-120L5K277-SG-A-33-SF277-SCM18; model no for 140 Watt Type IV distribution, WD18-D4-120L5K277-SG-A-33-SF277-SCM18; model no for 73 watt Type III distribution, WD14-D3-60L5K277-SG-A-33-SF277-SCM14D by Kim Lighting Inc. • P.O. Box 60080, City Of Industry, CA 91716, Tel: 626-968-5666, www.kimlighting.com/

2. Approved equal.

B. Roof eaves - Acceptable Models:

1. HALO 6 Inch LED Module, downlight, 120V, white reflector and trim ring, 300VA Transformer, model no. ML709840ICAT120D-493PS06-H2770ICAT by Cooper Lighting •1121 Highway 74 South Peachtree City, GA 30269, Tel: 770-486-4800, www.cooperlighting.com.

2. Approved equal.

C. Lighting fixture types shall be installed where shown on the drawings according to the manufacturer's recommendations, fixture locations and mounting bracket embedment in the building wall is critical to attaining proper photometric results. Where manufacturer's names and numbers are listed, they are intended as examples only. Fixtures of equal characteristics and quality by other manufacturers will be considered after proper submittals have been received. The burden of proof of equality is upon the Contractor.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. Install lighting fixtures of types indicated at locations as follows:

1. Mount fixtures rigidly in place Per the manufacturers recommendations embedded in the building wall

2. Use stainless steel fasteners. Where a metal contacts concrete or a dissimilar metal, separate contact surfaces with gasket, non-absorptive tape or bituminous coating to prevent corrosion.

3. Mount fixtures plumb, level and in straight lines.

4. Clean lamps, diffusers, globes, reflectors and exposed-to-view surfaces of fixtures after aiming and adjusting has been approved.

5. Concrete foundations for lighting poles shall be constructed in accordance with the details on the Contract Drawings and as specified in Section 03300, Cast-in-Place Concrete.

6. Install lighting fixtures (where indicated on Contract Plans) in accordance with approved shop drawings.

7. Connect wiring using waterproof connectors.

B. Ground lighting fixtures, mounting brackets enclosures in accordance with NEC and Section 16060.

3.02 FIELD QUALITY CONTROL:

A. Testing:

1. Furnish necessary personnel and equipment and perform tests and adjustments in the presence of the Engineer. Schedule adjustment of exterior installations to occur during hours of darkness.

2. Test lighting circuit for continuity and operation.

3. Test fixtures, mounting brackets and equipment enclosures for continuity of grounding system.

4. Aim and adjust fixtures to provide distribution pattern approximately as shown and as approved.

5. Test time switches, control devices and contactor for connection in accordance with wiring diagram.

6. Check tightness of cable connections of time switches, lighting contactors, photoelectric controls and limit switches.

7. Test operations of circuits, control devices and contactors.

PART 4 - MEASUREMENT AND PAYMENT

4.01 EXTERIOR LIGHTING

A. Exterior Lighting will not be measured for payment.

B. Exterior Lighting will be paid for at the lump sum bid price, complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16570

NETWORK LIGHTING CONTROLS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This section includes the following:

1. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.

2. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)

3. All system devices shall be networked together enabling digital communication and shall be individually addressable.

4. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.

5. The system architecture shall facilitate remote operation via a computer connection.

6. The system shall not require any centrally hardwired switching equipment.

B. Related Sections include the following:

1. Division 16 Section “Wiring Devices” for wiring box dimmers and light switches

2. Division 16 Section “Lighting Control Devices” for day light sensors, photo electric switches, occupancy sensors, contactors etc.

1.03 DEFINITIONS

A. LED: Light-emitting Diode

B. BAS: Building Automation System

1.04 SUBMITTALS

A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature)

B. Riser Diagrams – typical per room type (detailed drawings showing device interconnectivity of devices)

C. Other Diagrams – as needed for special operation or interaction with other system(s)

D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up

E. Hardware and Software Operation Manuals

F. Other operational descriptions as needed

G. Detailed assemblies of all the components assembled for this project.

H. Operation and Maintenance Data: Include software manuals, adjustment of pre-set controls, and operation of adjustable zone controls.

1.05 QUALITY ASSURANCE

A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.

B. All components and the manufacturing facility where product was manufactured must be ROHS compliant.

C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.

D. All applicable products must be UL / CUL Listed or other acceptable national testing organization.

1.06 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

B. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.07 WARRANTY

A. All devices in lighting control system shall have a 5 year warranty.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. This specification is based on the nLight® Network Control System from Sensor Switch, an Acuity Brands Company (800-727-7483, www.sensorswitch.com).

B. All products of the system shall meet “Buy America” requirements as specified in Division 1.

C. Subject to compliance with the requirements, manufacturers offering products that may be incorporated into work include:

1. Lutron

2.02 SYSTEM REQUIREMENTS

A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.

B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section)

D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and posses RJ-45 style connectors.

E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

F. Devices within a lighting control zone shall be connected with CAT-5 or above low voltage cabling in any order.

G. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

H. System shall have one or more primary wall mounted network control "gateway" devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

I. System shall use "bridge" devices that route communication and distribute power for up to 8 directly connected lighting zones together for purposes of decreasing

J. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.

K. Individual lighting zones shall be capable of being segmented into several "local" channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

L. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information.

M. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.

2.03 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control Module (Gateway)

1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.

2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.

3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.

4. Device shall automatically detect all devices downstream of it.

5. Device shall have a standard and astronomical internal time clock.

6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.

7. Device shall have a USB port

8. Each control gateway device shall be capable of linking 1500

devices to the management software.

9. Device shall be capable of using a dedicated or DHCP assigned IP address.

10. Network Control Gateway device shall be the following Sensor Switch model Series: nGWY2

B. Networked System Occupancy Sensors

1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.

2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions.

3. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.

4. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.

5. Sensors shall be available in multiple lens options which are customized for specific applications.

6. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

7. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.

8. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue

9. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.

10. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.

11. Sensors shall be equipped with an automatic override for 100 hour

burn-in of lamps. This feature must be available at any time for lamp replacements.

12. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.

13. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.

14. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).

C. Networked System Daylight (Photocell and or Dimming) Sensors

1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

2. Photocell and dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).

5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)

6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.

7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an "offset" from the primary zone.

D. Networked System Power (Relay) Packs

1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.

2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.

3. All devices shall have two RJ-45 ports.

4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.

5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.

6. When required by local code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

E. Networked LED Luminaires

1. Networked LED luminaire shall have a mechanically integrated control device

2. Networked LED luminaire shall have two RJ-45 ports

3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)

4. Networked LED luminaire shall provide low voltage power to other networked control devices

5. System shall be able to turn on/off LED luminaire.

6. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).

F. Networked System Wall Switches & Dimmers

1. Devices shall recess into single-gang switch box and fit a standard GFI opening.

2. Devices shall be available with zero or one integrated Class 1 switching relay.

3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

4. All sensors shall have two RJ-45 ports.

5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.

6. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).

7. Devices with mechanical push-buttons shall provide tactile and LED user feedback.

8. Devices with mechanical push-buttons shall be made available with custom button labeling

9. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.

G. Networked System Graphic Wall Station

1. Device shall have a 3.5” full color touch screen for selecting up to 8 programmable lighting control presets or acting as up to 16 on/off/dim control switches.

2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.

3. Device shall enable user supplied .jpg screen saver image to be uploaded.

4. Device shall surface mount to single-gang switch box

5. Device shall have a micro-USB style connector for local computer connectivity.

6. Device shall have two RJ-45 ports for communication

H. Networked System Scene Controllers

1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.

2. Device shall recess into single-gang switch box and fit a standard GFI opening.

3. Devices shall provide LED user feedback.

4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.

5. All sensors shall have two RJ-45 ports.

6. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.

7. Device shall be capable of selecting a lighting profile be run by the system's upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).

8. Device shall have LEDs indicating current selection.

I. Communication Bridges

1. Device shall surface mount to a standard 4" x 4" square junction box.

2. Device shall have 8 RJ-45 ports.

3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.

4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.

5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with insufficient local power. This architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

2.04 LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.

F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.05 MANAGEMENT SOFTWARE

A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software

B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).

C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.

D. A printable network inventory report shall be available via the software.

E. A printable report detailing all system profiles shall be available via the software.

F. Software shall require all users to login with a User Name and Password.

G. Software shall provide at least three permission levels for users.

H. All sensitive stored information and privileged communication by the software shall be encrypted.

I. All device firmware and system software updates must be available for automatic download and installation via the internet.

J. Software shall be capable of managing systems interconnected via a WAN (wide area network).

2.06 START-UP & SUPPORT FEATURES

A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.

B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.

D. All system devices shall be capable of being given user defined names.

E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

F. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

PART 3: EXECUTION

3.01 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Conductors and

Cables." Minimum conduit size shall be ¾”.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

C. Install field-mounting, transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.02 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

B. Label each dimmer module with a unique designation.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

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

1. Continuity tests of circuits.

2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.

   a. Include testing of dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

3. Emergency Power Transfer: Test listed functions.

C. Remove and replace malfunctioning dimming control components and retest as specified above.

D. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

E. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain dimming controls. Refer to Division 1 Section "Demonstration and Training."

PART 4: MEASUREMENT AND PAYMENT

4.01 GENERAL SERVICE NETWORK LIGHTING CONTROLS

A. General Service Network Lighting Controls will not be measured for payment.

B. General Service Network Lighting Controls will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16711

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Optical-fiber-cable pathways and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface pathways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 16130 "Raceways and Boxes" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
2. Section 16712 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.03 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways and and for each color and texture specified, 12 inches (300 mm) long.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a Tyco International Ltd. Co.

3. Alpha Wire Company.

4. Anamet Electrical, Inc.

5. Electri-Flex Company.

6. O-Z/Gedney; a brand of EGS Electrical Group.

7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.

8. Republic Conduit.

9. Robroy Industries.

10. Southwire Company.

11. Thomas & Betts Corporation.

12. Western Tube and Conduit Corporation.

13. Wheatland Tube Company; a division of John Maneely Company.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:

a. Material: Steel or die cast.

b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.02 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Alpha Wire Company.

2. Arnco Corporation.

3. Endot Industries Inc.

4. IPEX.

5. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible-type pathway, approved for riser or general-use installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with TIA-569-B.

2.03 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.

2. Cooper Technologies Company; Cooper Crouse-Hinds.

3. EGS/Appleton Electric.

4. Erickson Electrical Equipment Company.

5. Hoffman; a Pentair company.

6. Hubbell Incorporated; Killark Division.

7. Lamson & Sessions; Carlon Electrical Products.

8. Milbank Manufacturing Co.

9. Molex; Woodhead Brand.

10. Mono-Systems, Inc.

11. O-Z/Gedney; a brand of EGS Electrical Group.

12. RACO; a Hubbell company.

13. Robroy Industries.

14. Spring City Electrical Manufacturing Company.

15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.

16. Thomas & Betts Corporation.

17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.

2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy Type FD, with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).

J. Gangable boxes are prohibited.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.04 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Comply with TIA-569-B.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. CDR Systems Corporation; Hubbell Power Systems.

d. NewBasis.

e. Oldcastle Precast, Inc.; Christy Concrete Products.

f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "COMMUNICATIONS.".

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes 24 Inches Wide by 24 Inches Long (600 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

10. Handholes 24 Inches Wide by 24 Inches Long (600 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.05 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit: RNC, Type EPC-80-PVC, concrete encased.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:

a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Damp or Wet Locations: GRC.

6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.

7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.

8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.

9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)

3.02 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 16073 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of two 90-degree bends in any pathway

run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.

3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to, GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg)tensile strength. Leave at least 12 inches (300 mm)of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.

2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.

3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).

2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service pathway enters a building or structure.

3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C)> temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

CC. Set metal floor boxes level and flush with finished floor surface.

DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 02317 "Excavation and Fill" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 02317 "Excavation and Fill."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade,

make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 02317 "Excavation and Fill."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, but a minimum of 6 inches (150 mm) below grade. Align planks along centerline of conduit.

7. Underground Warning Tape: Comply with requirements in Section 16075 "Electrical Identification."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 36” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions,

cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 16091 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

PART 4: MEASUREMENT AND PAYMENT

4.01 PATHWAYS FOR COMMUNICATIONS SYSTEMS:

A. Pathways for Communications Systems will not be measured for payment.

B. Pathways for Communications Systems will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16712

PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.

2. Optical-fiber-cable pathways and fittings.

3. Metal wireways and auxiliary gutters.

4. Surface pathways.

5. Boxes, enclosures, and cabinets.

6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 16130 "Raceways and Boxes" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

2. Section 16711 "Pathways for Communications Systems" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving communications systems.

1.03 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.

2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways and surface pathways and for each color and texture specified, 12 inches (300 mm) long.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of pathway groups with common supports.

2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.01 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a Tyco International Ltd. Co.

3. Alpha Wire Company.

4. Anamet Electrical, Inc.

5. Electri-Flex Company.

6. O-Z/Gedney; a brand of EGS Electrical Group.

7. Picoma Industries; Subsidiary of Mueller Water Products, Inc.

8. Republic Conduit.

9. Robroy Industries

10. Southwire Company.

11. Thomas & Betts Corporation.

12. Western Tube and Conduit Corporation.

13. Wheatland Tube Company; a division of John Maneely Company.

B. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with TIA-569-B.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:

a. Material: Steel or die cast.

b. Type: compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 467, rated for environmental conditions where installed, and including flexible external bonding jumper.

2.02 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.

2. Arnco Corporation.

3. Endot Industries Inc.

4. IPEX.

5. Lamson & Sessions; Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible-type pathway, approved for riser or general-use installation unless otherwise indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Comply with TIA-569-B.

2.03 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.

2. Cooper Technologies Company; Cooper Crouse-Hinds.

3. EGS/Appleton Electric.

4. Erickson Electrical Equipment Company.

5. Hoffman; a Pentair company.

6. Hubbell Incorporated; Killark Division.

7. Lamson & Sessions; Carlon Electrical Products.

8. Milbank Manufacturing Co.

9. Molex, Woodhead Brand

10. Mono-Systems, Inc.

11. O-Z/Gedney; a brand of EGS Electrical Group.

12. RACO; a Hubbell Company.

13. Robroy Industries.

14. Spring City Electrical Manufacturing Company.

15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.

16. Thomas & Betts Corporation.

17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-B.

2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy Type FD, with gasketed cover.

E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

F. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.

2. Type: Fully adjustable.

3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and

marked for intended location and application.

H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

J. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep).

K. Gangable boxes are prohibited.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.04 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND CABLING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for

intended location and application.

3. Comply with TIA-569-B.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. CDR Systems Corporation; Hubbell Power Systems.

d. NewBasis.

e. Oldcastle Precast, Inc.; Christy Concrete Products.

f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "ELECTRIC."

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes 24 Inches Wide by 24 Inches Long (600 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.05 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified

tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.01 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.

2. Concealed Conduit, Aboveground: GRC.

3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: GRC locations include the following:

a. Loading dock.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and

Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: GRC.

7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.

8. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.

9. Pathways for Concealed General Purpose Distribution of Optical-Fiber or Communications Cable: EMT.

10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch (21-mm) trade size. Minimum size for optical-fiber cables is 1 inch (27 mm).

D. Pathway Fittings: Compatible with pathways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

B. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

C. Complete pathway installation before starting conductor installation.

D. Comply with requirements in Section 16073 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.

3. Arrange pathways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to GRC before rising above floor.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.

P. Cut conduit perpendicular to the length. For conduits of 2-inch (53-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.

R. Surface Pathways:

1. Install surface pathway for surface electrical outlet boxes only where indicated on Drawings.

2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.

3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

S. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (21-mm) Trade Size and Smaller: Install pathways in maximum lengths of 50 feet (15 m).

2. 1-Inch (27-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).

3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

T. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.

U. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service pathway enters a building or structure.

3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to top of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 02317 "Excavation and Fill" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 02317 "Excavation and Fill."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 02317 "Excavation and Fill."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches

(1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 16075 "Electrical Identification."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line, 36” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 16091 "Sleeves and Sleeve Seals for Electronic Safety and Security Pathways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

PART 4: MEASUREMENT AND PAYMENT

4.01 PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY:

A. Pathways for Electronic Safety and Security will not be measured for payment.

B. Pathways for Electronic Safety and Security will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16714

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.

2. Backboards.

3. Telecommunications equipment racks and cabinets.

4. Grounding.

B. Related Requirements:

1. Section 16136 "Cable Trays for Communications Systems" for cable trays and accessories.

2. Section 16716 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

3. Section 16717 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

4. Section 16718 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.

3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Equipment frames shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without

separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.02 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 06105 "Miscellaneous Carpentry."

2.03 EQUIPMENT FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. Belden Inc.
3. Cooper B-Line.
4. Emerson Network Power Connectivity Solutions.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Middle Atlantic Products, Inc.
8. Ortronics, Inc.
9. Panduit Corp.
10. Siemon Co. (The).
11. Tyco Electronics Corporation; AMP Products.

B. General Frame Requirements:

1. Distribution Frames: 8’ x 19’’ Standard Equipment Rack, Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, steel construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.

2. Baked-polyester powder coat finish.

D. Modular Freestanding Cabinets:

1. Removable and lockable side panels.

2. Hinged and lockable front and rear doors.

3. Adjustable feet for leveling.

4. Screened ventilation openings in the roof and rear door.

5. Cable access provisions in the roof and base.

6. Grounding bus bar.

7. Rack-mounted, 550-cfm (260-L/s) fan with filter.

8. Power strip.

9. Baked-polyester powder coat finish.

10. All cabinets keyed alike.

E. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.

2. Baked-polyester powder coat finish.

3. Vertical cable management panels shall have front and rear channels, with covers.

4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.04 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Rack mounting.

3. Six, 15-A, 120-V ac, NEMA WD 6, Configuration 5-15R receptacles.

4. LED indicator lights for power and protection status.

5. LED indicator lights for reverse polarity and open outlet ground.

6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.

7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.

8. Close-coupled, direct plug-in line cord.

9. Rocker-type on-off switch, illuminated when in on position.

10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.

11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.05 GROUNDING

A. Comply with requirements in Section 16060 "Grounding and Bonding" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.

3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with J-STD-607-A.

2.06 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

B. Comply with requirements in Section 16711 "Pathways for Communications Systems" for materials and installation requirements for underground, buried

C. Comply with NECA 1.

D. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

E. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

F. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

G. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.02 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 16091 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.03 FIRESTOPPING

A. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.04 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.05 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section 16075 "Electrical Identification."

B. Comply with requirements in Section 09915 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Labels shall be preprinted or computer-printed type.

PART 4 - MEASUREMENT AND PAYMENT

4.01 COMMUNICATIONS EQUIPMENT ROOM FITTINGS:

A. Communications Equipment Room Fittings will not be measured for payment.

B. Communications Equipment Room Fittings will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16716

COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cable.
3. 62.5/125-micrometer, optical fiber cabling.
4. Coaxial cable.
5. Cable connecting hardware, patch panels, and cross-connects.
6. Cabling identification products.

B. Related Sections:

1. Section 16718 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. UTP: Unshielded twisted pair.

1.04 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.05 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

1.06 ACTION SUBMITTALS

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

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.

b. Minimum bending radius.

c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration drawings and printouts.

4. Wiring diagrams to show typical wiring schematics including the following:

a. Cross-connects.

b. Patch panels.

c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

6. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:

a. Vertical and horizontal offsets and transitions.

b. Clearances for access above and to side of cable trays.

c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.

d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.

1.07 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

D. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.08 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.09 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. Patch-Panel Units: One of each type.

2. Connecting Blocks: One of each type.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand

end to end. Use optical loss test set.

2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

1.12 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.13 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

1.14 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.01 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support brackets with cable tie slots for fastening cable ties to

brackets.

2. Lacing bars, spools, J-hooks, and D-rings.

3. Straps and other devices.

C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cable Management Solutions, Inc.

b. Cablofil Inc.

c. Cooper B-Line, Inc.

d. Cope - Tyco/Allied Tube & Conduit.

e. GS Metals Corp.

2. Cable Tray Material: Metal, suitable for indoors, and protected against corrosion by hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inches (0.055 mm) thick.

a. Ladder Cable Trays: Nominally 18 inches (455 mm) wide, and a rung spacing of 12 inches (305 mm).

D. Conduit and Boxes: Comply with requirements in Section 16130 "Raceways and Boxes."

1. Outlet boxes shall be no smaller than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

2.02 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated,3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 06105 "Miscellaneous Carpentry" for plywood backing panels.

2.03 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Berk-Tek; a Nexans company.

2. CommScope, Inc.

3. Draka USA.

4. Genesis Cable Products; Honeywell International, Inc.

5. KRONE Incorporated.

6. Mohawk; a division of Belden CDT.

7. Nordex/CDT; a subsidiary of Cable Design Technologies.

8. Superior Essex Inc.

9. SYSTIMAX Solutions; a CommScope Inc. brand.

10. 3M.

11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 100-pair UTP, formed into 25-pair and 50 pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-B.1 for performance specifications.

3. Comply with TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG.

b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

c. Communications, Riser Rated: Type CMR, complying with UL 1666.

d. Communications, Limited Purpose: Type CMX.

e. Multipurpose: Type MP or MPG.

f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.04 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. American Technology Systems Industries, Inc.

2. Dynacom Corporation.

3. Hubbell Premise Wiring.

4. KRONE Incorporated.

5. Leviton Voice & Data Division.

6. Molex Premise Networks; a division of Molex, Inc.

7. Nordex/CDT; a subsidiary of Cable Design Technologies.

8. Panduit Corp.

9. Siemon Co. (The).

10. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated .

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, 4-pair cables in 36-inch (900-mm)lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.05 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek; a Nexans company.

2. CommScope, Inc.

3. Corning Cable Systems.

4. General Cable Technologies Corporation.

5. Mohawk; a division of Belden CDT.

6. Nordex/CDT; a subsidiary of Cable Design Technologies.

7. Optical Connectivity Solutions Division; Emerson Network Power.

8. Superior Essex Inc.

9. SYSTIMAX Solutions; a CommScope Inc. brand.

10. 3M.

11. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: Multimode, 62.5/125-micrometer, 24 -fiber,tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA/EIA-568-B.3 for performance specifications.

3. Comply with TIA/EIA-492AAAA-B for detailed specifications.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

a. General Purpose, Nonconductive: Type OFN or OFNG.

b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

c. Riser Rated, Nonconductive: Type OFNR.

d. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.

e. Riser Rated, Conductive: Type OFCR, or OFNP, complying with UL 1666.

5. Conductive cable shall be steel armored type.

6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Orange for 62.5/125-micrometer cable.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.06 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.

2. American Technology Systems Industries, Inc.

3. Berk-Tek; a Nexans company.

4. Corning Cable Systems.

5. Dynacom Corporation.

6. Hubbell Premise Wiring.

7. Molex Premise Networks; a division of Molex, Inc.

8. Nordex/CDT; a subsidiary of Cable Design Technologies.

9. Optical Connectivity Solutions Division; Emerson Network Power.

10. Siemon Co. (The).

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch (900-mm) lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

2. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.

2.07 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.

2. Belden CDT Inc.; Electronics Division.

3. Coleman Cable, Inc..

4. CommScope, Inc.

5. Draka USA.

B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

C. RG-11/U: NFPA 70, Type CATV.

1. No. 14 AWG, solid, copper-covered steel conductor.

2. Gas-injected, foam-PE insulation.

3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.

4. Jacketed with sunlight-resistant, black PVC or PE.

5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG59/U: NFPA 70, Type CATVR.

1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.

2. Gas-injected, foam-PE insulation.

3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.

4. Color-coded PVC jacket.

E. RG-6/U: NFPA 70, Type CATV or CM.

1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.

3. Jacketed with black PVC or PE.

4. Suitable for indoor installations.

F. RG59/U: NFPA 70, Type CATV.

1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.

3. PVC jacket.

G. RG59/U (Plenum Rated): NFPA 70, Type CMP.

1. No. 20ed steel conductor; foam fluorinated ethylene propylene insulation.

2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.

3. Copolymer jacket.

H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70, "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATVomplying with NFPA 262.

2. CATV Riser Rated: Type CATVR, complying with UL 1666.

3. CATV Limited Rating: Type CATVX.

2.08 COAXIAL CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aim Electronics; a brand of Emerson Electric Co.

2. Leviton Voice & Data Division.

3. Siemon Co. (The).

2.09 GROUNDING

A. Comply with requirements in Section 16060 "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.

E. Cable will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.02 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Section 16130 "Raceways and Boxes."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.03 INSTALLATION OF PATHWAYS

A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.

B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 16714 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.

C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

D. Comply with requirements in Section 16130 "Raceways and Boxes" for installation of conduits and wireways.

E. Install manufactured conduit sweeps and long-radius elbows whenever possible.

F. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a

single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard when entering room from overhead.

4. Extend conduits 3 inches (76 mm) above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.04 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

10. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.

2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway, a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 6 feet (1800 mm) long not less than 12 inches (300 mm)

in diameter below each feed point.

G. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

H. Group connecting hardware for cables into separate logical fields.

I. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.05 FIRESTOPPING

A. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.06 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.07 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

1. Administration Class: 1.

2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Comply with requirements in Section 09915 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Comply with requirements in Section 16717 "Communications Horizontal Cabling" for cable and asset management software.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device with name and number of particular device as shown.

b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and

Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA 606-A, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and

adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

i. Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

ii. Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 4: MEASUREMENT AND PAYMENT

4.01 COMMUNICATIONS BACKBONE CABLING:

A. Communications Backbone Cabling will not be measured for payment.

B. Communications Backbone Cabling will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16717

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Coaxial cable.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.
6. Cable management system.

B. Related Requirements:

1. Section 16716 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
2. Section 16718 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.

G. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.

H. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

I. RCDD: Registered Communications Distribution Designer.

J. UTP: Unshielded twisted pair.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.

b. Minimum bending radius.

c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.

3. Cabling administration drawings and printouts.

4. Wiring diagrams to show typical wiring schematics, including the following:

a. Cross-connects.

b. Patch panels.

c. Patch cords.

5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Samples: For workstation outlets, jacks, jack assemblies, .

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On magnetic media or compact disk, complete with data files.

3. Device address list.

4. Printout of software application and graphic screens.

1.08 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. Patch-Panel Units: One of each type.

2. Connecting Blocks: One of each type.

3. Device Plates: One of each type.

4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.09 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.

2. Test optical fiber cables while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; including the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.01 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.

2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.

4. Splitters shall not be installed as part of the optical fiber cabling.

B. A work area is approximately 100 sq. ft. (9.3 sq. m), and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

C. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

2.02 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

2.03 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements in Section 06105 "Rough Carpentry" for plywood backing panels.

2.04 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.

2. Belden Inc.

3. Berk-Tek; a Nexans company.

4. CommScope, Inc.

5. Draka Cableteq USA.

6. Genesis Cable Products; Honeywell International, Inc.

7. Mohawk; a division of Belden Networking, Inc.

8. Superior Essex Inc.

9. SYSTIMAX Solutions; a CommScope, Inc. brand.

10. 3M Communication Markets Division.

11. Tyco Electronics Corporation; AMP Products.

B. Description: Category 6, 4-pair UTP.

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-B.1 for performance specifications.

3. Comply with TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG

b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

c. Communications, Riser Rated: Type CMR, complying with UL 1666.

d. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

e. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.05 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.

2. American Technology Systems Industries, Inc.

3. Belden Inc.

4. Dynacom Inc.

5. Hubbell Premise Wiring.

6. Leviton Commercial Networks Division.

7. Molex Premise Networks; a division of Molex, Inc.

8. Panduit Corp.

9. Siemon Co. (The).

10. Tyco Electronics Corporation; AMP Products.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

1. Number of Jacks per Field: One for each four-pair UTP cable indicated.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in 36-inch (900 mm) lengths; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.06 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.

2. Belden Inc.

3. Coleman Cable, Inc.

4. CommScope, Inc.

5. Draka Cableteq USA.

B. Cable Characteristics: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

C. RG-11/U: NFPA 70, Type CATV.

1. No. 14 AWG, solid, copper-covered steel conductor.

2. Gas-injected, foam-PE insulation.

3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.

4. Jacketed with sunlight-resistant, black PVC or PE.

5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG59/U: NFPA 70, Type CATVR.

1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.

2. Gas-injected, foam-PE insulation.

3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.

4. Color-coded PVC jacket.

E. RG-6/U: NFPA 70, Type CATV or CM.

1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.

3. Jacketed with black PVC or PE.

4. Suitable for indoor installations.

F. RG59/U: NFPA 70, Type CATV.

1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.

3. PVC jacket.

G. RG59/U (Plenum Rated): NFPA 70, Type CMP.

1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.

2. Double shielded with 100 percent aluminum-foil shield and 65 percent aluminum braid.

3. Copolymer jacket.

H. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655 and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV.

2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

3. CATV Riser Rated: Type CATVR, complying with UL 1666.

4. CATV Limited Rating: Type CATVX.

2.07 COAXIAL CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Emerson Network Power Connectivity Solutions.

2. Leviton Commercial Networks Division.

3. Siemon Co. (The).

B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.08 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.

1. Metal Faceplate: Stainless steel, complying with requirements in Section 16140 "Wiring Devices."

2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

3. Flush mounting jacks, positioning the cord at a 45-degree angle.

4. Legend: Machine printed, in the field, using adhesive-tape label.

2.09 GROUNDING

A. Comply with requirements in Section 16060 "Grounding and Bonding" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.10 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 16075 "Electrical Identification."

2.11 CABLE MANAGEMENT SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. iTRACS Corporation, Inc.

2. TelSoft Solutions.

B. Description: Computer-based cable management system, with integrated database capabilities.

C. Document physical characteristics by recording the network, TIA/EIA details, and connections between equipment and cable.

D. Information shall be presented in database view, schematic plans, or technical drawings.

1. Microsoft Visio Professional or AutoCAD drawing software shall be used as drawing and schematic plans software.

E. System shall interface with the following testing and recording devices:

1. Direct upload tests from circuit testing instrument into the personal computer.

2. Direct download circuit labeling into labeling printer.

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.

E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.02 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements in Section 16711 "Pathways for Communications Systems."

3. Comply with requirements in Section 16136 "Cable Trays for Communications Systems."

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

2. Install lacing bars and distribution spools.

3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.03 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.

4. MUTOA shall not be used as a cross-connect point.

5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:

a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.

b. Locate consolidation points for UTP at least 49 feet (15 m) from communications equipment room.

6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

12. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.

13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

F. Group connecting hardware for cables into separate logical fields.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.04 FIRESTOPPING

A. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.05 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.06 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

1. Administration Class: 1.

2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.

C. Comply with requirements in Section 09915 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

D. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

F. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.

3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.

b. Label each unit and field within distribution racks and

frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

G. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Visually inspect UTP and cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and

adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

i. Wire map.

ii. Length (physical vs. electrical, and length requirements).

iii. Insertion loss.

iv. Near-end crosstalk (NEXT) loss.

v. Power sum near-end crosstalk (PSNEXT) loss.

vi. Equal-level far-end crosstalk (ELFEXT).

vii. Power sum equal-level far-end crosstalk (PSELFEXT).

viii. Return loss.

ix. Propagation delay.

x. Delay skew.

6. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.

7. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

D. Document data for each measurement. Data for submittals shall be printed

in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.08 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

3.09 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

PART 4 - MEASUREMENT AND PAYMENT

4.01 DATA OUTLET:

A. Data outlets will be measured for at the contract unit price bid per each.

B. Data outlets will be paid per each complete in place, accepted, which price will be full compensation for all material, equipment, tools, labor and all work incidental to complete the item as specified.

END OF SECTION

SECTION 16718

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. UTP cabling.
2. 62.5/125-micrometer, multimode optical fiber cabling.
3. Coaxial cabling.
4. RS-232 cabling.
5. RS-485 cabling.
6. Low-voltage control cabling.
7. Control-circuit conductors.
8. Identification products.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

E. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

F. RCDD: Registered Communications Distribution Designer.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For coaxial cable, include the following installation data for each type used:

a. Nominal OD.

b. Minimum bending radius.

c. Maximum pulling tension.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.

2. Test optical fiber cable on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector; include the loss value of each. Retain test data and include the record in maintenance data.

3. Test each pair of UTP cable for open and short circuits.

1.08 FIELD CONDITIONS

A. Do not install conductors and cables that are wet, moisture damaged, or mold damaged.

1. Indications that wire and cables are wet or moisture damaged include, but are not limited to, discoloration and sagging of factory

packing materials.

B. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 50 or less.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.03 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.

2. AMP Netconnect; a brand of Tyco Electronics Corporation.

3. Belden Inc.

4. Berk-Tek; a Nexans company.

5. CommScope, Inc.

6. Draka Cableteq USA.

7. Genesis Cable Products; Honeywell International, Inc.

8. Mohawk; a division of Belden Networking, Inc.

9. Superior Essex Inc.

10. SYSTIMAX Solutions; a CommScope, Inc. brand.

11. 3M; Communication Markets Division.

B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.

2. Comply with TIA/EIA-568-B.1 for performance specifications.

3. Comply with TIA/EIA-568-B.2, Category 6.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, General Purpose: Type CM or CMG.

b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

c. Communications, Riser Rated: Type CMR, complying with UL 1666.

d. Communications, Limited Purpose: Type CMX.

e. Multipurpose: Type MP or MPG.

f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.04 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.

2. American Technology Systems Industries, Inc.

3. AMP Netconnect; a brand of Tyco Electronics Corporation.

4. Belden Inc.

5. Dynacom Inc.

6. Hubbell Incorporated; Hubbell Premise Wiring.

7. Leviton Commercial Networks Division.

8. Molex Premise Networks; a division of Molex, Inc.

9. Panduit Corp.

10. Siemon.

B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.

C. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.05 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMP Netconnect; a brand of Tyco Electronics Corporation.

2. Belden Inc.

3. Berk-Tek; a Nexans company.

4. CommScope, Inc.

5. Corning Incorporated; Corning Cable Systems.

6. CSI Technologies Inc.

7. General Cable Technologies Corporation.

8. Mohawk; a division of Belden Networking, Inc.

9. Superior Essex Inc.

10. SYSTIMAX Solutions; a CommScope, Inc. brand.

11. 3M; Communication Markets Division.

B. Description: Multimode, 62.5/125-micrometer, (Number of fibers as indicated on the drawings), tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.

2. Comply with TIA/EIA-568-B.3 for performance specifications.

3. Comply with TIA-492AAAB for detailed specifications.

4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:

   a. General Purpose, Nonconductive: Type OFN or OFNG.

   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.

   c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.

   d. General Purpose, Conductive: Type OFC or OFCG.

   e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.

   f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Conductive cable shall be steel armored type.

6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.

7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Orange for 62.5/125-micrometer cable.

2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.

3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches (1000 mm).

2.06 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.

2. American Technology Systems Industries, Inc.

3. Belden Inc.

4. Berk-Tek; a Nexans company.

5. Corning Incorporated; Corning Cable Systems.

6. CSI Technologies Inc.

7. Dynacom Inc.

8. Hubbell Incorporated; Hubbell Premise Wiring.

9. Molex Premise Networks; a division of Molex, Inc.

10. Siemon.

B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA-604-2-B, TIA-604-3-B, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, Type SC connectors. Insertion loss not more than 0.75 dB.

2.07 COAXIAL CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.

2. Belden Inc.

3. Coleman Cable, Inc.

4. CommScope, Inc.

5. Draka Cableteq USA.

B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.

C. RG-11/U: NFPA 70, Type CATV.

1. No. 14 AWG, solid, copper-covered steel conductor.

2. Gas-injected, foam-PE insulation.

3. Double shielded with 100 percent aluminum polyester tape and 60 percent aluminum braid.

4. Jacketed with sunlight-resistant, black PVC or PE.

5. Suitable for outdoor installations in ambient temperatures ranging from minus 40 to plus 85 deg C.

D. RG59/U: NFPA 70, Type CATVR.

1. No. 20 AWG, solid, silver-plated, copper-covered steel conductor.

2. Gas-injected, foam-PE insulation.

3. Triple shielded with 100 percent aluminum polyester tape and 95 percent aluminum braid; covered by aluminum foil with grounding strip.

4. Color-coded PVC jacket.

E. RG-6/U: NFPA 70, Type CATV or CM.

1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.

3. Jacketed with black PVC or PE.

4. Suitable for indoor installations.

F. RG59/U: NFPA 70, Type CATV.

1. No. 20 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.

2. Double shielded with 100 percent aluminum polyester tape and 40 percent aluminum braid.

3. PVC jacket.

G. RG59/U (Plenum Rated): NFPA 70, Type CMP.

1. No. 20 AWG, solid, copper-covered steel conductor; foam fluorinated ethylene propylene insulation.

2. Double shielded with 100 percent aluminum-foil shield and 65

percent aluminum braid.

3. Copolymer jacket.

H. NFPA and UL Compliance: Coaxial cables shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:

1. CATV Cable: Type CATV.

2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.

3. CATV Riser Rated: Type CATVR.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Emerson Network Power Connectivity Solutions; AIM Electronics Brand.

2. Leviton Commercial Networks Division.

3. Siemon.

J. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.08 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.

2. Polypropylene insulation.

3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.

4. PVC jacket.

5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper

conductors.

2. Plastic insulation.

3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.

4. Plastic jacket.

5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

6. Flame Resistance: Comply with NFPA 262.

2.09 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.

2. PVC insulation.

3. Unshielded.

4. PVC jacket.

5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.

2. Fluorinated ethylene propylene insulation.

3. Unshielded.

4. Fluorinated ethylene propylene jacket.

5. Flame Resistance: NFPA 262, Flame Test.

2.10 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. One pair, twisted, No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.

2. PVC insulation.

3. Unshielded.

4. PVC jacket.

5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. One pair, twisted,[No. 16 AWG, stranded (19x29) and No. 18 AWG, stranded (19x30) tinned copper conductors.

2. PVC insulation.

3. Unshielded.

4. PVC jacket.

5. Flame Resistance: Comply with NFPA 262.

2.11 CONTROL-CIRCUIT CONDUCTORS

A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, complying with UL 83, in raceway.

2.12 IDENTIFICATION PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Worldwide, Inc.

2. HellermannTyton North America.

3. Kroy LLC.

4. Panduit Corp.

B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

C. Comply with requirements in Section 16075 "Electrical Identification."

2.13 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.

C. Factory test UTP cables according to TIA/EIA-568-B.2.

D. Factory test multimode optical fiber cables according to TIA-526-14-A and TIA/EIA-568-B.3.

E. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.

F. Cable will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 16073 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.02 WIRING METHOD

A. Install wiring in metal pathways and wireways.

1. Minimum conduit size shall be 3/4 inch (21 mm). Control and data transmission wiring shall not share conduit with other building wiring systems.

2. Comply with requirements in Section 16712 "Pathways for Electronic Safety and Security."

3. Comply with requirements in Section 16136 "Cable Trays for Communication Systems."

B. Install cable, concealed in accessible ceilings, walls, and floors when possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

2. Install lacing bars and distribution spools.

3. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer.

4. Install conductors parallel with or at right angles to sides and back of enclosure.

5. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks.

6. Mark each terminal according to system's wiring diagrams.

7. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. Conductors: Size according to system manufacturer's written instructions unless otherwise indicated.

C. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.

4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

6. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

7. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

8. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

D. UTP Cable Installation: Install using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

1. Comply with TIA/EIA-568-B.2.

2. Install 110-style IDC termination hardware unless otherwise indicated.

3. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

E. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.

2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

F. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.

2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches (915 mm).

G. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1525 mm) apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

H. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.

2. Install cabling after the flooring system has been installed in raised floor areas.

3. Coil cable 72 inches (1830 mm) long shall be neatly coiled not less than 12 inches (300 mm) in diameter below each feed point.

I. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).

   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).

   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (600 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).

   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).

   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (75 mm).

   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Cables and Fluorescent Fixtures: A minimum

of 5 inches (127 mm).

3.04 POWER AND CONTROL-CIRCUIT CONDUCTORS

A. 120-V Power Wiring: Install according to Section 16120 "Conductors and Cables" unless otherwise indicated.

B. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits, No. 14 AWG.

2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.

3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.05 CONNECTIONS

A. Comply with requirements in Section 13720 "Intrusion Detection" for connecting, terminating, and identifying wires and cables.

B. Comply with requirements in Section 13730 "Security Access" for connecting, terminating, and identifying wires and cables.

C. Comply with requirements in Section 13760 "Video Surveillance" for connecting, terminating, and identifying wires and cables.

D. Comply with requirements in "Section 13852 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

E. Comply with requirements in Section 15900 "HVAC Instrumentation and Controls" for connecting, terminating, and identifying wires and cables.

3.06 FIRESTOPPING

A. Comply with requirements in Section 07841 "Through-Penetration Firestop Systems."

B. Comply with TIA-569-B, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.07 GROUNDING

A. For communications wiring, comply with J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. For low-voltage wiring and cabling, comply with requirements in Section 16060 "Grounding and Bonding."

3.08 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

3.09 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

4. Optical Fiber Cable Tests:

   a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

b. Link End-to-End Attenuation Tests:

1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to TIA-526-14-A, Method B, One Reference Jumper.

2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

5. Coaxial Cable Tests: Comply with requirements in Section 16785 "Master Antenna Television System."

D. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

E. End-to-end cabling will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

PART 4: MEASUREMENT AND PAYMENT

4.01 CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY:

A. Conductors and Cables for Electronic Safety and Security will not be measured for payment.

B. Conductors and Cables for Electronic Safety and Security will not be paid directly, but will be included in the lump sum bid prices for maintenance building.

END OF SECTION

SECTION 16722

INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Microprocessor-switchedintercommunications and program systems with the following components:

1. Master stations.
2. Speaker-microphone stations.
3. Call-switch unit.
4. All-call amplifier.
5. Intercommunication amplifier.
6. Paging amplifier.
7. Loudspeakers/speaker microphones.
8. Conductors and cables.
9. Raceways.

1.03 ACTION SUBMITTALS

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

B. Shop Drawings: For intercommunications and program systems. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include scaled drawings for master station that detail built-in equipment.

3. Wiring Diagrams: For power, signal, and control wiring.

   a. Identify terminals to facilitate installation, operation, and maintenance.

   b. Single-line diagram showing interconnection of components.

   c. Cabling diagram showing cable routing.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from Installers of the items involved.

B. Qualification Data: For qualified [Installer] [and] [testing agency].

C. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intercommunications and program systems to include in operation and maintenance manuals. In addition to items specified in Section 01780 "Closeout," include the following:

   1. A record of Owner's equipment-programming option decisions.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.

   1. Testing Agency's Field Supervisor: Certified by NICET as Audio Systems Level III Technician.

   2. Testing Agency's Field Supervisor:

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

1.07 COORDINATION

A. Coordinate layout and installation of ceiling-mounted speaker microphones with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aiphone Corporation.
2. Alpha Communications.
3. Bogen Communications, Inc.
4. Dukane Communication Systems; part of GE Infrastructure, Security.
5. Federal Signal Corporation; Electrical Products Division.
6. Jeron Electronic Systems, Inc.
7. Rauland-Borg Corporation.
8. TOA Electronics, Inc.
9. Zenitel USA; the home of STENTOFON brand products.

2.02 FUNCTIONAL DESCRIPTION OF MANUALLY SWITCHED SYSTEMS

A. Master Station:

1. Communicating selectively with other master and speaker-microphone stations by actuating selector switches.
2. Communicating simultaneously with all other stations by actuating a single all-call switch.
3. Communicating with individual stations in privacy.
4. Including other master-station connections in a multiple-station conference call.
5. Accessing separate paging speakers or groups of paging speakers

by actuating selector switches.

6. Overriding any conversation by a designated master station.

B. Speaker-Microphone Station:

1. Having privacy from remote monitoring without a warning tone signal at monitored station. Designated speaker-microphone stations have a privacy switch to prevent another station from listening and to permit incoming calls.

2. Communicating hands free.

3. Calling master station by actuating call switch.

4. Returning a busy signal to indicate that station is already in use.

5. Being free of noise and distortion during operation and when in standby mode.

C. Speakers: Free of noise and distortion during operation and when in standby mode.

2.03 FUNCTIONAL DESCRIPTION OF MICROPROCESSOR-SWITCHED SYSTEMS

A. Master Station:

1. Communicating selectively with other master and speaker-microphone stations by dialing station's number on a 12-digit keypad.

2. Communicating simultaneously with all other stations by dialing a designated number on a 12-digit keypad.

3. Communicating with individual stations in privacy.

4. Including other master-station connections in a multiple-station conference call.

5. Accessing separate paging speakers or groups of paging speakers by dialing designated numbers on a 12-digit keypad.

6. Overriding any conversation by a designated master station.

7. Displaying selected station.

B. Speaker-Microphone Station:

1. Having privacy from remote monitoring without a warning tone signal at monitored station. Designated speaker-microphone stations have a privacy switch to prevent another station from listening and to permit incoming calls.

2. Communicating hands free.

3. Calling master station by actuating call switch.

4. Returning a busy signal to indicate that station is already in use.

5. Being free of noise and distortion during operation and when in standby mode.

C. Speakers: Free of noise and distortion during operation and when in standby mode.

2.04 GENERAL REQUIREMENTS FOR EQUIPMENT AND MATERIALS

A. Coordinate features and select components to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Expansion Capability: Increase number of stations in the future by 25 percent above those indicated without adding any internal or external components or main trunk cable conductors.

C. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

D. Weather-Resistant Equipment: Listed and labeled by an NRTL for duty outdoors or in damp locations.

2.05 MASTER STATION FOR MICROPROCESSOR-SWITCHED SYSTEMS

A. 12-Digit Keypad Selector: Transmits calls to other stations and initiates commands for programming and operation.

B. Volume Control: Regulates incoming-call volume.

C. LED Annunciation: Identifies calling stations and stations in use. LED remains on until call is answered.

D. Tone Annunciation: Momentary audible tone signal announces incoming calls.

E. Handset with Hook Switch: Telephone type with 18-inch- (450-mm-) long, permanently coiled cord. Arrange to disconnect speaker when

handset is lifted.

F. Reset Control: Cancels call and resets system for next call.

G. Equipment Cabinet: Comply with TIA/EIA-310-D. Lockable, ventilated metal cabinet houses terminal strips, power supplies, amplifiers, system volume control, and other switching and control devices required for conversation channels and control functions.

2.06 SPEAKER-MICROPHONE STATIONS

A. Mounting: Flush unless otherwise indicated, and suitable for mounting conditions indicated.

B. Faceplate: Stainless steel or anodized aluminum with tamperproof mounting screws.

C. Back Box: Two-gang galvanized steel with 2-1/2-inch (64-mm) minimum depth.

D. Speaker: 3 inches (76 mm), 2.3 oz. (65 g) minimum; permanent magnet.

E. Tone Annunciation: Recurring momentary tone indicates incoming calls.

F. Call Switch: Mount on faceplate. Permits calls to master station.

G. Privacy Switch: Mount on faceplate. When in on position, switch prevents transmission of sound from remote station to system; when in off position, without further switch manipulation, response can be made to incoming calls.

H. Handset with Hook Switch: Telephone type with 18-inch- (450-mm-) long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.

2.07 CALL-SWITCH UNIT

A. Enclosure: Single-gang box with stainless-steel faceplate.

B. Call Switch: Momentary contact signals system that a call has been placed.

C. Privacy Switch: Prevents transmission of sound signals from station to system.

D. Volume Control: Operated by screwdriver blade through a hole in faceplate to adjust output level of associated speaker.

E. Handset with Hook Switch: Telephone type with 18-inch- (450-mm-)

long, permanently coiled cord. Arrange to disconnect speaker when handset is lifted.

2.08 ALL-CALL AMPLIFIER

A. Output Power: 70-V balanced line. 80 percent of the sum of wattage settings of connected for each station and speaker connected in all-call mode of operation, plus an allowance for future stations.

B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to quantity of stations connected in all-call mode of operation.

C. Minimum Signal-to-Noise Ratio: 45 dB, at rated output.

D. Frequency Response: Within plus or minus 3 dB from 70 to 12,000 Hz.

E. Output Regulation: Maintains output level within 2 dB from full to no load.

F. Input Sensitivity: Compatible with master stations and central equipment so amplifier delivers full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations, speaker microphones, or handset transmitters.

G. Amplifier Protection: Prevents damage from shorted or open output.

2.09 INTERCOMMUNICATION AMPLIFIER

A. Minimum Output Power: 2 W ; adequate for all functions.

B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to one station connected to output terminals.

C. Minimum Signal-to-Noise Ratio: 45 dB, at rated output.

D. Frequency Response: Within plus or minus 3 dB from 70 to 10,000 Hz.

E. Output Regulation: Maintains output level within 2 dB from full to no load.

F. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on master stations, speaker microphones, or handset transmitters.

G. Amplifier Protection: Prevents damage from shorted or open output.

2.10 PAGING AMPLIFIER

A. Input Voltage: 120-V ac, 60 Hz.

B. Frequency Response: Within plus or minus 3 dB from 60 to 10,000 Hz.

C. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.

D. Total Harmonic Distortion: Less than 3 percent at rated power output from 70 to 12,000 Hz.

E. Output Regulation: Less than 2 dB from full to no load.

F. Controls: On-off, input levels, and low-cut filter.

G. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on speaker microphones or handset transmitters.

H. Amplifier Protection: Prevents damage from shorted or open output.

I. Output Circuit: 70-V line.

2.11 CONE-TYPE LOUDSPEAKERS/SPEAKER MICROPHONES

A. Minimum Axial Sensitivity: 91 dB at one meter, with 1-W input.

B. Frequency Response: Within plus or minus 3 dB from 70 to 15,000 Hz.

C. Minimum Dispersion Angle: 100 degrees.

D. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.

E. Enclosures: Steel housings or back boxes, acoustically dampened, with front face of at least 0.0478-inch (1.2-mm) steel and whole assembly rust proofed and factory primed; complete with mounting assembly and suitable for surface ceiling, flush ceiling, pendant or wall mounting; with relief of back pressure.

F. Baffle: For flush speakers, minimum thickness of 0.032-inch (0.8-mm) aluminum brushed to a satin sheen and lacquered.

G. Vandal-Proof, High-Strength Baffle: For surface-mounted speakers, self-aging cast aluminum with tensile strength of 44,000 psi (303 MN/sq. m), 0.025-inch (0.65-mm) minimum thickness; countersunk heat-treated alloy mounting screws; and textured white epoxy finish.

H. Size: 8 inches (200 mm) with 1-inch (25-mm) voice coil and minimum 5-

oz. (140-g) ceramic magnet.

2.12 HORN-TYPE LOUDSPEAKERS/SPEAKER MICROPHONES

A. Speakers shall be all-metal, weatherproof construction; complete with universal mounting brackets.

B. Frequency Response: Within plus or minus 3 dB from 275 to 14,000 Hz.

C. Minimum Power Rating of Driver: 15 W, continuous.

D. Minimum Dispersion Angle: 110 degrees.

E. Line Transformer: Maximum insertion loss of 0.5 dB, power rating equal to speaker's, and at least four level taps.

2.13 HORN-TYPE EXPLOSION-PROOF LOUDSPEAKERS

A. Speakers shall be all-metal construction; complete with universal mounting brackets.

B. Units in Hazardous (Classified) Locations: Listed and labeled for environment in which they are located.

C. Frequency Response: Within plus or minus 3 dB from 300 to 12,000 Hz.

D. Minimum Power Rating of Driver: 60 W, continuous.

E. Minimum Dispersion Angle: 60 by 120 degrees.

F. Line Transformer: Internally mounted and factory installed, power rating equal to speaker's, and at least four level taps.

2.14 CONDUCTORS AND CABLES

A. Conductors: Jacketed, twisted pair and twisted multipair, untinned solid copper. Sizes as recommended by system manufacturer, but no smaller than No. 22 AWG.

B. Insulation: Thermoplastic, not less than 1/32 inch (0.8 mm) thick.

C. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG, tinned, soft-copper strands formed into a braid or equivalent foil.

1. Minimum Shielding Coverage on Conductors: 60 percent.

D. Plenum Cable: Listed and labeled for plenum installation.

2.15 RACEWAYS

A. Intercommunication and Program System Raceways and Boxes: Comply with requirements in Section 16130 "Raceways and Boxes."

B. Intercommunication and Program System Raceways and Boxes: Same as required for electrical branch circuits specified in Section 16130 "Raceways and Boxes."

C. Intercommunication and Program System Raceways and Boxes: EMT

D. Outlet boxes shall be not less than 2 inches (50 mm) wide, 3 inches (75 mm) high, and 2-1/2 inches (64 mm) deep.

E. Flexible metal conduit is prohibited.

PART 3 - EXECUTION

3.01 WIRING METHODS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters, and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

2. Comply with requirements for raceways and boxes specified in Section 16130 "Raceways and Boxes."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF RACEWAYS

A. Comply with requirements in Section 16130 "Raceways and Boxes" for installation of conduits and wireways.

B. Install manufactured conduit sweeps and long-radius elbows whenever possible.

3.03 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements:

1. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at outlets and terminals.

2. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Cables may not be spliced.

3. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

5. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

6. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunication spaces with terminating hardware and interconnection equipment.

2. Suspend speaker cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceiling by cable supports not more than 60 inches (1524 mm) apart.

3. Cable shall not be run through structural members or be in contact with pipes, ducts, or other potentially damaging items.

D. Separation of Wires: Separate speaker-microphone, line-level, speaker-level, and power wiring runs. Install in separate raceways or, where exposed or in same enclosure, separate conductors at least 12 inches (300 mm) apart for speaker microphones and adjacent parallel power and telephone wiring. Separate other intercommunication equipment conductors as recommended by equipment manufacturer.

3.04 INSTALLATION

A. Match input and output impedances and signal levels at signal interfaces.

Provide matching networks where required.

B. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

C. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

D. Speaker-Line Matching Transformer Connections: Make initial connections using tap settings indicated on Drawings.

E. Connect wiring according to Section 16120 "Conductors and Cables."

3.05 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Section 16060 "Grounding and Bonding."

3.06 SYSTEM PROGRAMMING

A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Schedule tests with at least seven days' advance notice of test performance.

2. After installing intercommunications and program systems and after electrical circuitry has been energized, test for compliance with requirements.

3. Operational Test: Test originating station-to-station, all-call, and page messages at each intercommunication station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.

4. Frequency Response Test: Determine frequency response of two transmission paths, including all-call and paging, by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.

5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:

   a. Disconnect speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure signal-to-noise ratio at paging speakers.

   b. Repeat test for four speaker microphones and for each separately controlled zone of paging loudspeakers.

   c. Minimum acceptable ratio is 35 dB.

6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each paging and all-call amplifier, and a minimum of two selected intercommunication amplifiers. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.

7. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at three locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB; in levels between adjacent zones, plus or minus 5 dB.

8. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and

2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.

9. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Section 16060 "Grounding and Bonding."

E. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

F. Intercommunications and program systems will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.08 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

2. Complete installation and startup checks according to manufacturer's written instructions.

3.09 ADJUSTING

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the intercommunications and program systems.

1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.

PART 4 - MEASUREMENT AND PAYMENT

4.01 INTERCOMMUNICATIONS AND PROGRAM SYSTEMS

A. Intercommunications and program systems will not be measured for payment.

B. Intercommunications and program systems will not be paid for directly, but will be included in the lump sum bid price for Maintenance Building.

END OF SECTION

APPENDIX A

LIST OF CONTRACT DRAWINGS

T-0705-0140

KIRK BUS DIVISION MODERNIZATION - PHASE 1

APPENDIX A
CONTRACT NO. T-0705-0140
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4	C0001	CIVIL ABBREVIATIONS, SYMBOLS AND NOTES
5	V0101	PROPERTY AND RIGHT OF WAY PLAN
6	V0102	EXISTING CONDITIONS PLAN
7	B0101	GEOTECHNICAL BORING LOCATION PLAN
8	C1101	DEMOLITION PLAN
9	C2101	MAINTENANCE OF TRAFFIC (VEHICULAR)
10	C2102	MAINTENANCE OF TRAFFIC (PEDESTRIAN)
11	C3101	GRADING PLAN
12	C3102	SITE PLAN
13	C3103	PAVING PLAN
14	C3104	PROPOSED UTILITY PLAN
15	C3501	TYPICAL SECTIONS AND DETAILS
16	C3502	TYPICAL SECTIONS AND DETAILS
17	C4101	WATER SERVICE PLAN
18	C4102	SEWER SERVICE PLAN
19	C4501	STORM DRAIN PROFILES
20	C4502	STORM DRAIN PROFILES
21	C4503	STORMWATER MANAGEMENT DETAILS
22	C4504	STORMWATER MANAGEMENT DETAILS
23	C4505	STORMWATER MANAGEMENT DETAILS
24	C4506	STORMWATER MANAGEMENT NOTES
25	C4601	STORM DRAIN PIPE & STRUCTURE SCHEDULES
26	C5001	EROSION AND SEDIMENT CONTROL NOTES
27	C5002	EROSION AND SEDIMENT CONTROL NOTES
28	C5101	EROSION AND SEDIMENT CONTROL PLAN
29	C5102	EROSION AND SEDIMENT CONTROL PLAN
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31	C5502	EROSION AND SEDIMENT CONTROL DETAILS
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CONTRACT NO. T-0705-0140

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49	A2111	SECOND FLOOR - SEGMENT B
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51	A2120	MECHANICAL MEZZANINE PLAN
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62	A2141	REFLECTED CEILING PLAN-SEGMENT A
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67	A2146	REFLECTED CEILING PLAN-SEGMENT F
68	A2150	REFLECTED CEILING PLAN - SEGMENT B
69	A2151	REFLECTED CEILING PLAN - SEGMENT F
70	A2160	REFLECTED CEILING PLAN - SEGMENT B
71	A2161	REFLECTED CEILING PLAN - SEGMENT D
72	A2162	REFLECTED CEILING PLAN - SEGMENT F
73	A2170	FIRST FLOOR PAVEMENT MARKINGS PLAN
74	A2201	BUILDING ELEVATIONS
75	A2202	PARTIAL ELEVATION - NORTH
76	A2203	PARTIAL ELEVATION - SOUTH
77	A2204	PARTIAL ELEVATION - EAST

78	A2205	PARTIAL ELEVATION - WEST
79	A2301	BUILDING SECTIONS
80	A2302	BUILDING SECTIONS
81	A2303	PARTIAL BUILDING SECTIONS
82	A2304	PARTIAL BUILDING SECTIONS
83	A2305	PARTIAL BUILDING SECTIONS
84	A2306	PARTIAL BUILDING SECTIONS
85	A2307	PARTIAL BUILDING SECTIONS
86	A2308	PARTIAL BUILDING SECTIONS
87	A2309	PARTIAL BUILDING SECTIONS
88	A2310	PARTIAL BUILDING SECTIONS
89	A2311	PARTIAL BUILDING SECTIONS
90	A2312	PARTIAL BUILDING SECTIONS
91	A2313	PARTIAL BUILDING SECTIONS
92	A2320	WALL SECTIONS
93	A2321	WALL SECTIONS
94	A2322	WALL SECTIONS
95	A2323	WALL SECTIONS
96	A2324	WALL SECTIONS
97	A2325	WALL SECTIONS
98	A2326	WALL SECTIONS
99	A2327	WALL SECTIONS
100	A2330	SECTION DETAILS
101	A2331	SECTION DETAILS
102	A2401	PLAN DETAILS
103	A2402	PLAN DETAILS
104	A2403	PLAN DETAILS
105	A2404	PLAN DETAILS
106	A2405	ROOF DETAILS
107	A2406	ROOF DETAILS
108	A2407	ROOF DETAILS
109	A2408	ROOF DETAILS
110	A2501	ENLARGED PLANS, SECTIONS AND ELEVATIONS
111	A2502	ENLARGED PLANS, SECTIONS AND ELEVATIONS
112	A2503	ENLARGED PLANS, SECTIONS AND ELEVATIONS
113	A2504	ENLARGED PLANS, SECTIONS AND ELEVATIONS
114	A2505	ENLARGED PLANS, SECTIONS AND ELEVATIONS
115	A2506	ENLARGED PLANS, SECTIONS AND ELEVATIONS
116	A2507	ENLARGED PLANS, SECTIONS AND DETAILS
117	A2601	ENLARGED STAIR PLANS AND SECTIONS
118	A2602	ENLARGED STAIR PLANS AND SECTIONS
119	A2603	ENLARGED ELEVATOR PLANS AND SECTIONS
120	A2604	STAIR AND RAILING DETAILS
121	A2701	ENLARGED TOILET ROOM PLANS
122	A2702	ENLARGED TOILET ROOM ELEVATIONS

123	A2801	PARTITION SCHEDULE
124	A2802	PARTITION SCHEDULE
125	A2803	PARTITION DETAILS
126	A2804	DOOR SCHEDULE
127	A2805	DOOR DETAILS
128	A2806	DOOR DETAILS
129	A2810	WINDOW ELEVATIONS
130	A2811	WINDOW ELEVATIONS
131	A2812	LOUVER ELEVATIONS
132	A2813	WINDOW DETAILS
133	A2901	FIRST FLOOR INTERIORS PLAN - SEGMENT D, F
134	A2902	SECOND FLOOR INTERIORS PLAN - SEGMENT F
135	A2910	INTERIOR ELEVATIONS
136	A2911	SECOND FLOOR INTERIOR ELEVATIONS
137	A2920	CASEWORK SECTIONS
138	A2921	INTERIOR ARCHITECTURAL DETAILS
139	A2930	FINISH SCHEDULE

Sheet Number	Drawing Number	STRUCTURAL
140	S2001	GENERAL NOTES AND ABBREVIATION 1 OF 3
141	S2002	GENERAL NOTES AND ABBREVIATION 2 OF 3
142	S2003	GENERAL NOTES AND ABBREVIATION 3 OF 3
143	S2100	OVERALL FIRST FLOOR PLAN
144	S2100A	OVERALL FIRST FLOOR PART PLAN
145	S2101	FIRST FLOOR FOUNDATION PLAN - SEGMENT A
146	S2102	FIRST FLOOR FOUNDATION PLAN - SEGMENT B
147	S2103	FIRST FLOOR FOUNDATION PLAN - SEGMENT C
148	S2104	FIRST FLOOR FOUNDATION PLAN - SEGMENT D
149	S2105	FIRST FLOOR FOUNDATION PLAN - SEGMENT E
150	S2106	FIRST FLOOR FOUNDATION PLAN - SEGMENT F
151	S2107	WALL FOUNDATION PLAN - SEGMENT A
152	S2108	WALL FOUNDATION PLAN - SEGMENT B
153	S2109	WALL FOUNDATION PLAN - SEGMENT C
154	S2110	WALL FOUNDATION PLAN - SEGMENT D
155	S2111	WALL FOUNDATION PLAN - SEGMENT E
156	S2112	WALL FOUNDATION PLAN - SEGMENT F
157	S2113	FIRST FLOOR SLAB PLAN - SEGMENT A
158	S2114	FIRST FLOOR SLAB PLAN - SEGMENT B
159	S2115	FIRST FLOOR SLAB PLAN - SEGMENT C
160	S2116	FIRST FLOOR SLAB PLAN - SEGMENT D
161	S2117	FIRST FLOOR SLAB PLAN - SEGMENT E
162	S2118	FIRST FLOOR SLAB PLAN - SEGMENT F
163	S2120	OVERALL SECOND FLOOR PLAN

164	S2121	2ND FLOOR FOUNDATION PLAN - SEGMENT B
165	S2122	SECOND FLOOR FRAMING PLAN - SEGMENT F
166	S2130	OVERALL ROOF PLAN
167	S2131	OVERALL ROOF FRAMING PLAN - SEGMENT A
168	S2132	OVERALL ROOF FRAMING PLAN - SEGMENT B
169	S2133	OVERALL ROOF FRAMING PLAN - SEGMENT C
170	S2134	OVERALL ROOF FRAMING PLAN - SEGMENT D
171	S2135	OVERALL ROOF FRAMING PLAN - SEGMENT E
172	S2136	OVERALL ROOF FRAMING PLAN - SEGMENT F
173	S2140	CHASIS BAY AND OFFICE AREA ROOF PLAN
174	S2141	CHASIS BAY ROOF FRMG PLAN - SEGMENT B
175	S2142	OFFICE AREA ROOF FRMG PLAN - SEGMENT F
176	S2150	OVERALL MECHANICAL ROOF PLAN
177	S2151	MECHANICAL ROOF FRMG PLAN - SEGMENT B
178	S2152	MECHANICAL ROOF FRMG PLAN - SEGMENT D
179	S2153	MECHANICAL ROOF FRMG PLAN - SEGMENT F
180	S2200	COLUMN SCHEDULE 1 OF 3
181	S2201	COLUMN SCHEDULE 2 OF 3
182	S2202	COLUMN SCHEDULE 3 OF 3
183	S2203	BRACE FRAME ELEVATIONS 1 OF 2
184	S2204	BRACE FRAME ELEVATIONS 2 OF 2
185	S2205	BRACE FRAME CONNECTION DETAILS
186	S2206	PARTIAL ELEVATIONS 1 OF 3
187	S2207	PARTIAL ELEVATIONS 2 OF 3
188	S2208	PARTIAL ELEVATIONS 3 OF 3
189	S2215	FOUNDATION WALL ELEVATION 1 OF 3
190	S2216	FOUNDATION WALL ELEVATION 2 OF 3
191	S2217	FOUNDATION WALL ELEVATION 3 OF 3
192	S2400	FOUNDATION PART. PLANS 1 of 2
193	S2401	FOUNDATION PART. PLANS 2 of 2
194	S2402	ROOF FRAMING PART. PLANS
195	S2403	STAIR AND ELEVATOR PART. PLANS
196	S2404	MECHANICAL ROOF FRAMING PART. PLAN
197	S2405	UNDERHUNG CRANE DETAILS
198	S2406	UNDERHUNG CRANE FRAMING
199	S2407	UNDERHANG CRANE DETAILS
200	S2408	UNDERHUNG CRANE DETAILS
201	S2409	EXTERIOR WALL SUPPORT DETAILS 1 OF 3
202	S2410	EXT. WALL SUPPORT DETAILS 2 OF 3
203	S2411	EXT. WALL SUPPORT DETAILS 3 OF 3
204	S2412	ME PENTHOUSE SECTIONS AND DETAILS
205	S2413	ME PENTHOUSE STEEL DETAILS
206	S2500	PILE CAP PLANS AND SECTIONS 1 OF 2
207	S2501	PILE CAP PLANS AND SECTIONS 2 OF 2
208	S2502	TYPICAL FOUNDATION DETAILS

209	S2503	PIER PLANS AND DETAILS 1 OF 2
210	S2504	PIER PLANS AND SECTIONS 1 OF 2
211	S2505	GRADE BEAM SCHEDULE AND SECTIONS
212	S2506	GRADE BEAM SECTIONS AND ELEVATIONS
213	S2507	FOUNDATION DETAILS 1 OF 2
214	S2508	FOUNDATION DETAILS 2 OF 2
215	S2509	FOUNDATION DETAILS
216	S2520	FOUNDATION WALL SECTIONS 1 OF 3
217	S2521	FOUNDATION WALL SECTIONS 2 OF 3
218	S2522	FOUNDATION WALL SECTIONS 3 OF 3
219	S2530	STEEL DETAILS 1 OF 4
220	S2531	STEEL DETAILS 2 OF 4
221	S2532	STEEL DETAILS 3 OF 4
222	S2533	STEEL DETAILS 4 OF 4
223	S2534	MISCELLANEOUS DETAILS
224	S2535	EXTERIOR WALL SECTIONS AND DETAILS
225	S2536	EXTERIOR WALL SECTIONS AND DETAILS
226	S2537	EXTERIOR WALL SECTIONS AND DETAILS
227	S2538	EXTERIOR WALL SECTIONS AND DETAILS
228	S2539	EXTERIOR WALL SECTIONS AND DETAILS
229	S2550	CMU DETAILS
230	S2551	CMU DETAILS

Sheet Number	Drawing Number	MECHANICAL EQUIPMENT
231	ME101	FIRST FLOOR - SEGMENT A
232	ME102	FIRST FLOOR - SEGMENT B
233	ME103	FIRST FLOOR - SEGMENT C
234	ME104	FIRST FLOOR - SEGMENT D
235	ME105	FIRST FLOOR - SEGMENT E
236	ME106	FIRST FLOOR - SEGMENT F
237	ME501	EQUIPMENT SCHEDULE
238	ME601	DETAILS SHEET I

Sheet Number	Drawing Number	MECHANICAL
239	M2001	LEGEND AND ABBREVIATIONS
240	M2002	MECHANICAL SITE PLAN
241	M2003	MECHANICAL FOUNDATION PLAN
242	M2101	FIRST FLOOR - SEGMENT A
243	M2102	FIRST FLOOR - SEGMENT B
244	M2103	FIRST FLOOR - SEGMENT C
245	M2104	FIRST FLOOR - SEGMENT D

246	M2105	FIRST FLOOR - SEGMENT E
247	M2106	FIRST FLOOR - SEGMENT F
248	M2111	SECOND FLOOR - SEGMENT A
249	M2112	SECOND FLOOR - SEGMENT B
250	M2113	SECOND FLOOR - SEGMENT C
251	M2114	SECOND FLOOR - SEGMENT D
252	M2115	SECOND FLOOR - SEGMENT E
253	M2116	SECOND FLOOR - SEGMENT F
254	M2121	MECHANICAL MEZZANINE - SEGMENT B
255	M2122	MECHANICAL MEZZANINE - SEGMENT D
256	M2123	MECHANICAL MEZZANINE - SEGMENT F
257	M2134	ROOF PLAN - SEGMENT A
258	M2135	ROOF PLAN - SEGMENT B
259	M2136	ROOF PLAN - SEGMENT C
260	M2137	ROOF PLAN - SEGMENT D
261	M2138	ROOF PLAN - SEGMENT E
262	M2139	ROOF PLAN - SEGMENT F
263	M2201	MECHANICAL PIPING SCHEMATICS I
264	M2202	MECHANICAL PIPING SCHEMATICS II
265	M2301	MECHANICAL SECTIONS I
266	M2302	MECHANICAL SECTIONS II
267	M2401	MECHANICAL PART PLANS I
268	M2402	MECHANICAL PART PLANS II
269	M2501	DETAILS SHEET I
270	M2502	DETAILS SHEET II
271	M2503	DETAILS SHEET III
272	M2504	DETAILS SHEET IV
273	M2505	DETAILS SHEET V
274	M2506	DETAILS SHEET VI
275	M2601	SCHEDULES I
276	M2602	SCHEDULES II
277	M2603	SCHEDULES III
278	M2604	SCHEDULES IV
279	M2701	CONTROLS I
280	M2702	CONTROLS II
281	M2703	CONTROLS III
282	M2704	CONTROLS IV
283	M2705	CONTROLS V

Sheet Number	Drawing Number	ELECTRICAL
284	E0001	ELECTRICAL LEGEND
285	E0002	LEGENDS, ABBREVIATIONS, & NOTES
286	E0003	ELECTRICAL OVERALL SITE PLAN

287	E0004	FIRST FLOOR - OVERALL ELECTRICAL PLAN
288	E0005	SECOND FLOOR OVERALL - ELECTRICAL PLAN
289	E0006	MEZZANINE OVERALL - ELECTRICAL PLAN
290	E0007	SITE LIGHTING
291	E2101	FIRST FLOOR - LIGHTING PLAN - SEGMENT A
292	E2102	FIRST FLOOR - LIGHTING PLAN - SEGMENT B
293	E2103	FIRST FLOOR - LIGHTING PLAN - SEGMENT C
294	E2104	FIRST FLOOR - LIGHTING PLAN - SEGMENT D
295	E2105	FIRST FLOOR - LIGHTING PLAN - SEGMENT E
296	E2106	FIRST FLOOR - LIGHTING PLAN - SEGMENT F
297	E2107	SECOND FLOOR-LIGHTING PLAN-SEGMENT A
298	E2108	SECOND FLOOR-LIGHTING PLAN-SEGMENT B
299	E2109	SECOND FLOOR-LIGHTING PLAN-SEGMENT C
300	E2110	SECOND FLOOR-LIGHTING PLAN-SEGMENT D
301	E2111	SECOND FLOOR-LIGHTING PLAN- SEGMENT E
302	E2112	SECOND FLOOR-LIGHTING PLAN-SEGMENT F
303	E2113	MEZZANINE - LIGHTING PLAN - SEGMENT B
304	E2114	MEZZANINE - LIGHTING PLAN - SEGMENT D
305	E2115	MEZZANINE - LIGHTING PLAN - SEGMENT F
306	E2201	FIRST FLOOR - POWER PLAN - SEGMENT A
307	E2202	FIRST FLOOR - POWER PLAN - SEGMENT B
308	E2203	FIRST FLOOR - POWER PLAN - SEGMENT C
309	E2204	FIRST FLOOR - POWER PLAN - SEGMENT D
310	E2205	FIRST FLOOR - POWER PLAN - SEGMENT E
311	E2206	FIRST FLOOR - POWER PLAN - SEGMENT F
312	E2207	SECOND FLOOR - POWER PLAN - SEGMENT B
313	E2208	SECOND FLOOR - POWER PLAN - SEGMENT F
314	E2209	MEZZANINE - POWER PLAN - SEGMENT B
315	E2210	MEZZANINE - POWER PLAN - SEGMENT C
316	E2211	MEZZANINE - POWER PLAN - SEGMENT D
317	E2212	MEZZANINE - POWER PLAN - SEGMENT E
318	E2213	MEZZANINE - POWER PLAN - SEGMENT F
319	E2301	FIRST FLOOR - SP. SYSTEMS - SEGMENT A
320	E2302	FIRST FLOOR - SP. SYSTEMS - SEGMENT B
321	E2303	FIRST FLOOR - SP. SYSTEMS - SEGMENT C
322	E2304	FIRST FLOOR - SP. SYSTEMS - SEGMENT D
323	E2305	FIRST FLOOR - SP. SYSTEMS - SEGMENT E
324	E2306	FIRST FLOOR - SP. SYSTEMS - SEGMENT F
325	E2307	SECOND FLOOR - SP. SYSTEMS - SEGMENT B
326	E2308	SECOND FLOOR - SP. SYSTEMS - SEGMENT F
327	E2309	MEZZANINE - SP. SYSTEMS - SEGMENT B
328	E2310	MEZZANINE - SP. SYSTEMS - SEGMENT D
329	E2311	MEZZANINE - SP. SYSTEMS - SEGMENT F
330	E2401	LIGHTNING PROTECTION - SEGMENT A
331	E2402	LIGHTNING PROTECTION - SEGMENT B

332	E2403	LIGHTNING PROTECTION - SEGMENT C
333	E2404	LIGHTNING PROTECTION - SEGMENT D
334	E2405	LIGHTNING PROTECTION - SEGMENT E
335	E2406	LIGHTNING PROTECTION - SEGMENT F
336	E4001	ELECTRICAL RISER DIAGRAM
337	E4002	VOICE / DATA DETAILS
338	E4003	FIRE ALARM RISER DIAGRAM & MATRIX
339	E4004	CCTV RISER DIAGRAM & LIGHTING DETAILS
340	E5001	LIGHTING FIXTURE SCHEDULE
341	E5002	PANEL SCHEDULES I
342	E5003	PANEL SCHEDULES II
343	E5004	PANEL SCHEDULES III
344	E5005	PANEL SCHEDULES IV
345	E5006	PANEL SCHEDULES V
346	E5007	PANEL SCHEDULES VI
347	E5008	PANEL SCHEDULES VII
348	E5009	PANEL SCHEDULES VIII
349	E5010	PANEL SCHEDULES IX
350	E5011	PANEL SCHEDULES X
351	E5012	PANEL SCHEDULES XI
352	E5013	FIRE ALARM ANNUCIATOR PANEL
353	E6001	SECURITY DETAILS
354	E6002	LIGHTNING PROTECTION DETAILS
355	E6003	ELECTRICAL AND ELEVATOR ROOM DETAILS
356	E6004	ELECTRICAL AND IT ROOM DETAILS
357	E6005	FLUID MANAGEMENT SYSTEM
358	E6006	ELECTRICAL DETAILS I
359	E6007	ELECTRICAL DETAILS II
360	E6008	ELECTRICAL DETAILS III
361	E6009	ELECTRICAL DETAILS IV
362	E6010	ELECTRICAL DETAILS V
363	E6011	LIGHTING CONTROLS DETAILS

Sheet Number	Drawing Number	PLUMBING
364	P0001	PLUMBING LEGEND AND ABBREVIATIONS
365	P2101	FOUNDATION - SEGMENT A
366	P2102	FOUNDATION - SEGMENT B
367	P2103	FOUNDATION - SEGMENT C
368	P2104	FOUNDATION - SEGMENT D
369	P2105	FOUNDATION - SEGMENT E
370	P2106	FOUNDATION - SEGMENT F
371	P2111	FIRST FLOOR - SEGMENT A
372	P2112	FIRST FLOOR - SEGMENT B

373	P2113	FIRST FLOOR - SEGMENT C
374	P2114	FIRST FLOOR - SEGMENT D
375	P2115	FIRST FLOOR - SEGMENT E
376	P2116	FIRST FLOOR - SEGMENT F
377	P2121	SECOND FLOOR - SEGMENT A
378	P2122	SECOND FLOOR - SEGMENT B
379	P2123	SECOND FLOOR - SEGMENT C
380	P2124	SECOND FLOOR - SEGMENT D
381	P2125	SECOND FLOOR - SEGMENT E
382	P2126	SECOND FLOOR - SEGMENT F
383	P2131	MEZZANINE - SEGMENT B
384	P2132	MEZZANINE - SEGMENT D
385	P2133	MEZZANINE - SEGMENT F
386	P2141	ROOF PLAN - SEGMENT A
387	P2142	ROOF PLAN - SEGMENT B
388	P2143	ROOF PLAN - SEGMENT C
389	P2144	ROOF PLAN - SEGMENT D
390	P2145	ROOF PLAN- SEGMENT E
391	P2146	ROOF PLAN - SEGMENT F
392	P2301	PART PLAN - FIRST FLOOR
393	P2302	PART PLAN - SECOND FLOOR
394	P2401	RISER DIAGRAM - WATER I
395	P2402	RISER DIAGRAM - WATER II
396	P2403	RISER DIAGRAM - SANITARY I
397	P2404	RISER DIAGRAM - SANITARY II
398	P2405	RISER DIAGRAM - GAS
399	P2406	RISER DIAGRAM - COMPRESSED AIR
400	P2407	RISER DIAGRAM - LUBE SYSTEMS
401	P2501	PLUMBING SCHEDULES
402	P2601	PLUMBING DETAILS I
403	P2602	PLUMBING DETAILS II

Sheet Number	Drawing Number	FIRE PROTECTION
404	F0001	FIRST FLOOR PLAN
405	F0002	SECOND FLOOR PLAN
406	F0003	THIRD FLOOR PLAN
407	F0004	FIRE PROTECTION - DETAILS I

APPENDIX B

CONTRACT NO. T-0705-0140

NOT IN USE

APPENDIX C

CONTRACT NO. T-0705-0140

FEDERAL MINIMUM WAGE RATES

APPENDIX C

FEDERAL WAGE RATES

This Appendix contains the minimum wage rates to be paid for workers employed under this Contract on the jobsites in accordance with the supplementary General Provisions and the Wage Rate Decisions as defined below.

1. Wage rates - Decision No. MD130028 shall be used for all work at the Baltimore City sites as described in the Contract documents.

General Decision Number: MD130028 01/11/2013 MD28

Superseded General Decision Number: MD20120052

State: Maryland

Construction Type: Heavy

County: Baltimore City County in Maryland.

HEAVY CONSTRUCTION PROJECTS (including sewer/water construction).

Modification Number	Publication Date
0	01/04/2013
1	01/11/2013

CARP0101-014 07/01/2011

	Rates	Fringes
CARPENTER (Form Work Only).....	$ 24.84	11.00

CARP0101-015 04/01/2011

	Rates	Fringes
MILLWRIGHT.....	$ 27.91	11.25

CARP0101-016 07/01/2011

	Rates	Fringes
PILEDRIVERMAN.....	$ 24.84	11.00

ELEC0024-002 05/02/2012

	Rates	Fringes
ELECTRICIAN.....	$ 34.60	5.25%+13.45

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* ENGI0037-024 10/01/2009

	Rates	Fringes
OPERATOR: Backhoe.....	$ 23.95	11.05+a
OPERATOR: Bobcat/Skid Steer/Skid Loader.....	$ 23.05	11.05+a
OPERATOR: Bulldozer.....	$ 23.95	11.05+a
OPERATOR: Drill.....	$ 23.95	11.05+a
OPERATOR: Excavator 120,000 lbs. and Under.....	$ 23.95	11.05+a
Long and Ultra High Reach Excavators; Excavators Over 120,000 lbs.....	$ 24.95	11.05+a
Mini-Excavators.....	$ 23.05	11.05+a

OPERATOR: Gradall.....$ 24.95 11.05+a
OPERATOR: Grader/Blade.....$ 24.95 11.05+a
OPERATOR: Loader
Front End Loaders 1 1/4
yards and over.....$ 23.95 11.05+a
Front End Loaders 1 Yard
and Under.....$ 23.05 11.05+a
OPERATOR: Mechanic.....$ 23.95 11.05+a
OPERATOR: Paver (Asphalt,
Aggregate, and Concrete).....$ 23.05 11.05+a
OPERATOR: Piledriver.....$ 24.95 11.05+a
OPERATOR: Roller.....$ 23.05 11.05+a

a. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day.

IRON0016-014 04/01/2012

	Rates	Fringes
IRONWORKER, REINFORCING	$ 26.88	17.05

LABO0710-006 04/01/2010

	Rates	Fringes
LABORER: Common or General	$ 15.45	5.41
LABORER: Landscape	$ 15.45	5.41
LABORER: Mason Tender - Cement/Concrete	$ 16.61	5.41

PAIN0051-021 06/01/2012

	Rates	Fringes
PAINTER (Steel)	$ 31.86	8.91
PAINTER: Brush, Roller, and Spray	$ 24.14	8.91

PLAS0891-006 05/01/2010

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER	$ 27.15	9.58

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* PLUM0486-015 04/01/2012

	Rates	Fringes
PLUMBER/PIPEFITTER	$ 36.425	16.09

SUMD2010-067 07/08/2010

	Rates	Fringes
BRICKLAYER	$ 18.70	0.00

CARPENTER, Excludes Form Work....	$ 19.00	2.52
IRONWORKER, STRUCTURAL.....	$ 23.80	11.63
LABORER: Flagger.....	$ 15.71	8.58
LABORER: Grade Checker.....	$ 14.62	3.08
LABORER: Mason Tender - Brick...	$ 15.93	7.83
LABORER: Pipelayer.....	$ 12.85	2.04
OPERATOR: Crane.....	$ 22.00	8.85
OPERATOR: Trackhoe.....	$ 20.47	10.20
TRUCK DRIVER: Dump Truck.....	$ 11.84	0.00

TEAM0311-006 06/01/2012

	Rates	Fringes
TRUCK DRIVER: Lowboy Truck.....	$ 27.66	8.00+a+b

a. PAID HOLIDAYS: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day and Christmas Day.

b. VACATION: Employees with 1 year of service - 1 week paid vacation; 2 years service - 2 weeks paid vacation; 10 years service - 3 weeks paid vacation.

c. HEALTH AND WELFARE: $881 per month

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is union or non-union.

Union Identifiers

An identifier enclosed in dotted lines beginning with characters other than "SU" denotes that the union classification and rate have found to be prevailing for that classification. Example: PLUM0198-005 07/01/2011. The first four letters , PLUM, indicate the international union and the four-digit number, 0198, that follows indicates the local union number or district council number where applicable , i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2011, following these characters is the effective date of the most current negotiated rate/collective bargaining agreement which would be July 1, 2011 in the above example.

Union prevailing wage rates will be updated to reflect any changes in the collective bargaining agreements governing the rates.

0000/9999: weighted union wage rates will be published annually each January.

Non-Union Identifiers

Classifications listed under an "SU" identifier were derived from survey data by computing average rates and are not union rates; however, the data used in computing these rates may include both union and non-union data. Example: SULA2004-007 5/13/2010. SU indicates the rates are not union majority rates, LA indicates the State of Louisiana; 2004 is the year of the survey; and 007 is an internal number used in producing the wage determination. A 1993 or later date, 5/13/2010, indicates the classifications and rates under that identifier were issued as a General Wage Determination on that date.

Survey wage rates will remain in effect and will not change until a new survey is conducted.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour

Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

APPENDIX D

CONTRACT NO. T-0705-0140

BUY AMERICA REQUIREMENTS

Title 49 - Transportation

PART 661—BUY AMERICA REQUIREMENTS

Section Contents

§ 661.1 Applicability.
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§ 661.18 Intentional violations.
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§ 661.21 State Buy America provisions.

Authority: 49 U.S.C. 5323(j) (formerly sec. 165 of the Surface Transportation Assistance Act of 1982 (Pub. L. 97–424); as amended by sec. 337, Pub. L. 100–17; sec. 1048, Pub. L. 102–240; sec. 3020(b), Pub. L. 105–178; and sec. 3023(i) and (k), Pub. L. 109–59); 49 CFR 1.51.

Source: 56 FR 932, Jan. 9, 1991, unless otherwise noted.

§ 661.1 Applicability.

Unless otherwise noted, this part applies to all federally assisted procurements using funds authorized by 49 U.S.C. 5323(j); 23 U.S.C. 103(e)(4); and section 14 of the National Capital Transportation Act of 1969, as amended.

[56 FR 932, Jan. 9, 1991, as amended at 72 FR 53696, Sept. 20, 2007]

§ 661.3 Definitions.

As used in this part:

Act means the Federal Public Transportation Law (49 U.S.C. Chapter 53).

Administrator means the Administrator of FTA, or designee.

Component means any article, material, or supply, whether manufactured or unmanufactured, that is directly incorporated into the end product at the final assembly location.

Contractor means a party to a third party contract other than the grantee.

End product means any vehicle, structure, product, article, material, supply, or system, which directly incorporates constituent components at the final assembly location, that is acquired for public use under a federally-funded third-party contract, and which is ready to provide its

intended end function or use without any further manufacturing or assembly change(s). A list of representative end products is included at Appendix A to this section.

FTA means the Federal Transit Administration.

Grantee means any entity that is a recipient of FTA funds.

Manufactured product means an item produced as a result of the manufacturing process.

Manufacturing process means the application of processes to alter the form or function of materials or of elements of the product in a manner adding value and transforming those materials or elements so that they represent a new end product functionally different from that which would result from mere assembly of the elements or materials.

Negotiated procurement means a contract awarded using other than sealed bidding procedures.

Rolling stock means transit vehicles such as buses, vans, cars, railcars, locomotives, trolley cars and buses, and ferry boats, as well as vehicles used for support services.

System means a machine, product, or device, or a combination of such equipment, consisting of individual components, whether separate or interconnected by piping, transmission devices, electrical cables or circuitry, or by other devices, which are intended to contribute together to a clearly defined function. Factors to consider in determining whether a system constitutes an end product include: Whether performance warranties apply to an integrated system (regardless of whether components are separately warranteed); whether products perform on an integrated basis with other products in a system, or are operated independently of associated products in the system; or whether transit agencies routinely procure a product separately (other than as replacement or spare parts).

United States means the several States, the Commonwealth of Puerto Rico, the District of Columbia, Guam, American Samoa, the U.S. Virgin Islands, and the Commonwealth of the Northern Mariana Islands.

Appendix A to §661.3—End Products

The following is a list of representative end products that are subject to the requirements of Buy America. This list is representative, not exhaustive.

(1) *Rolling stock end products:* All individual items identified as rolling stock in §661.3 (*e.g.,* buses, vans, cars, railcars, locomotives, trolley cars and buses, ferry boats, as well as vehicles used for support services); train control, communication, and traction power equipment that meets the definition of end product at §661.3 (*e.g.,* a communication or traction power system, including manufactured bimetallic power rail).

(2) *Steel and iron end products:* Items made primarily of steel or iron such as structures, bridges, and track work, including running rail, contact rail, and turnouts.

(3) *Manufactured end products:* Infrastructure projects not made primarily of steel or iron, including structures (terminals, depots, garages, and bus shelters), ties and ballast; contact rail not made primarily of steel or iron; fare collection systems; computers; information systems; security systems; data processing systems; and mobile lifts, hoists, and elevators.

[72 FR 53696, Sept. 20, 2007, as amended at 74 FR 30239, June 25, 2009]

§ 661.5 General requirements.

(a) Except as provided in §661.7 and §661.11 of this part, no funds may be obligated by FTA for a grantee project unless all iron, steel, and manufactured products used in the project are produced in the United States.

(b) All steel and iron manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

(c) The steel and iron requirements apply to all construction materials made primarily of steel or iron and used in infrastructure projects such as transit or maintenance facilities, rail lines, and bridges. These items include, but are not limited to, structural steel or iron, steel or iron beams and columns, running rail and contact rail. These requirements do not apply to steel or iron used as components or subcomponents of other manufactured products or rolling stock, or to bimetallic power rail incorporating steel or iron components.

(d) For a manufactured product to be considered produced in the United States:

(1) All of the manufacturing processes for the product must take place in the United States; and

(2) All of the components of the product must be of U.S. origin. A component is considered of U.S. origin if it is manufactured in the United States, regardless of the origin of its subcomponents.

[61 FR 6302, Feb. 16, 1996, as amended at 74 FR 30239, June 25, 2009]

§ 661.6 Certification requirements for procurement of steel or manufactured products.

If steel, iron, or manufactured products (as defined in §§661.3 and 661.5 of this part) are being procured, the appropriate certificate as set forth below shall be completed and submitted by each bidder or offeror in accordance with the requirement contained in §661.13(b) of this part.

Certificate of Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j)(1), and the applicable regulations in 49 CFR part 661.

Date_____
Signature_____
Company_____
Name_____
Title_____

Certificate of Non-Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j), but it may qualify for an exception to the requirement pursuant to 49 U.S.C. 5323(j)(2), as amended, and the applicable regulations in 49 CFR 661.7.

Date_____
Signature_____
Company_____

Name_____
Title_____

[71 FR 14117, Mar. 21, 2006, as amended at 72 FR 53696, Sept. 20, 2007]

§ 661.7 Waivers.

(a) Section 5323(j)(2) of Title 49 United States Code provides that the general requirements of 49 U.S.C. 5323(j)(1) shall not apply in four specific instances. This section sets out the conditions for the three statutory waivers based on public interest, non-availability, and price-differential. Section 661.11 of this part sets out the conditions for the fourth statutory waiver governing the procurement of rolling stock and associated equipment.

(b) Under the provision of 49 U.S.C. 5323(j)(2)(A), the Administrator may waive the general requirements of 49 U.S.C. 5323(j)(1) if the Administrator finds that their application would be inconsistent with the public interest. In determining whether the conditions exist to grant this public interest waiver, the Administrator will consider all appropriate factors on a case-by-case basis, unless a general exception is specifically set out in this part. When granting a public interest waiver, the Administrator shall issue a detailed written statement justifying why the waiver is in the public interest. The Administrator shall publish this justification in the Federal Register providing the public with a reasonable time for notice and comment of not more than seven calendar days.

(c) Under the provision of 49 U.S.C. 5323(j)(2), the Administrator may waive the general requirements of 49 U.S.C. 5323(j) if the Administrator finds that the materials for which a waiver is requested are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.

(1) It will be presumed that the conditions exist to grant this non-availability waiver if no responsive and responsible bid is received offering an item produced in the United States.

(2) In the case of a sole source procurement, the Administrator will grant this non-availability waiver only if the grantee provides sufficient information which indicates that the item to be procured is only available from a single source or that the item to be procured is not produced in sufficient and reasonably available quantities of a satisfactory quality in the United States.

(3) After contract award, the Administrator may grant a non-availability waiver under this paragraph, in any case in which a bidder or Offeror originally certified compliance with the Buy America requirements in good faith, but can no longer comply with its certification. The Administrator will grant a non-availability waiver only if the grantee provides sufficient evidence that the original certification was made in good faith and that the item to be procured cannot now be obtained domestically due to commercial impossibility or impracticability. In determining whether the conditions exist to grant a post-award non-availability waiver, the Administrator will consider all appropriate factors on a case-by-case basis.

(d) Under the provision of section 165(b)(4) of the Act, the Administrator may waive the general requirements of section 165(a) if the Administrator finds that the inclusion of a domestic item or

domestic material will increase the cost of the contract between the grantee and its supplier of that item or material by more than 25 percent. The Administrator will grant this price-differential waiver if the amount of the lowest responsive and responsible bid offering the item or material that is not produced in the United States multiplied by 1.25 is less than the amount of the lowest responsive and responsible bid offering the item or material produced in the United States.

(e) The four statutory waivers of 49 U.S.C. 5323(j)(2) as set out in this part shall be treated as being separate and distinct from each other.

(f) The waivers described in paragraphs (b) and (c) of this section may be granted for a component or subcomponent in the case of the procurement of the items governed by 49 U.S.C. 5323(j)(2)(C) (requirements for rolling stock). If a waiver is granted for a component or a subcomponent, that component or subcomponent will be considered to be of domestic origin for the purposes of §661.11 of this part.

(g) The waivers described in paragraphs (b) and (c) of this section may be granted for a specific item or material that is used in the production of a manufactured product that is governed by the requirements of §661.5(d) of this part. If such a waiver is granted to such a specific item or material, that item or material will be treated as being of domestic origin.

(h) The provisions of this section shall not apply to products produced in a foreign country if the Secretary, in consultation with the United States Trade Representative, determines that:

(1) That foreign country is party to an agreement with the United States pursuant to which the head of an agency of the United States has waived the requirements of this section; and

(2) That foreign country has violated the terms of the agreement by discriminating against products covered by this section that are produced in the United States and are covered by the agreement.

Appendix A to §661.7—General Waivers

(a) All waivers published in 48 CFR 25.104 which establish excepted articles, materials, and supplies for the Buy American Act of 1933 (41 U.S.C. 10a–d), as the waivers may be amended from time to time, apply to this part under the provisions of §661.7 (b) and (c).

(b) Under the provisions of §661.7 (b) and (c) of this part, a general public interest waiver from the Buy America requirements applies to microprocessors, computers, microcomputers, or software, or other such devices, which are used solely for the purpose of processing or storing data. This general waiver does not extend to a product or device which merely contains a microprocessor or microcomputer and is not used solely for the purpose of processing or storing data.

(c) Under the provisions of §661.7(b) of this part, a general public interest waiver from the Buy America requirements for “small purchases” (as defined in the “common grant rule,” at 49 CFR 18.36(d)) made by FTA grantees with capital, planning, or operating assistance.

[56 FR 932, Jan. 9, 1991, as amended at 60 FR 37928, July 24, 1995, 61 FR 6302, Feb. 16, 1996; 71 FR 14117, Mar. 21, 2006; 72 FR 53697, Sept. 20, 2007; 74 FR 30239, June 25, 2009]

§ 661.9 Application for waivers.

(a) This section sets out the application procedures for obtaining all waivers, except those general exceptions set forth in this part for which individual applications are unnecessary and

those covered by 49 U.S.C. 5323(j)(2)(C). The procedures for obtaining an exception covered by 49 U.S.C. 5323(j)(2)(C) are set forth in §661.11 of this part.

(b) A bidder or Offeror who seeks to establish grounds for an exception must seek the exception, in a timely manner, through the grantee.

(c) Except as provided in paragraph (d) of this section, only a grantee may request a waiver. The request must be in writing, include facts and justification to support the waiver, and be submitted to the Administrator through the appropriate Regional Office.

(d) FTA will consider a request for a waiver from a potential bidder, Offeror, or supplier only if the waiver is being sought under §661.7 (f) or (g) of this part.

(e) The Administrator will issue a written determination setting forth the reasons for granting or denying the exception request. Each request for an exception, and FTA's action on the request, are available for public inspection under the provisions of 49 CFR part 601, subpart C.

[56 FR 932, Jan. 9, 1991, as amended at 71 FR 14117, Mar. 21, 2006; 72 FR 53697, Sept. 20, 2007]

§ 661.11 Rolling stock procurements.

(a) The provisions of §661.5 do not apply to the procurement of buses and other rolling stock (including train control, communication, and traction power equipment), if the cost of components produced in the United States is more than 60 percent of the cost of all components and final assembly takes place in the United States.

(b) The domestic content requirements in paragraph (a) of this section also apply to the domestic content requirements for components set forth in paragraphs (i), (j), and (l) of this section.

(c) A component is any article, material, or supply, whether manufactured or unmanufactured, that is directly incorporated into an end product at the final assembly location.

(d) A component may be manufactured at the final assembly location if the manufacturing process to produce the component is an activity separate and distinct from the final assembly of the end product.

(e) A component is considered to be manufactured if there are sufficient activities taking place to advance the value or improve the condition of the subcomponents of that component; that is, if the subcomponents have been substantially transformed or merged into a new and functionally different article.

(f) Except as provided in paragraph (k) of this section, a subcomponent is any article, material, or supply, whether manufactured or unmanufactured, that is one step removed from a component (as defined in paragraph (c) of this section) in the manufacturing process and that is incorporated directly into a component.

(g) For a component to be of domestic origin, more that 60 percent of the subcomponents of that component, by cost, must be of domestic origin, and the manufacture of the component must take place in the United States. If, under the terms of this part, a component is determined to be

of domestic origin, its entire cost may be used in calculating the cost of domestic content of an end product.

(h) A subcomponent is of domestic origin if it is manufactured in the United States.

(i) If a subcomponent manufactured in the United States is exported for inclusion in a component that is manufactured outside the United States and it receives tariff exemptions under the procedures set forth in 19 CFR 10.11 through 10.24, the subcomponent retains its domestic identity and can be included in the calculation of the domestic content of an end product even if such a subcomponent represents less than 60 percent of the cost of a particular component.

(j) If a subcomponent manufactured in the United States is exported for inclusion in a component manufactured outside the United States and it does not receive tariff exemption under the procedures set forth in 19 CFR 10.11 through 10.24, the subcomponent loses its domestic identity and cannot be included in the calculation of the domestic content of an end product.

(k) Raw materials produced in the United States and then exported for incorporation into a component are not considered to be a subcomponent for the purpose of calculating domestic content. The value of such raw materials is to be included in the cost of the foreign component.

(l) If a component is manufactured in the United States, but contains less than 60 percent domestic subcomponents, by cost, the cost of the domestic subcomponents and the cost of manufacturing the component may be included in the calculation of the domestic content of the end product.

(m) For purposes of this section, except as provided in paragraph (o) of this section:

(1) The cost of a component or a subcomponent is the price that a bidder or Offeror must pay to a subcontractor or supplier for that component or subcomponent. Transportation costs to the final assembly location must be included in calculating the cost of foreign components and subcomponents.

(2) If a component or subcomponent is manufactured by the bidder or Offeror, the cost of the component is the cost of labor and materials incorporated into the component or subcomponent, an allowance for profit, and the administrative and overhead costs attributable to that component or subcomponent under normal accounting principles.

(n) The cost of a component of foreign origin is set using the foreign exchange rate at the time the bidder or Offeror executes the appropriate Buy America certificate.

(o) The cost of a subcomponent that retains its domestic identity consistent with paragraph (j) of this section shall be the cost of the subcomponent when last purchased, f.o.b. United States port of exportation or point of border crossing as set out in the invoice and entry papers or, if no purchase was made, the value of the subcomponent at the time of its shipment for exportation, f.o.b. United States port of exportation or point of border crossing as set out in the invoice and entry papers.

(p) In accordance with 49 U.S.C. 5323(j), labor costs involved in final assembly shall not be included in calculating component costs.

(q) The actual cost, not the bid price, of a component is to be considered in calculating domestic content.

(r) Final assembly is the creation of the end product from individual elements brought together for that purpose through application of manufacturing processes. If a system is being procured as the end product by the grantee, the installation of the system qualifies as final assembly.

(s) [Reserved]

(t) Train control equipment includes, but is not limited to, the following equipment:

(1) Mimic board in central control

(2) Dispatcher's console

(3) Local control panels

(4) Station (way side) block control relay cabinets

(5) Terminal dispatcher machines

(6) Cable/cable trays

(7) Switch machines

(8) Way side signals

(9) Impedance bonds

(10) Relay rack bungalows

(11) Central computer control

(12) Brake equipment

(13) Brake systems

(14) Cab Signaling;

(15) ATO Equipment;

(16) ATP Equipment;

(17) Wayside Transponders;

(18) Trip Stop Equipment;

(19) Wayside Magnets;

(20) Speed Measuring Devices;

(21) Car Axle Counters;

(22) Communication Based Train Control (CBTC).

(u) Communication equipment includes, but is not limited to, the following equipment:

(1) Radios

(2) Space station transmitter and receivers

(3) Vehicular and hand-held radios

(4) PABX telephone switching equipment

(5) PABX telephone instruments

(6) Public address amplifiers

(7) Public address speakers

(8) Cable transmission system cable

(9) Cable transmission system multiplex equipment

(10) Communication console at central control

(11) Uninterruptible power supply inverters/rectifiers

(12) Uninterruptible power supply batteries

(13) Data transmission system central processors

(14) Data transmission system remote terminals

(15) Line printers for data transmission system

(16) Communication system monitor test panel

(17) Security console at central control

(18) Antennas;

(19) Wireless Telemetry Equipment;

(20) Passenger Information Displays;

(21) Communications Control Units;

(22) Communication Control Heads;

(23) Wireless Intercar Transceivers;

(24) Multiplexers;

(25) SCADA Systems;

(26) LED Arrays;

(27) Screen Displays such as LEDs and LCDs for communication systems;

(28) Fiber-optic transmission equipment;

(29) Fiber-optic transmission equipment;

(30) Frame or cell based multiplexing equipment; 13) Communication system network elements.

(v) Traction power equipment includes, but is not limited to the following:

(1) Primary AC switch gear

(2) Primary AC transformer rectifiers

(3) DC switch gear

(4) Traction power console and CRT display system at central control

(5) Bus ducts with buses (AC and DC)

(6) Batteries

(7) Traction power rectifier assemblies

(8) Distribution panels (AC and DC)

(9) Facility step-down transformers

(10) Motor control centers (facility use only)

(11) Battery chargers

(12) Supervisory control panel

(13) Annunciator panels

(14) Low voltage facility distribution switch board

(15) DC connect switches

(16) Negative bus boxes

(17) Power rail insulators

(18) Power cables (AC and DC)

(19) Cable trays

(20) Instrumentation for traction power equipment

(21) Connectors, tensioners, and insulators for overhead power wire systems

(22) Negative drainage boards

(23) Inverters

(24) Traction motors

(25) Propulsion gear boxes

(26) Third rail pick-up equipment

(27) Pantographs

(28) Propulsion Control Systems;

(29) Surge Arrestors;

(30) Protective Relaying.

(31) Bimetallic power rail.

(w) The power or third rail is not considered traction power equipment and is thus subject to the requirements of 49 U.S.C. 5323(j) and the requirements of §661.5.

(x) A bidder on a contract for an item covered by 49 U.S.C. 5323(j) who will comply with section 165(b)(3) and regulations in this section is not required to follow the application for waiver procedures set out in §661.9. In lieu of these procedures, the bidder must submit the appropriate certificate required by §661.12.

Appendix A to §661.11—General Waivers

(a) The provisions of §661.11 of this part do not apply when foreign sourced spare parts for buses and other rolling stock (including train control, communication, and traction power equipment) whose total cost is 10 percent or less of the overall project contract cost are being procured as part of the same contract for the major capital item.

(b) [Reserved]

Appendix B to §661.11—Typical Components of Buses

The following is a list of items that typically would be considered components of a bus. This list is not all-inclusive.

Car body shells, engines, transmissions, front axle assemblies, rear axle assemblies, drive shaft assemblies, front suspension assemblies, rear suspension assemblies, air compressor and pneumatic systems, generator/alternator and electrical systems, steering system assemblies, front and rear air brake assemblies, air conditioning compressor assemblies, air conditioning evaporator/condenser assemblies, heating systems. passenger seats, driver's seat assemblies, window assemblies, entrance and exit door assemblies, door control systems, destination sign assemblies, interior lighting assemblies, front and rear end cap assemblies, front and rear bumper assemblies, specialty steel (structural steel tubing, etc.) aluminum extrusions, aluminum, steel or fiberglass exterior panels, and interior trim, flooring, and floor coverings.

Appendix C to §661.11—Typical Components of Rail Rolling Stock

The following is a list of items that typically would be considered components of rail rolling stock. This list is not all inclusive.

Car shells, engines, main transformer, pantographs, traction motors, propulsion gear boxes, interior linings, acceleration and braking resistors, propulsion controls, low voltage auxiliary power supplies, air conditioning equipment, air brake compressors, brake controls, foundation brake equipment, articulation assemblies, train control systems, window assemblies, communication equipment, lighting, seating, doors, door actuators and controls, wheelchair lifts and ramps to make the vehicle accessible to persons with disabilities, couplers and draft gear, trucks, journal bearings, axles, diagnostic equipment, and third rail pick-up equipment.

Appendix D to §661.11—Minimum Requirements for Final Assembly

(a) Rail Cars: In the case of the manufacture of a new rail car, final assembly would typically include, as a minimum, the following operations: installation and interconnection of propulsion control equipment, propulsion cooling equipment, brake equipment, energy sources for auxiliaries and controls, heating and air conditioning, communications equipment, motors, wheels and axles, suspensions and frames; the inspection and verification of all installation and interconnection work; and the in-plant testing of the stationary product to verify all functions.

(b) Buses: In the case of a new bus, final assembly would typically include, at a minimum, the installation and interconnection of the engine, transmission, axles, including the cooling and braking systems; the installation and interconnection of the heating and air conditioning equipment; the installation of pneumatic and electrical systems, door systems, passenger seats, passenger grab rails, destination signs, wheelchair lifts; and road testing, final inspection, repairs and preparation of the vehicles for delivery.

(c) If a manufacturer's final assembly processes do not include all the activities that are typically considered the minimum requirements, it can request a Federal Transit Administration (FTA) determination of compliance. FTA will review these requests on a case-by-case basis to determine compliance with Buy America.

[61 FR 6302, Feb. 16, 1996, as amended at 62 FR 40954, July 31, 1997; 72 FR 53697, Sept. 20, 2007; 72 FR 55103, Sept. 28, 2007; 74 FR 30239, June 25, 2009]

§ 661.12 Certification requirement for procurement of buses, other rolling stock and associated equipment.

If buses or other rolling stock (including train control, communication, and traction power equipment) are being procured, the appropriate certificate as set forth below shall be completed and submitted by each bidder in accordance with the requirement contained in §661.13(b) of this part.

Certificate of Compliance with Buy America Rolling Stock Requirements

The bidder or Offeror hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j), and the applicable regulations of 49 CFR 661.11.

Date_____
Signature_____
Company_____
Name_____
Title_____

Certificate of Non-Compliance with Buy America Rolling Stock Requirements

The bidder or Offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j), but may qualify for an exception to the requirement consistent with 49 U.S.C. 5323(j)(2)(C), and the applicable regulations in 49 CFR 661.7.

Date_____
Signature_____
Company_____
Name_____
Title_____

[71 FR 14117, Mar. 21, 2006, as amended at 72 FR 53698, Sept. 20, 2007; 74 FR 30239, June 25, 2009]

§ 661.13 Grantee responsibility.

(a) The grantee shall adhere to the Buy America clause set forth in its grant contract with FTA.

(b) The grantee shall include in its bid or request for proposal (RFP) specification for procurement within the scope of this part an appropriate notice of the Buy America provision. Such specifications shall require, as a condition of responsiveness, that the bidder or Offeror submit with the bid or offer a completed Buy America certificate in accordance with §§661.6 or 661.12 of this part, as appropriate.

(1) A bidder or Offeror who has submitted an incomplete Buy America certificate or an incorrect certificate of noncompliance through inadvertent or clerical error (but not including failure to sign the certificate, submission of certificates of both compliance and non-compliance, or failure to submit any certification), may submit to the FTA Chief Counsel within ten (10) days of bid opening of submission or a final offer, a written explanation of the circumstances surrounding the submission of the incomplete or incorrect certification in

accordance with 28 U.S.C. 1746, sworn under penalty of perjury, stating that the submission resulted from inadvertent or clerical error. The bidder or Offeror will also submit evidence of intent, such as information about the origin of the product, invoices, or other working documents. The bidder or Offeror will simultaneously send a copy of this information to the FTA grantee.

(i) The FTA Chief Counsel may request additional information from the bidder or Offeror, if necessary. The grantee may not make a contract award until the FTA Chief Counsel issues his/her determination, except as provided in §661.15(m).

(ii) [Reserved]

(2) For negotiated procurements, compliance with the Buy America requirements shall be determined on the basis of the certification submitted with the final offer or final revised proposal. However, where a grantee awards on the basis of initial proposals without discussion, the certification submitted with the initial proposal shall control.

(3) Certification based on ignorance of the proper application of the Buy America requirements is not an inadvertent or clerical error.

(c) Whether or not a bidder or Offeror certifies that it will comply with the applicable requirement, such bidder or Offeror is bound by its original certification (in the case of a sealed bidding procurement) or its certification submitted with its final offer (in the case of a negotiated procurement) and is not permitted to change its certification after bid opening or submission of a final offer. Where a bidder or Offeror certifies that it will comply with the applicable Buy America requirements, the bidder, Offeror, or grantee is not eligible for a waiver of those requirements.

[56 FR 932, Jan. 9, 1991, as amended at 68 FR 9799, Feb. 28, 2003; 71 FR 14117, Mar. 21, 2006]

§ 661.15 Investigation procedures.

(a) It is presumed that a bidder or Offeror who has submitted the required Buy America certificate is complying with the Buy America provision. A false certification is a criminal act in violation of 18 U.S.C. 1001.

(b) Any party may petition FTA to investigate the compliance of a successful bidder or Offeror with the bidder's or Offeror's certification. That party ("the petitioner") must include in the petition a statement of the grounds of the petition and any supporting documentation. If FTA determines that the information presented in the petition indicates that the presumption in paragraph (a) of this section has been overcome, FTA will initiate an investigation.

(c) In appropriate circumstances, FTA may determine on its own to initiate an investigation without receiving a petition from a third party.

(d) When FTA determines under paragraph (b) or (c) of this section to conduct an investigation, it requests that the grantee require the successful bidder or Offeror to document its compliance with its Buy America certificate. The successful bidder or Offeror has the burden of proof to establish that it is in compliance. Documentation of compliance is based on the specific

circumstances of each investigation, and FTA will specify the documentation required in each case.

(e) The grantee shall reply to the request under paragraph (d) of this section within 15 working days of the request. The investigated party may correspond directly with FTA during the course of investigation, if it informs the grantee that it intends to do so, and if the grantee agrees to such action in writing. The grantee must inform FTA, in writing that the investigated party will respond directly to FTA. An investigated party may provide confidential or proprietary information (see paragraph (l) of this section) directly to FTA while providing other information required to be submitted as part of the investigation through the grantee.

(f) Any additional information requested or required by FTA must be submitted within 5 working days after the receipt of such request unless specifically exempted by FTA.

(g) The grantee's reply (or that of the bidder or Offeror) will be transmitted to the petitioner. The petitioner may submit comments on the reply to FTA within 10 working days after receipt of the reply. The grantee and the low bidder or Offeror will be furnished with a copy of the petitioner's comments, and their comments must be received by FTA within 5 working days after receipt of the petitioner's comments.

(h) The failure of a party to comply with the time limits stated in this section may result in resolution of the investigation without consideration of untimely filed comments.

(i) During the course of an investigation, with appropriate notification to affected parties, FTA may conduct site visits of manufacturing facilities and final assembly locations as it considers appropriate.

(j) FTA will, upon request, make available to any interested party information bearing on the substance of the investigation which has been submitted by the petitioner, interested parties or grantees, except to the extent that withholding of information is permitted or required by law or regulation.

(k) If a party submitting information considers that the information submitted contains proprietary material which should be withheld, a statement advising FTA of this fact may be included, and the alleged proprietary information must be identified wherever it appears. Any comments on the information provided shall be submitted within a maximum of ten days.

(l) For purposes of paragraph (j) of this section, confidential or proprietary material is any material or data whose disclosure could reasonably be expected to cause substantial competitive harm to the party claiming that the material is confidential or proprietary.

(m) When a petition for investigation has been filed before award, the grantee will not make an award before the resolution of the investigation, unless the grantee determines that:

(1) The items to be procured are urgently required;

(2) Delivery of performance will be unduly delayed by failure to make the award promptly; or

(3) Failure to make prompt award will otherwise cause undue harm to the grantee or the Federal Government.

(n) In the event that the grantee determines that the award is to be made during the pendency of an investigation, the grantee will notify FTA before to making such award. FTA reserves the right not to participate in the funding of any contract awarded during the pendency of an investigation.

(o) Initial decisions by FTA will be in written form. Reconsideration of an initial decision of FTA may be requested by any party involved in an investigation. FTA will only reconsider a decision only if the party requesting reconsideration submits new matters of fact or points of law that were not known or available to the party during the investigation. A request for reconsideration of a decision of FTA shall be filed not later than ten (10) working days after the initial written decision. A request for reconsideration will be subject to the procedures in this section consistent with the need for prompt resolution of the matter.

[56 FR 932, Jan. 9, 1991, as amended at 71 FR 14118, Mar. 21, 2006]

§ 661.17 Failure to comply with certification.

If a successful bidder or Offeror fails to demonstrate that it is in compliance with its certification, it will be required to take the necessary steps in order to achieve compliance. If a bidder or Offeror takes these necessary steps, it will not be allowed to change its original bid price or the price of its final offer. If a bidder or Offeror does not take the necessary steps, it will not be awarded the contract if the contract has not yet been awarded, and it is in breach of contract if a contract has been awarded.

[71 FR 14118, Mar. 21, 2006]

§ 661.18 Intentional violations.

A person shall be ineligible to receive any contract or subcontract made with funds authorized under the Federal Public Transportation Act of 2005 pursuant to part 29 of this title if it has been determined by a court or Federal agency that the person intentionally—

(a) Affixed a label bearing a “Made in America” inscription, or an inscription with the same meaning, to a product not made in the United States, but sold in or shipped to the United States and used in projects to which this section applies, or

(b) Otherwise represented that any such product was produced in the United States.

[61 FR 6303, Feb. 16, 1996, as amended at 72 FR 53698, Sept. 20, 2007]

§ 661.19 Sanctions.

A willful refusal to comply with a certification by a successful bidder or Offeror may lead to the initiation of debarment or suspension proceedings under part 29 of this title.

[71 FR 14118, Mar. 21, 2006]

§ 661.20 Rights of parties.

(a) A party adversely affected by an FTA action under this subsection shall have the right to seek review under the Administrative Procedure Act (APA), 5 U.S.C. 702 *et seq.*

(b) Except as provided in paragraph (a) of this section, the sole right of any third party under the Buy America provision is to petition FTA under the provisions of §661.15 of this part. No third party has any additional right, at law or equity, for any remedy including, but not limited to, injunctions, damages, or cancellation of the Federal grant or contracts of the grantee.

[71 FR 14118, Mar. 21, 2006]

§ 661.21 State Buy America provisions.

(a) Except as provided in paragraph (b) of this section, any State may impose more stringent Buy America or buy national requirements than contained in section 165 of the Act and the regulations in this part.

(b) FTA will not participate in contracts governed by the following:

(1) State Buy America or Buy National preference provisions which are not as strict as the Federal requirements.

(2) State and local Buy National or Buy America preference provisions which are not explicitly set out under State law. For example, administrative interpretations of non-specific State legislation will not control.

(3) State and local Buy Local preference provisions.

PART 663—PRE-AWARD AND POST-DELIVERY AUDITS OF ROLLING STOCK PURCHASES

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Subpart D—Certification of Compliance With or Inapplicability of Federal Motor Vehicle Safety Standards
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§ 663.43 Certification that Federal motor vehicle standards do not apply.

Authority: 49 U.S.C. 1608(j); 23 U.S.C. 103(e)(f); Pub. L. 96–184, 93 Stat. 1320; Pub. L. 101–551, 104 Stat. 2733; sec. 3023(m), Pub. L. 109–59; 49 CFR 1.51.
Source: 56 FR 48395, Sept. 24, 1991, unless otherwise noted.

Subpart A—General

§ 663.1 Purpose.

This part implements section 12(j) of the Federal Mass Transit Act of 1964, as amended, which was added by section 319 of the 1987 Surface Transportation and Uniform Relocation Assistance Act (Pub. L. 100–17). Section 12(j) requires the Federal Transit Administration, by delegation from the Secretary of Transportation, to issue regulations requiring pre-award and post-delivery audits when a recipient of Federal financial assistance purchases rolling stock with funds made available under the Federal Mass Transit Act, as amended.

§ 663.3 Scope.

This part applies to a recipient purchasing rolling stock to carry passengers in revenue service with funds made available under sections 3, 9, 18, and 16(b)(2) of the Federal Mass Transit Act, as amended; 23 U.S.C. 103(e)(4); and section 14 of the National Capital Transportation Act of 1969, as amended.

§ 663.5 Definitions.

As used in this part—

(a) *Pre-award* means that period in the procurement process before the recipient enters into a formal contract with the supplier.

(b) *Post-delivery* means the time period in the procurement process from when the rolling stock is delivered to the recipient until title to the rolling stock is transferred to the recipient or the rolling stock is put into revenue service, whichever is first.

(c) *Recipient* means a recipient of Federal financial assistance from FTA.

(d) *Revenue service* means operation of rolling stock for transportation of fare-paying passengers as anticipated by the recipient.

(e) *Rolling stock* means buses, vans, cars, railcars, locomotives, trolley cars and buses, ferry boats, and vehicles used for guide ways and incline planes.

(f) *Audit* means a review resulting in a report containing the necessary certifications of compliance with Buy America standards, purchaser's requirements specifications, and, where appropriate, a manufacturer's certification of compliance with or inapplicability of the Federal Motor Vehicle Safety Standards, required by section 319 of STURAA and this part.

(g) *FTA* means the Federal Transit Administration.

§ 663.7 Certification of compliance to FTA.

A recipient purchasing revenue service rolling stock with funds obligated by FTA on or after October 24, 1991, must certify to FTA that it will conduct or cause to be conducted pre-award and post-delivery audits as prescribed in this part. In addition, such a recipient must maintain on file the certifications required under subparts B, C, and D of this part.

§ 663.9 Audit limitations.

(a) An audit under this part is limited to verifying compliance with

(1) Applicable Buy America requirements [section 165 of the Surface Transportation Assistance Act of 1982, as amended,]; and

(2) Solicitation specification requirements of the recipient.

(b) An audit under this part includes, where appropriate, a copy of a manufacturer's self certification information that the vehicle complies with Federal Motor Vehicle Safety Standards or a certification that such standards are inapplicable.

(c) An audit conducted under this part is separate from the single annual audit requirement established by Office of Management and Budget Circular A–128, “Audits of State and Local Governments,” dated May 16, 1985.

§ 663.11 Audit financing.

A recipient purchasing revenue rolling stock with FTA funds may charge the cost of activities required by this part to the grant which FTA made for such purchase.

§ 663.13 Buy America requirements.

A Buy America certification under this part shall be issued in addition to any certification which may be required by part 661 of this title. Nothing in this part precludes FTA from conducting a Buy America investigation under part 661 of this title.

§ 663.15 Compliance.

A recipient subject to this part shall comply with all applicable requirements of this part. Such compliance is a condition of receiving Federal financial assistance from FTA. A recipient determined not to be in compliance with this part will be subject to the immediate suspension, withholding, or repayment of Federal financial assistance from FTA or other appropriate actions unless and until it comes into compliance with this part.

Subpart B—Pre-Award Audits

§ 663.21 Pre-award audit requirements.

A recipient purchasing revenue service rolling stock with FTA funds must ensure that a pre-award audit under this part is complete before the recipient enters into a formal contract for the purchase of such rolling stock.

§ 663.23 Description of pre-award audit.

A pre-award audit under this part includes—

(a) A Buy America certification as described in §663.25 of this part;

(b) A purchaser's requirements certification as described in §663.27 of this part; and

(c) Where appropriate, a manufacturer's Federal Motor Vehicle Safety certification information as described in §663.41 or §663.43 of this part.

§ 663.25 Pre-award Buy America certification.

For purposes of this part, a pre-award Buy America certification is a certification that the recipient keeps on file that—

(a) There is a letter from FTA which grants a waiver to the rolling stock to be purchased from the Buy America requirements under section 165(b)(1), (b)(2), or (b)(4) of the Surface Transportation Assistance Act of 1982, as amended; or

(b) The recipient is satisfied that the rolling stock to be purchased meets the requirements of section 165(a) or (b)(3) of the Surface Transportation Assistance Act of 1982, as amended, after having reviewed itself or through an audit prepared by someone other than the manufacturer or its agent documentation provided by the manufacturer which lists—

(1) Component and subcomponent parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and costs; and

(2) The location of the final assembly point for the rolling stock, including a description of the activities that will take place at the final assembly point and the cost of final assembly.

§ 663.27 Pre-award purchaser's requirements certification.

For purposes of this part, a pre-award purchaser's requirements certification is a certification a recipient keeps on file that—

(a) The rolling stock the recipient is contracting for is the same product described in the purchaser's solicitation specification; and

(b) The proposed manufacturer is a responsible manufacturer with the capability to produce a vehicle that meets the recipient's specification set forth in the recipient's solicitation.

Subpart C—Post-Delivery Audits

§ 663.31 Post-delivery audit requirements.

A recipient purchasing revenue service rolling stock with FTA funds must ensure that a post-delivery audit under this part is complete before title to the rolling stock is transferred to the recipient.

§ 663.33 Description of post-delivery audit.

A post-delivery audit under this part includes—

(a) A post-delivery Buy America certification as described in §663.35 of this part;

(b) A post-delivery purchaser's requirements certification as described in §663.37 of this part; and

(c) When appropriate, a manufacturer's Federal Motor Vehicle Safety Standard self-certification information as described in §663.41 or §663.43 of this part.

§ 663.35 Post-delivery Buy America certification.

For purposes of this part, a post-delivery Buy America certification is a certification that the recipient keeps on file that—

(a) There is a letter from FTA which grants a waiver to the rolling stock received from the Buy America requirements under sections 165 (b)(1), or (b)(4) of the Surface Transportation Assistance Act of 1982, as amended; or

(b) The recipient is satisfied that the rolling stock received meets the requirements of section 165 (a) or (b)(3) of the Surface Transportation Assistance Act of 1982, as amended, after having reviewed itself or by means of an audit prepared by someone other than the manufacturer or its agent documentation provided by the manufacturer which lists—

(1) Components and subcomponent parts of the rolling stock identified by manufacturer of the parts, their country of origin and costs; and

(2) The actual location of the final assembly point for the rolling stock including a description of the activities which took place at the final assembly point and the cost of the final assembly.

§ 663.37 Post-delivery purchaser's requirements certification.

For purposes of this part, a post-delivery purchaser's requirements certification is a certification that the recipient keeps on file that—

(a) Except for procurements covered under paragraph (c) in this section, a resident inspector (other than an agent or employee of the manufacturer) was at the manufacturing site throughout the period of manufacture of the rolling stock to be purchased and monitored and completed a report on the manufacture of such rolling stock. Such a report, at a minimum, shall—

(1) Provide accurate records of all vehicle construction activities; and

(2) Address how the construction and operation of the vehicles fulfills the contract specifications.

(b) After reviewing the report required under paragraph (a) of this section, and visually inspecting and road testing the delivered vehicles, the vehicles meet the contract specifications.

(c) For procurements of:

(1) Ten or fewer buses; or

(2) Procurements of twenty vehicles or fewer serving rural (other than urbanized) areas, or urbanized areas of 200,000 people or fewer; or

(3) Any number of primary manufacturer standard production and unmodified vans, after visually inspecting and road testing the vehicles, the vehicles meet the contract specifications.

[56 FR 48395, Sept. 24, 1991, as amended at 71 FR 14118, Mar. 21, 2006]

§ 663.39 Post-delivery audit review.

(a) If a recipient cannot complete a post-delivery audit because the recipient or its agent cannot certify Buy America compliance or that the rolling stock meets the purchaser's requirements specified in the contract, the rolling stock may be rejected and final acceptance by the recipient will not be required. The recipient may exercise any legal rights it has under the contract or at law.

(b) This provision does not preclude the recipient and manufacturer from agreeing to a conditional acceptance of rolling stock pending manufacturer's correction of deviations within a reasonable period of time.

Subpart D—Certification of Compliance with or Inapplicability of Federal Motor Vehicle Safety Standards

§ 663.41 Certification of compliance with Federal motor vehicle safety standards.

If a vehicle purchased under this part is subject to the Federal Motor Vehicle Safety Standards issued by the National Highway Traffic Safety Administration in part 571 of this title, a recipient shall keep on file its certification that it received, both at the pre-award and post-delivery stage, a copy of the manufacturer's self-certification information that the vehicle complies with relevant Federal Motor Vehicle Safety Standards.

§ 663.43 Certification that Federal motor vehicle standards do not apply.

(a) Except for rolling stock subject to paragraph (b) of this section, if a vehicle purchased under this part is not subject to the Federal Motor Vehicle Safety Standards issued by the National Highway Traffic Safety Administration in part 571 of this title, the recipient shall keep on file its certification that it received a statement to that effect from the manufacturer.

(b) This subpart shall not apply to rolling stock that is not a motor vehicle.

APPENDIX E

CONTRACT NO. T-0705-0140

NOT IN USE

APPENDIX F

CONTRACT DATA REQUIREMENT LIST

T-0705-0140

KIRK BUS DIVISION MODERNIZATION - PHASE 1

Kirk Bus Division Modernization Project - Phase 1 T-0705-0140

CONTRACT DATA REQUIREMENT LIST

This CDRL is a summary listing for Contractor's information. All submittal requirement provisions of the Contract Documents supersede this listing, and the Contractor shall verify that all items and required submittals have been included in the CDRL before commencing work or procuring items. Any discrepancy or ommissions should be brought to the immediate attention of the Engineer.

ITEM NO.	ITEM DESCRIPTIONS	Specification Reference	Product Literature/ Specification (A)	Shop Drawings (B)	Certifications (C)	Other Documentation (D)	Factory Test Procedures (E)	Factory Test Reports (F)	Samples (G)	Installation Drawings (H)	Field Test Procedures (I)	Field Test Reports (J)	Installation, Maintenance & Operations Manuals (K)	As-Built Drawings (L)
	DIVISION 1													
	CONSTRUCTION PROCEDURES													
01130-01	Construction Layout Drawings and Survey	01130	N/A	N/A	N/A	01130-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01130-02	Disposal of Material Outside the Work Site	01130	N/A	N/A	N/A	01130-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SUBMITTALS													
01300-01	Scheduling Representative Qualifications	01300	N/A	N/A	N/A	01300-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01300-02	Project CPM Detailed Schedule #1	01300	N/A	N/A	N/A	01300-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01300-03	Project CPM Detailed Schedule #2	01300	N/A	N/A	N/A	01300-03-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01300-04	Major Products List	01300	01300-04-A	N/A	N/A	01300-04-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01300-05	Source of Supply and Samples	01300	01300-05-A	N/A	N/A	01300-05-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01300-06	Progress Photographs	01300	N/A	N/A	N/A	01300-06-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01300-07	Estimated Cost Break Down	01300	N/A	N/A	N/A	01300-07-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01300-08	Operations and Maintenance Data	01300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	01300-08-K	N/A
01300-09	Abatement Lead and/or asbestos	01300	N/A	N/A	N/A	01300-09-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SAFETY AND SECURITY CERTIFICATION													
01360-01	Supporting documentation for verification/validation of safety and security elements	01360	N/A	N/A	N/A	01360-01-D	N/A	01360-01-F	N/A	N/A	N/A	N/A	N/A	N/A
	QUALITY CONTROL													
01450-01	Interim CQC Plan	01450	N/A	N/A	N/A	01450-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-02	Detailed CQC Plan	01450	N/A	N/A	N/A	01450-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-03	CQC Plan Manager Qualifications	01450	N/A	N/A	N/A	01450-03-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-04	CQC Plan Staff Qualifications	01450	N/A	N/A	N/A	01450-04-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-05	Source of Materials	01450	N/A	N/A	N/A	01450-05-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-06	Equipment Calibration Certifications	01450	N/A	N/A	01450-06-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-07	QC Testing Personnel Qualifications and Scope of Services	01450	N/A	N/A	N/A	01450-07-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-08	Monthly Record of All Control Testing	01450	N/A	N/A	N/A	01450-08-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-09	Periodic Internal Audit Reports	01450	N/A	N/A	N/A	01450-09-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-10	Test Procedures for All Tests Listed in the CQC Plan	01450	N/A	N/A	N/A	01450-10-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01450-11	Test Schedules Keyed to Work Activities	01450	N/A	N/A	N/A	01450-11-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MAINTENANCE OF TRAFFIC													
01550-01	Traffic Control Plan	01550	N/A	N/A	N/A	01550-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01550-02	Temporary Traffic Signs Plan	01550	N/A	N/A	N/A	01550-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Kirk Bus Division Modernization Project - Phase 1 T-0705-0140

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	ENVIRONMENTAL PROTECTION													
01570-01	Contractor Environmental Checklist	01570	N/A	N/A	N/A	01570-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01570-02	Contractor Environmental Activity Statement	01570	N/A	N/A	N/A	01570-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01570-03	Disposal Procedures For Waste	01570	N/A	N/A	01570-03-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01570-04	Tree Protection Plan	01570	N/A	N/A	N/A	01570-04-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01570-05	Dust Control Plan	01570	N/A	N/A	N/A	01570-05-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CONTRACT CLOSEOUT													
01780-01	Certification work is complete ready for inspecti	01780	N/A	N/A	N/A	01780-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01780-02	Record Documents	01780	01780-02-A	01780-02-B	01780-02-C	N/A	N/A	N/A	N/A	N/A	01780-02-I	01780-02-J	01780-02-K	01780-02-L
01780-03	Operation and Maintenance Data	01780	N/A	N/A	N/A	01780-03-D	N/A	N/A	N/A	N/A	N/A	N/A	01780-03-K	N/A
	COMMISSIONING													
01800-01	Comments on testing procedures/checklists	01800	N/A	N/A	N/A	N/A	01800-01-E	N/A	N/A	N/A	01800-01-I	N/A	N/A	N/A
01800-02	Certificates of installation/pre-start	01800	N/A	N/A	N/A	01800-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01800-03	Certificates of start-up activities	01800	N/A	N/A	N/A	01800-03-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01800-04	Lock-out Tag-out forms/cleaning forms	01800	N/A	N/A	N/A	01800-04-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01800-05	Physical complete forms/start-up forms	01800	N/A	N/A	N/A	01800-05-D	N/A	N/A	N/A	N/A	01800-05-I	N/A	N/A	N/A
01800-06	Certificates of Readiness & Acceptance	01800	N/A	N/A	N/A	01800-06-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01800-07	FPT Commissioning Reports	01800	N/A	N/A	N/A	01800-07-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
01800-08	Operations and Maintenance Documentation	01800	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	01800-08-K	N/A
	DIVISION 2													
	SITE DEMOLITION													
02220-01	Disposal	02220	N/A	N/A	N/A	02220-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	EXACAVATION													
02315-01	Sheeting, Shoring and Form Details	02315	02315-01-A	02315-01-B	02315-01-C	02315-01-D	N/A	N/A	N/A	02315-01-H	N/A	N/A	N/A	N/A
02315-02	Borrow Pit Plan	02315	N/A	N/A	02315-07-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	EXCAVATION AND FILL													
02317-01	Aggregate Backfill and #57 Course Aggregate	02317	N/A	N/A	02317-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02317-02	Embankment Material	02317	N/A	N/A	02317-02-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	FURNISHED SUBSOIL													
02320-01	Source of Supply	02320	N/A	N/A	02320-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	STONE PIERS													
02360-01	Stone Piers	02360	N/A	02360-01-B	N/A	02360-01-D	N/A	N/A	N/A	02360-01-H	02360-01-I	02360-01-J	N/A	N/A
	EROSION AND SEDIMENT CONTROL													
02370-01	Geotextile Fabric	02370	02370-01-A	N/A	02370-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SOIL STABILIZATION MATTING													
02372-01	Soil Stabilization Matting	02372	02372-01-A	02372-01-B	02372-01-C	N/A	N/A	N/A	02372-01-G	02372-01-H	N/A	N/A	N/A	N/A
	STEEL H-SECTION PILES													
02455-01	Piles	02455	N/A	02455-01-B	02455-01-C	02455-01-D	N/A	N/A	N/A	N/A	02455-01-I	02455-01-J	N/A	N/A
	WATER DISTRIBUTION													
02510-01	Water Distrubution System	02510	N/A	N/A	02510-01-C	02510-01-D	N/A	02510-01-F	N/A	N/A	N/A	N/A	N/A	N/A
	SANITARY SEWER													
02530-01	Sanitary Sewer Structures	02530	N/A	02530-01-B	02530-01-C	02530-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SUBDRAINAGE													
02620-01	Subdrainage System	02620	N/A	02620-01-B	02620-01-C	02620-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	PIPING													
02624-01	Piping	02624	N/A	02624-01-B	02624-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	STORM DRAINAGE													
02630-01	Concrete Mixes	02630	02630-01-A	N/A	N/A	N/A	N/A	02630-01-F	N/A	N/A	N/A	N/A	N/A	N/A
02630-02	Precast Concrete Structure	02630	02630-02-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	02630-02-L
02630-03	Reinforced Concrete Pipe and Fittings	02630	02630-03-A	N/A	02630-03-C	N/A	N/A	02630-03-F	N/A	N/A	N/A	N/A	N/A	02630-03-L
02630-04	Frames and Covers	02630	N/A	02630-04-B	02630-04-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	SAND FILTER													
02650-01	Sand Filter	02650	N/A	02650-01-A	N/A	02650-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	AGGREGATE BASE COURSE													
02720-01	Materials	02720	N/A	N/A	N/A	02720-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02720-02	Production Plants	02720	N/A	N/A	N/A	02720-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02720-03	Production and On-Site Equipment	02720	N/A	N/A	N/A	02720-03-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02720-04	Compaction	02720	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	02720-04-I	02720-04-J	N/A	N/A
	HOT MIX ASPHALT PAVEMENT													
02745-01	Mix Design	02745	02745-01-A	N/A	02745-01-C	N/A	N/A	02745-01-F	N/A	N/A	N/A	N/A	N/A	N/A
02745-02	Paving Plan	02745	N/A	N/A	N/A	02745-02-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02745-03	Production Plant	02745	N/A	N/A	N/A	02745-03-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02745-04	Production and Paving Equipment	02745	N/A	N/A	N/A	02745-04-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02745-05	Materials	02745	N/A	N/A	N/A	02745-05-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02745-06	Field Quality Control	02745	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	02745-06-I	02745-06-J	N/A	N/A
	REINFORCED CONCRETE PAVEMENT													
02750-01	Joint Layout	02750	N/A	02750-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02750-02	Concrete Mix	02750	02750-02-A	N/A	N/A	N/A	N/A	02750-02-F	N/A	N/A	N/A	N/A	N/A	N/A
02750-03	Materials	02750	N/A	N/A	02750-03-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CURB AND GUTTER													
02770-01	Curing Materials	02770	02770-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02770-02	Form Release Compound	02770	02770-02-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02770-03	Concrete Mix	02770	02770-03-A	N/A	02770-03-C	N/A	N/A	02770-03-F	N/A	N/A	N/A	N/A	N/A	N/A
02770-04	Admixtures	02770	N/A	N/A	02770-04-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02770-05	Joint Filler	02770	02770-05-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02770-06	Preformed Joint Filler	02770	02770-06-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CONCRETE SIDEWALK													
02775-01	Joint Layout	02775	N/A	02775-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02775-02	Concrete Mixes	02775	02775-02-A	N/A	N/A	N/A	N/A	02775-02-F	N/A	N/A	N/A	N/A	N/A	N/A
02775-03	Materials	02775	N/A	N/A	02775-03-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02775-04	Detectable Warning Surface Pavers	02775	02775-04-A	N/A	N/A	02775-04-D	N/A	N/A	02775-04-G	N/A	N/A	N/A	N/A	N/A

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	ORNAMENTAL FENCE													
02820-01	Materials	02830	02830-01-A	N/A	02830-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02820-02	Concrete Mixes	02775	02820-02-A	N/A	N/A	N/A	N/A	02820-02-F	N/A	N/A	N/A	N/A	N/A	N/A
	SIGNS													
02890-01	Retroreflective Sheeting	02890	02890-01-A	N/A	02890-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02890-02	Sign Supports	02890	N/A	N/A	02890-02-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	TURF ESTABLISHMENT													
02920-01	Topsoil	02920	N/A	N/A	02920-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02920-02	Grass Seed	02920	N/A	N/A	02920-02-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02920-03	Bioretention Seed Mix	02920	02920-03-A	N/A	N/A	N/A	N/A	N/A	02920-03-G	N/A	N/A	N/A	N/A	N/A
02920-04	Straw Mulch	02920	02920-04-A	N/A	N/A	N/A	N/A	N/A	02920-04-G	N/A	N/A	N/A	N/A	N/A
02920-05	Wood Cellulose Fiber	02920	02920-05-A	N/A	N/A	N/A	N/A	N/A	02920-05-G	N/A	N/A	N/A	N/A	N/A
02920-06	Sod	02920	N/A	N/A	02920-06-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02920-07	Fertilizer	02920	02920-07-A	N/A	N/A	N/A	N/A	N/A	02920-07-G	N/A	N/A	N/A	N/A	N/A
02920-08	Lime	02920	02920-08-A	N/A	N/A	N/A	N/A	N/A	02920-08-G	N/A	N/A	N/A	N/A	N/A
02920-09	Water	02920	02920-09-A	N/A	N/A	N/A	N/A	N/A	02920-09-G	N/A	N/A	N/A	N/A	N/A
02920-10	Schedule of Turf Establishment Procedures	02920	N/A	N/A	N/A	02920-10-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02920-11	Schedule of Seed Mix Establishment Procedures	02920	N/A	N/A	N/A	02920-11-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	TREES, SHRUBS AND GROUND COVER													
02930-01	Plant Sources	02930	N/A	N/A	N/A	02930-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
02930-02	Plant Materials	02930	02930-02-A	N/A	N/A	N/A	N/A	N/A	02930-02-G	N/A	N/A	N/A	N/A	N/A
02930-03	Organic Compost	02930	02930-03-A	N/A	N/A	N/A	N/A	N/A	02930-03-G	N/A	N/A	N/A	N/A	N/A
02930-04	Ureaform Fertilizer	02930	02930-04-A	N/A	N/A	N/A	N/A	N/A	02930-04-G	N/A	N/A	N/A	N/A	N/A
02930-05	Supplemental Fertilizer	02930	02930-05-A	N/A	N/A	N/A	N/A	N/A	02930-05-G	N/A	N/A	N/A	N/A	N/A
02930-06	Muching Material	02930	02930-06-A	N/A	N/A	N/A	N/A	N/A	02930-06-G	N/A	N/A	N/A	N/A	N/A
02930-07	Planiting Accessories	02930	02930-07-A	N/A	N/A	N/A	N/A	N/A	02930-07-G	N/A	N/A	N/A	N/A	N/A
02930-08	Mychorrizal Fungi	02930	02930-08-A	N/A	N/A	N/A	N/A	N/A	02930-08-G	N/A	N/A	N/A	N/A	N/A
	GREENSCREEN FENCE													
02940-01	Greenscreen Fence	02940	02940-01-A	02940-01-B	N/A	02940-01-D	N/A	N/A	02940-01-G	N/A	N/A	N/A	N/A	N/A

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	DIVISION 3													
	PORTLAND CEMENT CONCRETE													
03050-01	Compliance with Hot and Cold Weather mixing and delivery requirements	03050	N/A	N/A	N/A	03050-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
03050-02	Laboratory Test Reports or Certifications attesting to conformance of ingredients	03050	N/A	N/A	03050-02-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
03050-03	Delivery Tickets	03050	N/A	N/A	N/A	03050-03-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
03050-04	Test Reports	03050	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	03050-04-J	N/A	N/A
03050-05	Design Mix	03050	03050-05-A	N/A	03050-05-C	03050-05-D	03050-05-E	03050-05-F	N/A	N/A	N/A	N/A	N/A	N/A
03050-06	Admixtures	03050	N/A	N/A	03050-06-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	REINFORCING STEEL													
03210-01	Test Reports/Certified Mill Tests	03210	N/A	N/A	03210-01-C	N/A	N/A	03210-01-F	N/A	N/A	N/A	N/A	N/A	N/A
03210-02	Materials/Manufacturer's Test Reports	03210	N/A	N/A	N/A	N/A	N/A	03210-02-F	N/A	N/A	N/A	N/A	N/A	N/A
	CAST-IN-PLACE CONCRETE													
03301-01	Formwork working drawings	03300	N/A	03300-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
03300-02	Snap-off Form ties	03300	N/A	N/A	N/A	N/A	N/A	N/A	03300-02-G	N/A	N/A	N/A	N/A	N/A
03300-03	Form and Bond Breaker Oils	03300	N/A	N/A	N/A	N/A	N/A	N/A	03300-03-G	N/A	N/A	N/A	N/A	N/A
03300-04	Membrane-forming curing compound	03300	N/A	N/A	N/A	N/A	N/A	N/A	03300-04-G	N/A	N/A	N/A	N/A	N/A
03300-05	Manufacturer's Certifications	03300	N/A	N/A	03300-05-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
03300-06	Certified Concrete Test Reports early form removal	03300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	03300-06-J	N/A	N/A
03300-07	Calculations & Quality Control Reports for early form removal	03300	N/A	N/A	N/A	03300-07-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
03300-08	Grout Design Mix	03300	03300-08-A	N/A	03300-08-C	03300-08-D	03300-08-E	03300-08-F	N/A	N/A	N/A	N/A	N/A	N/A
03300-09	Coverage rate of liquid membrane compound	03300	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	03300-08-K	N/A
	CONCRETE FINISHES													
03350-01	Concrete Finishes	03350	03350-01-A	N/A	03350-01-C	03350-01-D	N/A	N/A	N/A	N/A	N/A	N/A	03350-01-K	N/A
	DIVISION 4													
	MASONRY MORTAR													
04060-01	Masonry Mortar	04060	N/A	N/A	04060-01-C	04060-01-D	N/A	04060-01-F	04060-01-G	N/A	N/A	N/A	N/A	N/A

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	MASONRY GROUT													
04070-01	Masonry Grout	04070	N/A	N/A	04070-01-C	04070-01-D	N/A	04070-01-F	04070-01-G	N/A	N/A	N/A	N/A	N/A
	MASONRY ANCHORAGE AND REINFORCEMENT													
04080-01	Masonry Anchorage, Reinforcement, and Accessories	04080	04080-01-A	N/A	N/A	04080-01-D	N/A	N/A	N/A	N/A	N/A	N/A	04080-01-K	N/A
	CAST STONE SPECIALITIES													
04720-01	Precast Concrete Specialties	04720	N/A	N/A	N/A	04720-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CONCRETE UNIT MASONRY													
04810-01	Concrete Unit Masonry	04810	N/A	N/A	N/A	04810-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CLAY BRICK MASONRY UNIT													
04811-01	Clay Brick Masonry Unit	04811	04811-01-A	N/A	04811-01-C	04811-01-D	N/A	04811-01-F	04811-01-G	N/A	N/A	N/A	N/A	N/A
	DIVISION 5													
	STRUCTURAL STEEL													
05120-01	Structural Steel	05120	N/A	05120-01-B	05120-01-C	05120-01-D	N/A	05120-01-F	N/A	05120-01-H	N/A	05120-01-J	N/A	N/A
	STEEL JOISTS													
05210-01	Steel Joists	05210	05210-01-A	05210-01-B	05210-01-C	05210-01-D	N/A	N/A	N/A	05210-01-H	N/A	N/A	N/A	N/A
	STEEL DECK													
05310-01	Steel Deck	05310	05310-01-A	05310-01-B	05310-01-C	05310-01-D	N/A	N/A	N/A	05310-01-H	N/A	N/A	05310-01-K	N/A
	COLD FORMED METAL FRAMING													
05400-01	Cold Formed Metal Framing	05400	05400-01-A	05400-01-B	05400-01-C	05400-01-D	N/A	05400-01-F	N/A	N/A	N/A	05400-01-J	N/A	N/A
	METAL FABRICATIONS													
05500-01	Metal Fabrications	05500	05500-01-A	05500-01-B	05500-01-C	05500-01-D	N/A	N/A	N/A	05500-01-H	N/A	N/A	N/A	N/A

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	METAL STAIRS, HANDRAILS, AND GUARDRAILS													
05511-01	Metal Stairs, Handrails, and Guardrails	05511	05511-01-A	05511-01-B	N/A	05511-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DIVISION 6													
	MISCELLANEOUS CARPENTRY													
06105-01	Miscellaneous Carpentry	06105	06105-01-A	N/A	06105-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	PLASTIC LAMINATE FACED ARCHITECTURAL CABINETS													
06412-01	Plastic Laminate Faced Architectural Cabinets	06412	06412-01-A	06412-01-B	06412-01-C	06412-01-D	N/A	N/A	06412-01-G	N/A	N/A	N/A	N/A	N/A
	WOOD PANELING													
06420-01	Wood Paneling	06420	06420-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SOLID SURFACE COUNTERTOPS													
06615-01	Solid Surface Countertops	06615	06615-01-A	06615-01-B	N/A	06615-01-D	N/A	N/A	06615-01-G	N/A	N/A	N/A	N/A	N/A
	DIVISION 7													
	BITUMINOUS DAMPPROOFING													
07110-01	Bituminous Dampproofing	07110	07110-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SHEET WATERPROOFING (MODIFIED BITUMINOUS)													
07130-01	Sheet Waterproofing (Modified Bituminous)	07130	07130-01-A	N/A	N/A	07130-01-D	N/A	N/A	N/A	N/A	N/A	N/A	07130-01-K	N/A
	CRYSTALLINE WATERPROOFING													
07161-01	Crystalline Waterproofing	07161	07161-01-A	N/A	07161-01-C	N/A	N/A	N/A	N/A	07161-01-H	N/A	N/A	N/A	N/A

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	BOARD AND BATT INSULATION													
07210-01	Board and Batt Insulation	07210	07210-01-A	N/A	N/A	N/A	N/A	07210-01-F	N/A	N/A	N/A	N/A	N/A	N/A
	VAPOR RESISTIVE BARRIER													
07260-01	Vapor Resistive Barrier	07260	07260-01-A	07260-01-B	N/A	07260-01-D	N/A	N/A	07260-01-G	N/A	N/A	N/A	N/A	N/A
	METAL ROOF PANELS													
07411-01	Metal Roof Panels	07411	07411-01-A	07411-01-B	N/A	N/A	N/A	N/A	07411-01-G	N/A	N/A	N/A	N/A	N/A
	COMPOSITE WALL PANELS													
07415-01	Composite Wall Panels	07415	07415-01-A	07415-01-B	N/A	N/A	N/A	N/A	07415-01-G	N/A	N/A	N/A	N/A	N/A
	THERMOPLASTIC POLYOLEFIN (TPO) ROOFING													
07543-01	Thermoplastic Polyolefin (TPO) Roofing	07543	07543-01-A	07543-01-B	07543-01-C	N/A	N/A	07543-01-F	07543-01-G	N/A	N/A	N/A	075463-01-K	N/A
	SHEET METAL FLASHING AND TRIM													
07620-01	Sheet Metal Flashing and Trim	07620	07620-01-A	07620-01-B	07620-01-C	N/A	N/A	N/A	07620-01-G	N/A	N/A	N/A	N/A	N/A
	ROOF ACCESSORIES													
07720-01	Roof Accessories	07720	07720-01-A	07720-01-B	N/A	07720-01-D	N/A	N/A	07720-01-G	N/A	N/A	N/A	07720-01-K	N/A
	SPRAYED FIRE-RESISTIVE MATERIALS													
07811-01	Spray Fire-Resistive Materials	07811	07811-01-A	07811-01-B	07811-01-C	N/A	N/A	07811-01-F	07811-01-G	N/A	N/A	N/A	N/A	N/A
	THROUGH-PENETRATION FIRESTOP SYSTEMS													
07841-01	Through-Penetration Firestop Systems	07841	07841-01-A	N/A	N/A	N/A	N/A	07841-01-F	N/A	N/A	N/A	N/A	N/A	N/A
	ARCHITECTURAL JOINT SEALANTS													
07920-01	Architectural Joint Sealants	07920	07920-01-A	N/A	07920-01-C	N/A	N/A	07920-01-F	07920-01-G	N/A	N/A	N/A	N/A	N/A

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	DIVISION 8													
	METAL DOORS AND FRAMES													
08100-01	Metal Doors and Frames	08100	08100-01-A	08100-01-B	08100-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	WOOD DOORS													
08210-01	Wood Doors	08210	08210-01-A	08210-01-B	N/A	N/A	N/A	N/A	08210-01-G	N/A	N/A	N/A	08210-01-K	N/A
	SPECIALTY DOORS													
08300-01	Specialty Doors	08300	08310-01-A	08310-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	08310-01-K	N/A
	OVERHEAD COILING DOORS													
08331-01	Overhead Coiling Doors	08331	08331-01-A	08331-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	08331-01-K	N/A
	COILING COUNTER DOORS													
08332-01	Coiling Counter Doors	08332	08332-01-A	08332-01-B	N/A	N/A	N/A	N/A	08332-01-G	N/A	N/A	N/A	08332-01-K	N/A
	HIGH SPEED ROLLING DOORS													
08360-01	High Speed Rolling Doors	08360	08360-01-A	08360-01-B	N/A	N/A	N/A	N/A	08360-01-G	N/A	N/A	N/A	08360-01-K	N/A
	ALUMINUM FRAMED ENTRANCES AND STOREFRONTS													
08411-01	Aluminum Framed Entrances and Storefronts	08411	08411-01-A	08411-01-B	N/A	08411-01-D	N/A	08411-01-F	08411-01-G	N/A	N/A	N/A	N/A	N/A
	DOOR HARDWARE													
08710-01	Door Hardware	08710	08710-01-A	N/A	N/A	08710-01-D	N/A	N/A	08710-01-G	N/A	N/A	N/A	08710-01-K	N/A
	GLAZING													
08800-01	Glazing	08800	08800-01-A	N/A	08800-01-C	08800-01-D	N/A	N/A	08800-01-G	N/A	N/A	N/A	N/A	N/A

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	DIVISION 9													
	NON-LOAD BEARING STEEL FRAMING													
09111-01	Non-Load Bearing Steel Framing	09111	09111-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	GYPSUM BOARD													
09250-01	Gypsum Board	09250	09250-01-A	N/A	N/A	09250-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CERAMIC TILE													
09310-01	Ceramic Tile	09310	09310-01-A	09310-01-B	09310-01-C	09310-01-D	N/A	09310-01-F	09310-01-G	N/A	N/A	N/A	N/A	N/A
	RESINOUS MATRIX TERRAZZO FLOORING													
09402-01	Resinous Matrix Terrazzo Flooring	09402	09402-01-A	09402-01-B	09402-01-C	09402-01-D	N/A	N/A	09402-01-G	N/A	N/A	N/A	09402-01-K	N/A
	ACOUSTICAL TILE CEILINGS													
09512-01	Acoustical Tile Ceilings	09512	09512-01-A	N/A	N/A	09512-01-D	N/A	09512-01-F	09512-01-G	N/A	N/A	N/A	09512-01-K	N/A
	RESLIENT FLOOR TILE													
09651-01	Resilient Floor Tile	09651	09651-01-A	09651-01-B	N/A	09651-01-D	N/A	N/A	09651-01-G	N/A	N/A	N/A	09651-01-K	N/A
	RESLIENT WALL BASE AND ACCESSORIES													
09653-01	Resilient Wall Base and Accessories	09653	09653-01-A	N/A	N/A	09653-01-D	N/A	N/A	09653-01-G	N/A	N/A	N/A	N/A	N/A
	CARPET TILE													
09681-01	Carpet Tile	09681	09681-01-A	09681-01-B	N/A	09681-01-D	N/A	09681-01-F	09681-01-G	N/A	N/A	N/A	09681-01-K	N/A
	EXTERIOR PAINTING													
09911-01	Exterior Painting	09911	09911-01-A	N/A	N/A	09911-01D	N/A	N/A	09911-01-G	N/A	N/A	N/A	N/A	N/A
	INTERIOR PAINTING													
09915-01	Interior Painting	09915	09915-01-A	N/A	N/A	09915-01-D	N/A	N/A	09915-01-G	N/A	N/A	N/A	09915-01-K	N/A

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	PAVEMENT MARKINGS PAINT													
09919-01	Pavement Markings Paint	09919	09919-01-A	09919-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	HIGH-PERFORMANCE COATINGS													
09960-01	High Performance Coatings	09960	09960-01-A	N/A	N/A	09960-01-D	N/A	N/A	09960-01-G	N/A	N/A	N/A	N/A	N/A
	DIVISION 10													
	VISUAL DISPLAY SYSTEMS													
10147-01	Visual Display Systems	10147	10147-01-A	10147-01-B	N/A	10147-01-D	N/A	10147-01-F	10147-01-G	N/A	N/A	N/A	N/A	N/A
	TOILET COMPARTMENTS													
10170-01	Toilet Compartments	10170	10170-01-A	10170-01-B	N/A	N/A	N/A	N/A	10170-01-G	N/A	N/A	N/A	10170-01-K	N/A
	WELDING CURTAINS													
10194-01	Welding Curtains	10194	10194-01-A	10194-01-B	N/A	10194-01-D	N/A	N/A	10194-01-G	N/A	N/A	N/A	N/A	N/A
	WALL LOUVERS													
10210-01	Wall Louvers	10210	10210-01-A	10210-01-B	N/A	10210-01-D	N/A	10210-01-F	N/A	N/A	N/A	N/A	N/A	N/A
	PANEL SIGNAGE													
10434-01	Panel Signage	10434	10434-01-A	10434-01-B	N/A	10434-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	METAL LOCKERS													
10505-01	Metal Lockers	10505	10505-01-A	10505-01-B	N/A	10505-01-D	N/A	N/A	10505-01-G	N/A	N/A	N/A	10505-01-K	N/A
	FIRE EXTINGUISHERS													
10523-01	Fire Extinguishers	10523	10523-01-A	N/A	N/A	10523-01-D	N/A	N/A	N/A	N/A	N/A	N/A	10523-01-K	N/A
	WIRE MESH PARTITIONS													
10605-01	Wire Mesh Partitions	10605	10605-01-A	10605-01-B	N/A	10605-01-D	N/A	N/A	10605-01-G	N/A	N/A	N/A	10605-01-K	N/A

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	STORAGE EQUIPMENT													
10670-01	Pallet Rack	10670	10670-01-A	10670-01-B	10670-01-C	10670-01-D	N/A	N/A	N/A	10670-01-H	N/A	N/A	10670-01-K	N/A
10670-02	Parts Storage Rack with Deck	10670	10670-02-A	10670-02-B	10670-02-C	10670-02-D	N/A	N/A	N/A	10670-02-H	N/A	N/A	10670-02-K	N/A
10670-03	Pallet Rack with Deck	10670	10670-03-A	10670-03-B	10670-03-C	10670-03-D	N/A	N/A	N/A	10670-03-H	N/A	N/A	10670-03-K	N/A
10670-04	Storage Shelving	10670	10670-04-A	10670-04-B	10670-04-C	10670-04-D	N/A	N/A	N/A	10670-04-H	N/A	N/A	10670-04-K	N/A
10670-05	Flammable Material Cabinet	10670	10670-05-A	10670-05-B	10670-05-C	10670-05-D	N/A	N/A	N/A	10670-05-H	N/A	N/A	10670-05-K	N/A
10670-06	Modular Drawer Cabinet with 2 Shelves	10670	10670-06-A	10670-06-B	10670-06-C	10670-06-D	N/A	N/A	N/A	10670-06-H	N/A	N/A	10670-06-K	N/A
10670-07	Storage Cabinet (Heavy Duty)	10670	10670-07-A	10670-07-B	10670-07-C	10670-07-D	N/A	N/A	N/A	10670-07-H	N/A	N/A	10670-07-K	N/A
10670-08	Tire Storage Rack, Two Tier	10670	10670-08-A	10670-08-B	10670-08-C	10670-08-D	N/A	N/A	N/A	10670-08-H	N/A	N/A	10670-08-K	N/A
09670-09	Cylinder Storage Cabinet	10670	10670-09-A	10670-09-B	10670-09-C	10670-09-D	N/A	N/A	N/A	10670-09-H	N/A	N/A	10670-09-K	N/A
10670-10	Bin Units	10670	10670-10-A	10670-10-B	10670-10-C	10670-10-D	N/A	N/A	N/A	10670-10-H	N/A	N/A	10670-10-K	N/A
10670-11	Recycling Bins	10670	10670-11-A	10670-11-B	10670-11-C	10670-11-D	N/A	N/A	N/A	10670-11-H	N/A	N/A	10670-11-K	N/A
10670-12	SupplyBay Cabinet	10670	10670-12-A	10670-12-B	10670-12-C	10670-12-D	N/A	N/A	N/A	10670-12-H	N/A	N/A	10670-12-K	N/A
10670-13	SupplyLocker	10670	10670-13-A	10670-13-B	10670-13-C	10670-13-D	N/A	N/A	N/A	10670-13-H	N/A	N/A	10670-13-K	N/A
10670-14	Roller Battery Storage Bench	10670	10670-14-A	10670-14-B	10670-14-C	10670-14-D	N/A	N/A	N/A	10670-14-H	N/A	N/A	10670-14-K	N/A
10670-15	Reel Rack	10670	10670-15-A	10670-15-B	10670-15-C	10670-15-D	N/A	N/A	N/A	10670-15-H	N/A	N/A	10670-15-K	N/A
	TOILET AND BATH ACCESSORIES													
10801-01	Toilet and Bath Accessories	10801	10801-01-A	N/A	N/A	10801-01-D	N/A	N/A	10801-01-G	N/A	N/A	N/A	10801-01-K	N/A
	DIVISION 11													
	SHOP WORK STATIONS													
11510-01	Heavy Duty Workbench with Vise	11510	11510-01-A	11510-01-B	11510-01-C	11510-01-D	N/A	N/A	N/A	11510-01-H	N/A	N/A	11510-01-K	N/A
11510-02	Electrostatic Workbench with Vise	11510	11510-02-A	11510-02-B	11510-02-C	11510-02-D	N/A	N/A	N/A	11510-02-H	N/A	N/A	11510-02-K	N/A
11510-03	Machinist Vise	11510	11510-03-A	11510-03-B	11510-03-C	11510-03-D	N/A	N/A	N/A	11510-03-H	N/A	N/A	11510-03-K	N/A
11510-04	Welding Table with Hood	11510	11510-04-A	11510-04-B	11510-04-C	11510-04-D	N/A	N/A	N/A	11510-04-H	N/A	N/A	11510-04-K	N/A
11510-05	Shipping Table	11510	11510-05-A	11510-05-B	11510-05-C	11510-05-D	N/A	N/A	N/A	11510-05-H	N/A	N/A	11510-05-K	N/A
11510-06	Hydraulic Hose Workbench	11510	11510-06-A	11510-06-B	11510-06-C	11510-06-D	N/A	N/A	N/A	11510-06-H	N/A	N/A	11510-06-K	N/A

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	SHOP EQUIPMENT													
11520-01	Buffer/Grinder with Dust Collector - 8 inch	11520	11520-01-A	11520-01-B	11520-01-C	11520-01-D	N/A	N/A	N/A	11520-01-H	N/A	N/A	11520-01-K	N/A
11520-02	55 Ton Air Hydraulic Press	11520	11520-02-A	11520-02-B	11520-02-C	11520-02-D	N/A	N/A	N/A	11520-02-H	N/A	N/A	11520-02-K	N/A
11520-03	Used Oil Filter Crusher	11520	11520-03-A	11520-03-B	11520-03-C	11520-03-D	N/A	N/A	N/A	11520-03-H	N/A	N/A	11520-03-K	N/A
11520-04	Drill Press Variable Speed - 15 inch	11520	11520-04-A	11520-04-B	11520-04-C	11520-04-D	N/A	N/A	N/A	11520-04-H	N/A	N/A	11520-04-K	N/A
11520-05	Welder/Plasma Cutter	11520	11520-05-A	11520-05-B	11520-05-C	11520-05-D	N/A	N/A	N/A	11520-05-H	N/A	N/A	11520-05-K	N/A
11520-06	Welder/Arc	11520	11520-06-A	11520-06-B	11520-06-C	11520-06-D	N/A	N/A	N/A	11520-06-H	N/A	N/A	11520-06-K	N/A
11520-07	AC Repair Portable Platform	11520	11520-07-A	11520-07-B	11520-07-C	11520-07-D	N/A	N/A	N/A	11520-07-H	N/A	N/A	11520-07-K	N/A
11520-08	Cylinder Lift Truck	11520	11520-08-A	11520-08-B	11520-08-C	11520-08-D	N/A	N/A	N/A	11520-08-H	N/A	N/A	11520-08-K	N/A
11520-09	Cylinder Scale	11520	11520-09-A	11520-09-B	11520-09-C	11520-09-D	N/A	N/A	N/A	11520-09-H	N/A	N/A	11520-09-K	N/A
11520-10	Refrigerant Leak Detector	11520	11520-10-A	11520-10-B	11520-10-C	11520-10-D	N/A	N/A	N/A	11520-10-H	N/A	N/A	11520-10-K	N/A
11520-11	Refrigerant Recovery System	11520	11520-11-A	11520-11-B	11520-11-C	11520-11-D	N/A	N/A	N/A	11520-11-H	N/A	N/A	11520-11-K	N/A
11520-12	Vacuum Pump	11520	11520-12-A	11520-12-B	11520-12-C	11520-12-D	N/A	N/A	N/A	11520-12-H	N/A	N/A	11520-12-K	N/A
11520-13	Nitrogen Tire Inflation System	11520	11520-13-A	11520-13-B	11520-13-C	11520-13-D	N/A	N/A	N/A	11520-13-H	N/A	N/A	11520-13-K	N/A
11520-14	Table with Hydraulic Hose Cut-off Machine	11520	11520-14-A	11520-14-B	11520-14-C	11520-14-D	N/A	N/A	N/A	11520-14-H	N/A	N/A	11520-14-K	N/A
11520-15	Hydraulic Hose Crimper	11520	11520-15-A	11520-15-B	11520-15-C	11520-15-D	N/A	N/A	N/A	11520-15-H	N/A	N/A	11520-15-K	N/A
11520-16	Diesel Fuel Caddy	11520	11520-16-A	11520-16-B	11520-16-C	11520-16-D	N/A	N/A	N/A	11520-16-H	N/A	N/A	11520-16-K	N/A
11520-17	Portable Fume Exhauster	11520	11520-17-A	11520-17-B	11520-17-C	11520-17-D	N/A	N/A	N/A	11520-17-H	N/A	N/A	11520-17-K	N/A
11520-18	Portable Welding Curtain	11520	11520-18-A	11520-18-B	11520-18-C	11520-18-D	N/A	N/A	N/A	11520-18-H	N/A	N/A	11520-18-K	N/A
	CLEANING EQUIPMENT													
11535-01	High Pressure Wash with 4 Remote Control Stations and Holse Reels	11535	11535-01-A	11535-01-B	11535-01-C	11535-01-D	N/A	N/A	N/A	11535-01-H	N/A	N/A	11535-01-K	N/A
11535-02	Parts Washer	11535	11535-02-A	11535-02-B	11535-02-C	11535-02-D	N/A	N/A	N/A	11535-02-H	N/A	N/A	11535-02-K	N/A
11535-03	Small Parts Washer	11535	11535-03-A	11535-03-B	11535-03-C	11535-03-D	N/A	N/A	N/A	11535-03-H	N/A	N/A	11535-03-K	N/A
	DIVISION 12													
	HORIZONTAL LOUVER BLINDS													
12491-01	Horizontal Louver Blinds	12491	12491-01-A	N/A	N/A	N/A	N/A	N/A	12491-01-G	N/A	N/A	N/A	N/A	N/A
	DIVISION 13													
	LIGHTNING PROTECTION													
13100-01	Lightning Protection System	13100	13100-01-A	13100-01-B	13100-01-C	13100-01-D	N/A	N/A	N/A	N/A	N/A	13100-01-J	N/A	13100-01-L
	INTRUSION DETECTION													
13720-01	Intrusion Detection	13720	13720-01-A	13720-01-B	N/A	13720-01-D	N/A	N/A	13720-01-G	N/A	N/A	13720-01-J	13720-01-K	N/A

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	SECURITY ACCESS													
13730-01	Security Access	13730	13730-01-A	13730-01-B	N/A	N/A	N/A	N/A	13730-01-G	N/A	N/A	13730-01-J	13730-01-K	N/A
	VIDEO SURVEILLANCE	13760	13760-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13760-01	Video Surveillance	13760	13760-01-A	13760-01-B	13760-01-C	N/A	N/A	N/A	N/A	N/A	N/A	13760-01-J	13760-01-K	N/A
	DOOR VIDEO INTERCOM SYSTEM													
13830-01	Door Video Intercom System	13830	13830-01-A	13830-01-B	13830-01-C	13830-01-D	N/A	N/A	N/A	N/A	N/A	N/A	13830-01-K	N/A
	DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM													
13852-01	Digital, Addressable Fire-Alarm System	13852	13852-01-A	13852-01-B	N/A	13852-01-D	N/A	N/A	N/A	N/A	N/A	13852-01-J	13852-01-K	N/A
	WET-PIPE FIRE-SUPPRESSION SPRINKLERS													
13930-01	Wet-Pipe Fire-Suppression Sprinklers	13930	13930-01-A	13930-01-B	13930-01-C	13930-01-D	N/A	N/A	N/A	N/A	N/A	13930-01	N/A	N/A
	CLEAN-AGENT FIRE-EXTINGUISHING SYSTEMS													
13967-01	Clean-Agent Fire-Extinguishing Systems	13967	13967-01-A	13967-01-B	N/A	13967-01-D	N/A	N/A	N/A	N/A	N/A	N/A	13967-01-K	N/A
	FIRE-SUPPRESSION STANDPIPES													
13974-01	Fire Suppresion Standpipes	13974	13974-01-A	13974-01-B	N/A	13974-01-D	N/A	N/A	N/A	N/A	N/A	13974-01-J	13974-01-K	N/A
	DIVISION 14													
	HYDRAULIC ELEVATOR													
14240-01	Hydraulic Elevator	14240	14240-01-A	14240-01-B	14240-01-C	14240-01-D	N/A	N/A	N/A	N/A	N/A	N/A	14240-01-K	N/A
	WHEEL CHAIR LIFTS													
14420-01	Wheel Chair Lifts	14420	14420-01-A	14420-01-B	14420-01-C	14420-01-D	N/A	N/A	14420-01-G	N/A	N/A	N/A	14420-01-K	N/A

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	VEHICLE LIFTS													
14450-01	Portable Bus Lifts (Set of 4 or 6)	14450	14450-01-A	14450-01-B	14450-01-C	14450-01-D	N/A	N/A	N/A	14450-01-H	N/A	N/A	14450-01-K	N/A
	FORKLIFTS													
14513-01	Forklift and Charging Station	14513	14513-01-A	14513-01-B	14513-01-C	14513-01-D	N/A	N/A	N/A	14513-01-H	N/A	N/A	14513-01-K	N/A
	BRIDGE CRANE													
14630-01	1/2 Ton Underhung Bridge Crane with Hoist	14630	14630-01-A	14630-01-B	14630-01-C	14630-01-D	N/A	N/A	N/A	14630-01-H	N/A	N/A	14630-01-K	N/A
	FALL ARREST SYSTEM													
14635-01	Fall Arrest System	14635	14635-01-A	14635-01-B	14635-01-C	14635-01-D	N/A	N/A	N/A	14635-01-H	N/A	N/A	14635-01-K	N/A
	MONORAIL CRANES													
14920-01	Monorail and Hoist - 2 Ton	14920	14920-01-A	14920-01-B	14920-01-C	14920-01-D	N/A	N/A	N/A	14920-01-H	N/A	N/A	14920-01-K	N/A
	DIVISION 15													
	HANGERS AND SUPPORTS FOR HVAC AND PLUMBING PIPING AND EQUIPMENT													
15062-01	Hangers and Supports for HVAC and Plumbing Piping and Equipment	15062	15062-01-A	15062-01-B	N/A	15062-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT													
15072-01	Vibration and Seismic Controls for Fire-Suppression Piping and Equipment	15072	15072-01-A	N/A	15072-01-C	15072-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	VIBRATION AND SEISMIC CONTROLS FOR HVAC AND PLUMBING PIPING AND EQUIPMENT													
15074-01	Vibration and Seismic Controls for HVAC and Plumbing Piping and Equipment	15074	15074-01-A	N/A	15074-01-C	15074-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	IDENTIFICATION FOR HVAC AND PLUMBING PIPING AND EQUIPMENT													
15077-01	Identification for HVAC and Plumbing Piping and Equipment	15077	15077-01	N/A	N/A	15077-01-D	N/A	N/A	15077-01-G	N/A	N/A	N/A	N/A	N/A
	DUCT INSULATION													
15086-01	Duct Insulation	15086	15086-01-A	15086-01-B	N/A	15086-01-D	N/A	15086-01-F	15086-01-G	N/A	N/A	N/A	N/A	N/A
	HVAC AND PLUMBING EQUIPMENT INSULATION													
15087-01	HVAC and Plumbing Equipment Insulation	15087	15087-01-A	15087-01-B	N/A	15087-01-D	N/A	15087-01-F	15087-01-G	N/A	N/A	N/A	N/A	N/A
	HVAC AND PLUMBING PIPING INSULATION													
15088-01	HVAC and Plumbing Piping Insulation	15088	15088-01-A	15088-01-B	N/A	15088-01-D	N/A	15088-01-F	15088-01-G	N/A	N/A	N/A	N/A	N/A
	SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING													
15091-01	Sleeves and Sleeve Seals for Fire-Suppression Piping	15091	15091-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	SLEEVES AND SLEEVE SEALS FOR HVAC AND PLUMBING PIPING													
15093-01	Sleeves and Sleeve Seals for HVAC and Plumbing Piping	15093	15093-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING													
15096-01	Escutcheons for Fire-Suppression Piping	15096	15096-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	ESCUTCHEONS FOR HVAC AND PLUMBING PIPING													
15098-01	Escutcheons for HVAC and Plumbing Piping	15098	15098-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	PLUMBING VALVES													
15110-01	Plumbing Valves	15110	15110-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	GENERAL-DUTY VALVES FOR HVAC PIPING													
15112-01	General-Duty Valves for HVAC Piping	15112	15112-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	PLUMBING PIPING SPECIALITES													
15120-01	Plumbing Piping Specialiteis	15120	15120-01-A	15120-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15120-01-J	15120-01-K	N/A
	EXPANSION FITTINGS AND LOOPS FOR HVAC AND PLUMBING PIPING													
15124-01	Expansion Fittings and Loops for HVAC and Plumbing Piping	15124	15124-01-A	N/A	15124-01-C	15124-01-D	N/A	N/A	N/A	N/A	N/A	N/A	15124-01-K	N/A
	METERS AND GAGES FOR HVAC AND PLUMBING PIPING													
15127-01	Meters and Gages for HVAC and Plumbing Piping	15127	15127-01-A	N/A	15127-01-C	15127-01-D	N/A	N/A	N/A	N/A	N/A	N/A	15127-01-K	N/A
	PUMPS FOR PLUMBING													
15130-01	Pumps for Plumbing	15130	15130-01-A	15130-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15130-01-K	N/A
	DOMESTIC WATER PIPING													
15140-01	Domestic Water Piping	15140	15140-01-A	N/A	N/A	N/A	N/A	N/A	15140-01-G	N/A	N/A	15140-01-J	N/A	N/A

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	SANITARY WASTE AND VENT PIPING													
15150-01	Sanitary Waste and Vent Piping	15150	15150-01-A	15150-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15150-01-J	N/A	N/A
	STORM AND CONDENSATE DRAINAGE PIPING													
15160-01	Storm and Condensate Drainage Piping	15160	15160-01-A	15160-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15160-01-J	N/A	N/A
	HYDRONIC PIPING SPECIALTIES													
15179-01	Hydronic Piping Specialties	15179	15179-01-A	N/A	N/A	15179-01-D	N/A	N/A	N/A	N/A	N/A	N/A	15179-01-K	N/A
	HYDRONIC PIPING													
15181-01	Hydronic Piping	15181	15181-01-A	15181-01-B	15181-01-C	15181-01-D	N/A	N/A	N/A	N/A	N/A	15181-01-J	15181-01-K	N/A
	GROUND-LOOP HEAT-PUMP PIPING													
15182-01	Ground-Loop Heat-Pump Piping	15182	15182-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15182-01-J	N/A	N/A
	REFRIGERANT PIPING													
15183-01	Refrigerant Piping	15183	15183-01-A	15183-01-B	15183-01-C	N/A	N/A	N/A	N/A	N/A	N/A	15183-01--J	15183-01-K	N/A
	HYDRONIC PUMPS													
15185-01	Hydronic Pumps	15185	15185-01-A	15185-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15185-01-K	N/A
	HVAC WATER TREATMENT													
15189-01	HVAC Water Treatment	15189	15189-01-A	15189-01-B	15189-01-C	15189-01-D	N/A	N/A	N/A	N/A	N/A	15189-01-J	15189-01-K	N/A
	FACILITY FUEL-OIL PIPING													
15192-01	Facility Fuel-Oil Piping	15192	15192-01-A	15192-01-B	15192-01-C	15192-01-D	N/A	N/A	N/A	N/A	N/A	15192-01-J	15192-01-K	N/A
	ABOVEGROUND STORAGE TANKS													
15193-01	Aboveground Storage Tanks	15193	15193-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	FUEL GAS PIPING													
15194-01	Fuel Gas Piping	15194	15194-01-A	15194-01-B	15194-01-C	N/A	N/A	N/A	N/A	N/A	N/A	15194-01-J	15194-01-K	N/A
	FLUID MANAGEMENT SYSTEM													
15195-01	Fluid Management System	15195	15195-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	FLUID HANDLING SYSTEMS													
15198-01	Fluid Handling System	15198	15198-01-A	15198-01-B	15198-01-C	15198-01-D	N/A	N/A	N/A	N/A	N/A	15198-01-J	15198-01-K	N/A
	PROCESS AIR AND GAS PIPING													
15210-01	Process Air and Gas Piping	15210	15210-01-A	N/A	15210-01-C	15210-01-D	N/A	N/A	N/A	N/A	N/A	15210-01-J	N/A	N/A
	GENERAL SERVICE COMPRESSED AIR EQUIPMENT													
15251-01	General Service Compressed Air Equipment	15251	15251-01-A	15251-01-B	15251-01-C	15251-01-D	N/A	N/A	N/A	N/A	N/A	N/A	15251-01-K	N/A
	PLUMBING FIXTURES													
15410-01	Plumbing Fixtures	15410	15410-01-A	15410-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15410-01-K	N/A
	DOMESTIC WATER HEATERS													
15480-01	Domestic Water Heaters	15480	15480-01-A	15480-01-B	15480-01-C	N/A	N/A	15480-01-F	N/A	N/A	N/A	15480-01-J	15480-01-K	N/A
	CAST-IRON BOILERS													
15512-01	Cast-Iron Boilers	15512	15512-01-A	15512-01-B	15512-01-C	15512-01-D	N/A	15512-01-F	N/A	N/A	N/A	15512-01-J	15512-01-K	N/A
	BREECHINGS, CHIMNEYS, AND STACKS													
15550-01	Breechings, Chimneys, and Stacks	15550	15550-01-A	15550-01-B	15550-01-C	15550-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DRAFT CONTROL DEVICES													
15555-01	Draft Control Devices	15555	1555-01-A	15555-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	15555-01-K	N/A

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	PACKAGED COMPRESSOR AND CONDENSOR UNITS													
15671-01	Packaged Compressor and Condensor Units	15671	15671-01-A	15671-01-B	15671-01-C	15671-01-D	N/A	N/A	N/A	N/A	N/A	N/A	15671-01-K	N/A
	MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS													
15725-01	Modular Indoor Central-Station Air-Handling Units	15725	15725-01-A	N/A	15725-01-C	15725-01-D	N/A	N/A	N/A	N/A	N/A	N/A	15725-01-K	N/A
	SPLIT-SYSTEM AIR-CONDITIONING UNITS													
15738-01	Split-System Air-Conditioning Units	15738	15738-01-A	15738-01-B	N/A	N/A	N/A	N/A	15738-01-G	N/A	N/A	N/A	15738-01-K	N/A
	WATER-SOURCE HEAT PUMPS													
15745-01	Water-Source Heat Pumps	15745	15745-01-A	15745-01-B	15745-01-C	15745-01-D	N/A	N/A	15745-01-G	N/A	N/A	15745-01-J	15745-01-K	N/A
	AIR COILS													
15761-01	Air Coils	15761	15761-01-A	15761-01-B	N/A	15761-01-D	N/A	N/A	N/A	N/A	N/A	15761-01-J	15761-01-K	N/A
	AIR-TO-AIR ENERGY RECOVERY EQUIPMENT													
15785-01	Air-to-Air Energy Recovery Equipment	15785	15785-01-A	15785-01-B	15785-01-C	15785-01-D	N/A	N/A	N/A	N/A	N/A	15785-041-J	15785-01-K	N/A
	CABINET UNIT HEATERS													
15791-01	Cabinet Unit Heaters	15791	15791-01-A	15791-01-B	15791-01-C	15791-01-D	N/A	N/A	N/A	N/A	N/A	15791-01-J	15791-01-K	N/A
	PROPELLER UNIT HEATERS													
15792-01	Propeller Unit Heaters	15792	15792-01-A	15792-01-B	15792-01-C	15792-01-D	N/A	N/A	N/A	N/A	N/A	15792-01-J	15792-01-K	N/A
	METAL DUCTS													
15815-01	Metal Ducts	15815	15815-01-A	15815-01-B	N/A	15815-01-D	N/A	N/A	N/A	N/A	N/A	15815-01-J	N/A	N/A

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	DUCT ACCESSORIES													
15820-01	Duct Accessories	15820	15820-01-A	15820-01-B	N/A	15820-01-D	N/A	N/A	N/A	N/A	N/A	N/A	15820-01-K	N/A
	FANS													
15838-01	Fans	15838	15838-01-A	15838-01-B	15838-01-C	15838-01-D	N/A	N/A	N/A	N/A	N/A	15838-01-J	15838-01-K	N/A
	DIFFUSERS, REGISTERS, AND GRILLES													
15855-01	Diffusers, Registers, and Grilles	15855	15855-01-A	N/A	N/A	15855-01-D	N/A	15855-01-F	15855-01-G	N/A	N/A	N/A	N/A	N/A
	HVAC INSTRUMENTATION AND CONTROLS													
15900-01	HVAC Instrumentation and Controls	15900	15900-01-A	15900-01-B	N/A	15900-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	TESTING, ADJUSTING, AND BALANCING													
15950-01	Testing, Adjusting, and Balancing	15950	N/A	N/A	15950-01-C	15950-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	DIVISION 16													
	OVERCURRENT PROTECTIVE DEVICE COORDINATION AND ARC-FLASH STUDY													
16055-01	Overcurrent Protective Device Coordination and Arc-Flash Study	16055	16055-01-A	N/A	16055-01-C	16055-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	GROUNDING AND BONDING													
16060-01	Grounding and Bonding	16060	16060-01-A	N/A	N/A	16060-01-D	N/A	N/A	N/A	N/A	N/A	16060-01-J	N/A	N/A
	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS													
16073-01	Hangers and Supports for Electrical Systems	16073	16073-01-A	16073-01-B	16073-01-C	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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	ELECTRICAL IDENTIFICATION													
16075-01	Electrical Identification	16075	16075-01-A	N/A	N/A	16075-01-D	N/A	N/A	16075-01-G	N/A	N/A	N/A	N/A	N/A
	SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING													
16091-01	Sleeves and Sleeve Seals for Electrical Raceways and Cabling	16091	16091-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	CONDUCTORS AND CABLES													
16120-01	Conductors and Cables	16120	16120-01-A	N/A	N/A	16120-01-D	N/A	N/A	N/A	N/A	N/A	16120-01-J	N/A	N/A
	RACEWAYS AND BOXES													
16130-01	Raceways and Boxes	16130	16130-01-A	16130-01-B	16130-01-C	16130-01-D	N/A	16130-01-F	N/A	N/A	N/A	N/A	N/A	N/A
	CABLE TRAYS FOR COMMUNICATIONS SYSTEMS													
16136-01	Cable Trays for Communications Systems	16136	16136-01-A	16136-01-B	16136-01-C	16136-01-D	N/A	N/A	N/A	N/A	N/A	16136-01-J	N/A	N/A
	WIRING DEVICES													
16140-01	Wiring Devices	16140	16140-01-A	16140-01-B	N/A	N/A	N/A	N/A	16140-01-G	N/A	N/A	16140-01-J	16140-01-K	N/A
	LIGHTING CONTROL DEVICES													
16145-01	Lighting Control Devices	16140	16140-01-A	16140-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16140-01-J	16140-01-K	N/A
	ELECTRICITY METERING													
16211-01	Electricity Metering	16211	16211-01-A	16211-01-B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16211-01-J	16211-01-K	N/A
	PACKAGED ENGINE GENERATORS													
16231-01	Packaged Engine Generators	16231	16231-01-A	16231-01-B	16231-01-C	16231-01-D	N/A	16231-01-F	N/A	N/A	N/A	16231-01-J	16231-01-K	N/A

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	STATIC UNINTERRUPTIBLE POWER SUPPLY													
16264-01	Static Uninterruptible Power Supply	16264	16264-01-A	N/A	16264-01-C	N/A	N/A	16264-01-F	N/A	N/A	N/A	16264-01-J	16264-01-K	N/A
	VARIABLE FREQUENCY CONTROLLERS													
16269-01	Variable Frequency Controllers	16269	16269-01-A	16269-01-B	16269-01-C	16269-01-D	N/A	N/A	N/A	N/A	N/A	N/A	16269-01-K	N/A
	SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS													
16289-01	Surge Protection for Low-Voltage Electrical Power Circuits	16289	16289-01-A	N/A	16289-01-C	N/A	N/A	N/A	N/A	N/A	N/A	16289-01-J	16289-01-K	N/A
	ENCLOSED SWITCHES AND CIRCUIT BREAKERS													
16410-01	Enclosed Switches and Circuit Breakers	16410	16410-01-A	16410-01-B	16410-01-C	16410-01-D	N/A	N/A	N/A	N/A	N/A	16410-01-J	16410-01-K	N/A
	TRANSFER SWITCHES													
16415-01	Transfer Switches	16415	16415-01-A	16415-01-B	16415-01-C	16415-01-D	N/A	N/A	N/A	N/A	N/A	16415-01-J	16415-01-K	N/A
	ENCLOSED CONTROLLERS													
16420-01	Enclosed Controllers	16420	16420-01-A	16420-01-B	16420-01-C	16420-01-D	N/A	N/A	N/A	N/A	N/A	16420-01-J	16420-01-K	N/A
	SWITCHBOARDS													
16441-01	Switchboards	16441	16441-01-A	16441-01-B	16441-01-C	16441-01-D	N/A	N/A	16441-01-G	N/A	N/A	16441-01-J	16441-01-K	N/A
	PANELBOARDS													
16442-01	Panelboards	16442	16442-01-A	16442-01-B	N/A	16442-01-D	N/A	N/A	N/A	N/A	N/A	16442-01-J	16442-01-K	N/A
	LOW-VOLTAGE TRANSFORMERS													
16461-01	Low-Voltage Transformers	16461	16461-01-A	16461-01-B	16461-01-C	16461-01-D	N/A	16461-01-F	N/A	N/A	N/A	16461-01-J	16461-01-K	N/A

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	FUSES													
16491-01	Fuses	16491	16491-01-A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	16491-01-K	N/A
	INTERIOR LIGHTING													
16510-01	Interior Lighting	16510	16510-01-A	16510-01-B	N/A	16510-01-D	N/A	N/A	16510-01-G	N/A	N/A	16510-01-J	16510-01-K	N/A
	EXTERIOR BUILDING LIGHTING													
16520-01	Exterior Building Lighting	16520	16520-01-A	16520-01-B	16520-01-C	16520-01-D	N/A	N/A	16520-01-G	N/A	N/A	16520-01-J	16520-01-K	N/A
	NETWORK LIGHTING CONTROLS													
16570-01	Network Lighting Controls	16570	16570-01-A	N/A	N/A	16570-01-D	N/A	N/A	N/A	N/A	N/A	N/A	16570-01-K	N/A
	PATHWAYS FOR COMMUNICATIONS SYSTEMS													
16711-01	Pathways for Communications Systems	16711	16711-01-A	16711-01-B	16711-01-C	16711-01-D	N/A	16711-01-F	16711-01-G	N/A	N/A	N/A	N/A	N/A
	PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY													
16712-01	Pathways for Electronic Safety and Security	16712	16712-01-A	16712-01-B	16712-01-C	16712-01-D	N/A	16712-01-F	16712-01-G	N/A	N/A	N/A	N/A	N/A
	COMMUNICATIONS EQUIPMENT ROOM FITTINGS													
16714-01	Communications Equipment Room Fittings	16714	16714-01-A	16714-01-B	16714-01-C	16714-01-D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	COMMUNICATIONS BACKBONE CABLING													
16716-01	Communications Backbone Cabling	16716	16716-01-A	16716-01-B	N/A	16716-01-D	N/A	16716-01-F	N/A	N/A	N/A	16716-01-J	N/A	N/A
	COMMUNICATIONS HORIZONTAL CABLING													
16717-01	Communications Horizontal Cabling	16717	16717-01-A	16717-01-B	N/A	16717-01-D	N/A	16717-01-F	16717-01-G	N/A	N/A	16717-01-J	16717-01-K	N/A

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	CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY													
16718-01	Conductors and Cables for Electronic Safety and Security	16718	16718-01-A	N/A	N/A	16718-01-D	N/A	16718-01-F	N/A	N/A	N/A	16718-01-J	N/A	N/A
	INTERCOMMUNICATIONS AND PROGRAM SYSTEMS													
16722-01	Intercommunications and Program Systems	16722	16722-01-A	16722-01-B	N/A	16722-01-D	N/A	N/A	N/A	N/A	N/A	N/A	16722-01-K	N/A

APPENDIX G

GEOTECHNICAL DATA – FOR INFORMATION ONLY

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KIRK BUS DIVISION MODERNIZATION - PHASE 1

7.2 MAINTENANCE BUILDING

The proposed Maintenance Building will be approximately 94,000 square feet in plan, as shown on Figure 2B, Site Location Plan – Maintenance Building, with 3 partial floors. The FF elevation is at El. 114.6 feet.

The proposed improvements at the Maintenance Building site include:

- New 94,000± square foot Storage Building – 3 levels.
- The building will be supported on steel columns and concrete slabs.
- Retaining walls for the Maintenance building: The exterior wall of the Maintenance Building will also retain some fills.
  - On the east side, the exterior grade is at El. 130± feet and the bottom of excavation will probably be at about El. 111.5± (i.e. FF of El. 114.6 minus about 3 feet). Therefore, the east wall will retain about 18.5 feet of fill. There is sufficient space to slope the excavation hence support of excavation will probably not be required.
  - On the north side, the exterior grade is sloping, but, there is sufficient space to slope the excavation so support of excavation will not be required.
  - On the south side (along Curtain Avenue), at the east end, the depth of excavation will be about 18.5 feet. The edge of building wall is only about 15 feet from the road. Hence support of excavation will probably be required for some distance along the south face of the building.
- Pavement for parking lot on north side and east side.

There is a grade difference of about 20 feet from Garrett Avenue to Kirk Avenue. The highest elevation is at the northeast corner where the ground elevation is at about El. 133± feet. Garrett Avenue slopes down from north (El. 132±) to south (El. 130±). Kirk Avenue also slopes down from north (El. 115±) to south (El. 110±). There is a steep grassy slope (of about 10± feet) at the east end, adjacent to Garrett Avenue. The paved parking lot is at about El. 122± near the east end (i.e. adjacent to the bottom of slope near Garrett Avenue) and the pavement gradually slopes down to Kirk Avenue.

A total of 18 borings (i.e. RB-1 through RB-18) were drilled by E2CR, Inc. at the location of the Maintenance Building. Two test pits (i.e. TP-2 and TP-3) were also excavated by E2CR. In addition, borings B-08 through B-11 were drilled by others in March 2008.

The existing boring data is summarized below.

Boring Number	Ex. Grade El. (ft)	Boring Depth (ft)	Depth of Fill (ft)	Decomp. Rock		Bedrock		Ground water depth (ft)	GW Elev.
				Depth (ft)	El. (ft)	Depth (ft)	El. (ft)		
RB-1	119.2	62.6	11.0	42.0	77.2	62.6	56.6	11.0	108.2
RB-2	121.7	68.8	8.0	47.0	74.7	n/a		9.8	111.9
RB-3	134.8	39.0	0.0	22.0	112.8	n/a		39.5	95.3
RB-4	115.7	49.0	18.0	32.0	83.7	n/a		8.5	107.2
RB-5	116.7	54.5	10.5	37.0	79.7	n/a		16.0	100.7
RB-6	116.7	59.0	15.5	42.0	74.7	n/a		8.5	108.2
RB-7	116.9	48.8	5.5	32.0	84.9	n/a		33.0	83.9

Boring Number	Ex. Grade El. (ft)	Boring Depth (ft)	Depth of Fill (ft)	Decomp. Rock		Bedrock		Ground water depth (ft)	GW Elev.
				Depth (ft)	El. (ft)	Depth (ft)	El. (ft)		
RB-8	117.1	59.4	3.0	42.0	75.1	n/a		11.0	106.1
RB-9	132.8	28.5	8.0	27.0	105.8	28.5	104.3	14.0	118.8
RB-10	112.4	43.9	18.0	27.0	85.4	n/a		15.0	97.4
RB-11	114.1	49.5	15.5	32.0	82.1	n/a		8.5	105.6
RB-12	114.2	50.0	5.5	32.0	82.2	n/a		7.0	107.2
RB-13	126.4	64.0	21.0	42.0	84.4	n/a		17.0	109.4
RB-14	128.6	50.0	19.0	32.0	96.6	n/a		15.0	113.6
RB-15	132.2	59.5	15.5	42.0	90.2	n/a		15.0	117.2
RB-16	113.5	80.0	23.0	42.0	71.5	n/a		8.5	105.0
RB-17	114.5	70.0	18.0	52.0	62.5	n/a		8.0	106.5
RB-18	128.0	79.0	18.0	57.0	71.0	n/a		17.0	111.0
B-08	118.2	40	13	27	91.2	-		6.5	111.7
B-09	123.6	40	8	32	91.6	-		5	118.6
B-10	132	50	17	-		-		18	114
B-11	127.5	45	22	-		-		17.5	110
TP-2	132.4	12.0	5.0	n/a		n/a		DRY	DRY
TP-3	128.3	8.5	2.5	n/a		n/a		DRY	DRY

7.2.1 Column Foundation

The column layout at the location of the Maintenance Building is shown on Figure 4B, Column Line plan – Maintenance Building. The preliminary column loading information provided to us indicates that the vertical loads on the columns varies significantly from about 10 kips to 580 kips. Currently, it is envisioned that there will be about thirty eight (38) columns.

The column line “A” is at the extreme south end (near Curtain Avenue) and column line “F” is at the north end (near Alley). Column line “1” is at the west end (near Kirk Avenue) and column line “10” is at the east end (near Garrett Avenue).

The borings encountered up to about 23 feet of fill on the property, as shown on the table in Section 7.2 and on Figures 5A to 5C and 5F - Generalized Subsurface Profiles. The fill is deeper at the west end of the property, i.e. near Kirk Avenue. The fill thickness reduces towards the east end of the property. The decomposed rock (or highly weathered rock) was generally below a depth of 30 feet below existing grade.

Two options were considered for support of the columns:
Option 1: Shallow Spread Footings
Option 2: Deep Foundations

7.2.1.1 Shallow Spread Footings

The soils at shallow depth are generally loose to medium dense un-engineered fills and are not considered to be suitable for supporting the column loads. The use of spread footings to support the columns loads is therefore not recommended at the Maintenance Building site.

7.2.1.2 Deep Foundations

A deep foundation alternative will be required to transfer the loads to the decomposed rock or bedrock at deeper depths.

i) *Drilled Shafts:* Drilled shafts could be used at the site. Drilled shafts are generally more efficient when large column loads have to be supported. At the site, the column loads are highly variable (25 kips to 550 kips), and are relatively low. Therefore, drilled shafts would be quite inefficient.

ii) Auger cast piles: Auger cast piles are also viable. They are generally of smaller diameter than drilled shafts, and carry smaller loads. At the site, auger cast piles of 12 inch to 14 inch diameter are considered to be a better option than drilled shafts. 14 inch auger cast piles could be installed to El. 65. The allowable axial compressive capacity of these piles should be limited to 50 tons.

iii) Driven H-Piles: Driven H-piles (HP 10x42) are also a viable option. These piles could be driven to refusal and would have an allowable bearing capacity in axial compression of 55 tons. The lengths of these piles are estimated to vary from 40 feet to 50 feet.

Based on the subsurface conditions the depth to decomposed rock is generally below a depth of about 30 feet below existing grade. The bedrock was encountered only in boring RB-1 at a depth of 62.6 feet (i.e. El. 56.6) and RB-9 at a depth of 28.5 feet (i.e. El. 104.3). For ease of installation, it is recommended that the piles be installed to El. 65 or to refusal as shown on Figure 6B – Storage Building Foundation Options and also as described below.

Type	Dimension	Installation Criteria	Allowable Capacity (tons)	
			Compression	Uplift
Augercast Piles	Dia = 14 inches	Tip @ El. 65 feet (L = 45± feet)	50	10
H-Piles	HP 10x42	Drive to refusal (L = 35 to 45 feet)	55	10

The estimated pile lengths (L) are from bottom of pile cap.

If augercast piles are selected for this Project, the piles must be installed to a tip elevation of El. 65 feet or to refusal, whichever occurs first.

If H-piles are selected, then these piles must be driven to refusal. The estimated H-pile tip elevation is El. 65 feet. It should be noted that due to differential weathering conditions, the estimated tip elevation could vary by about ±10-feet at various locations at the site.

Piles should be located as symmetrically as possible about the applied load with the center-to-center spacing no less than three pile diameters in any direction. The pile cap should be sufficiently rigid so that the load is adequately distributed to the piles.

It is recommended that at least one compression pile load tests be performed prior to production piling. The test piles should be selected from four test piles installed at the site. The test piles will help in determining pile length in different areas. The final installation criteria will be established based on the results of the test piles and the pile load tests.

The site is located adjacent to existing houses. Due to the proximity of these houses and potential citizen complaints, if the H-piles can not be installed by driving, then the H-piles could be installed in pre-drilled holes. Groundwater was encountered at shallow depth in the borings, therefore groundwater will be encountered during drilling of these holes for the H-piles. The use of a liner or the use of drilling mud should be considered during drilling. It is recommended that a 16 inch liner should be used for HP 10x42 pile and a 20 inch liner should be used for HP 12x53 pile. It is anticipated that this will considerably reduce the flow of water into the hole for the pile.

Once the hole is augered and cleaned, the predrilled hole should be grouted and the H-pile inserted in the grouted hole. The liner can be removed after the hole has been fully grouted and the H-pile lowered into it, however, a positive head of grout should always be maintained.

For lightly loaded columns, an option could be that the H-pile could be extended above the surface and become the permanent column of the structure

7.2.2 Building Slab

The building slab may be supported on firm, natural soils or on a layer of controlled, structural fill and isolated from the building columns and footings.

Since the building slab will be mainly used by buses, the building slab could be designed as:

a) Slab-on-grade
b) concrete rigid pavement

The entire site contains up to about 23 feet of loose to medium dense fill. Even thought the fill is loose, it was placed a long time back and should have stabilized under the current loading conditions. The proposed FF elevation is at El. 114.6. The existing grade varies from about El. 115 at Kirk Avenue to about El. 128 at the southeast end (near boring RB-18). Thus the southeast side will have about 14 feet of cut. This will result in a stress reduction of about 1700 psf, which is less than the proposed floor loads. The remainder of the building will have lesser cuts, but, will not receive any new fill.

Since there is an existing concrete slab at the site, which will be removed and another concrete slab will be installed at the same elevation or lower, there will be no significant stress increase on the fill. Hence no significant improvements of the fill will be required. However, it is recommended that the top two feet of the proposed subgrade be improved as discussed below.

The top two feet of the existing fill below the proposed top of subgrade should be undercut. After undercutting, the area should be proof rolled and localized areas of soft and/or unsuitable material should be further undercut to stable ground or 2 feet, whichever is "shallower". The undercut area should be backfilled with approved select borrow or granular fill. If the material removed during undercutting meets the requirement of select borrow, it could be reused as backfill, otherwise offsite borrow will be required.

Six (6) inches of No. 57 stone should be used beneath the floor slabs. A suitable moisture barrier should be provided under the slab. The moisture barrier will help prevent capillary rise and damp floor slab conditions. For native soil or fill material placed and compacted in the top two feet below the slab, a value of modulus of subgrade reaction of 100 pounds per cubic inch should be used to design the slab. The floor slab should be isolated from the columns. Control joints should be provided at about 20 feet spacing.

7.2.3 Maintenance Building Exterior Walls (below grade)

The exterior perimeter walls are anticipated to be load bearing walls. The loading information on the exterior walls is not available at this time.

Significant amounts of loose fill was encountered in the borings, therefore the perimeter walls should not be founded on this un-engineered fill. Two options are available:

i) Place the perimeter wall on a grade beam and transfer the load to the columns.
ii) Support the perimeter wall on piles.

Since the perimeter wall will be subjected to lateral loads from the backfill, battered piles will be required. If piles are used, it is recommended that the perimeter walls be supported on driven HP 10x42 piles. The piles should be driven to refusal (10 blows/ inch). The allowable axial compressive load per pile should be limited to 55 tons.

The Maintenance Building exterior walls should be designed as described in Section7.1.3 for Storage Building exterior walls.

7.2.4 Parking Lot / Pavement

A parking lot is proposed on north side, parallel to Alley and on the east side parallel to Garrett Avenue. The proposed entrances will be from Kirk Avenue and from Garrett Avenue.

This proposed parking area on the north side will require some fill since the area will be sloped down from Garrett Avenue (at El. 133) to Kirk Avenue (at about El. 115). Additional fill of up to 10 feet will be placed on the east end. The fill should be placed and compacted as per SHA Standard Specifications.

See Section 7.1.6 for design CBR information.

The traffic details and other design parameters are not available at this time. Further recommendations can be provided once traffic details and design parameters are made available to us.

7.3 Groundwater Control

Groundwater levels vary considerably at the site. Groundwater levels are summarized in Table 1 in the Appendix and are also shown on the boring logs. During drilling, groundwater was encountered at depths of 2.5 feet to 39 feet below the existing ground surface, but was generally at a depth of 10 feet to 15 feet below the ground surface.

In general, groundwater is anticipated to follow the weathered rock (i.e. Stratum III) profile. Therefore, groundwater should be anticipated at locations where the excavation extends to the weathered rock (i.e. Stratum III), especially at the west end of the Storage Building site where the excavation will extend into stratum III.

Most of the excavation is anticipated to be above the groundwater, but, localized areas could encounter groundwater. Therefore some amount of groundwater should be anticipated during construction of the Storage and Maintenance Buildings. Moreover, surficial water that enters the site will have to be dewatered. The methods of dewatering during construction should be left to the construction contractor.

7.4 Earthwork

The earthwork should be performed in accordance with SHA Standard Specifications, July 2008.

The borings indicate that the thickness of topsoil and/or rootmat, where encountered, could vary from about 4 inches to 6 inches. Where "topsoil" is stated in the boring logs, it generally indicates soil with some organic matter.

Prior to the construction of the foundations, pavements or the placement of fill in any structural areas, all existing organic materials, frozen or wet, excessively soft or loose soils, and other deleterious materials should be removed and wasted.

After the stripping operations, removal of the existing pavement and/or excavation to prescribed limits, have been completed, the exposed subgrade soils should be inspected by the Geotechnical Engineer or his approved representative. The exposed subgrade should be proof-rolled utilizing a heavily-loaded dump truck or other pneumatic tired vehicle of similar size and weight. The purpose of proof-rolling is to locate any isolated areas of soft or loose soils requiring undercutting. Proof-rolling is not advised in wet areas which may deteriorate under repeated vehicular loading. Wet areas should be drained and allowed to dry prior to proof-rolling.

Soft or pumping material, as revealed by proof rolling, should be undercut and should be backfilled with No. 57 stone or with soil material meeting the requirements for select borrow or capping borrow, as per Maryland SHA Standard Classifications.

The soil backfill should be placed in 8-inch loose (uncompacted) lifts and should be compacted to a minimum of 97% compaction within the top 1 foot of subgrade and a minimum of 92% compaction below a depth of 1-foot below subgrade, based on modified Proctor (AASHTO T-180C) and/or as per Maryland SHA requirements.

In general, the on-site soils that are free from organic material and other deleterious material, and meet the Specification requirements can be re-used as backfill. The SHA Standard Specification requires that the soil backfill in the top 2-feet, in structural areas, should consist of "select borrow" or "capping borrow", as per SHA Standard Specification Section 916. The laboratory tests conducted on four bulk samples (from borings BK-4, BK-9, RB-2 and TP-2) indicated that 2 of the samples to be in conformance with "Select Borrow". Therefore, some of the on-site Sandy soils are suitable for re-use as backfill within the top 2-feet.

The natural moisture content of the on-site Clayey soils in cut areas ranged from 14±% to 400±% and the natural moisture content of the on-site Sandy soils in the cut areas ranged from 8% to 23%. The results of modified Proctor compaction tests on bulk soil samples obtained indicated optimum moisture content for the Sandy soils was in the range of 6% to 8%. In order to achieve 92% to 97% compaction, the soils would need to have their moisture contents within ±2% of optimum moisture content. Therefore, the moisture content of the wet soils will need to be reduced (or the soils will need to be dried) in some areas to achieve required compaction of on site soils.

All fill placement and compaction operations in critical areas, i.e., building and pavement areas, should be monitored by an experienced soils inspector on a full-time basis to ensure that fill materials are being placed and compacted in compliance with the project specifications.

7.5 Utilities

All utilities should be designed and constructed in accordance with Maryland SHA and/or Baltimore City Specifications. This would include support of excavation, undercutting, backfilling and paving, if paving is required.

7.6 Excavations and Support

The borings indicate hard digging through weathered (or decomposed) rock will be required in some of the areas during construction. Based on the boring information, rock excavation is also anticipated during construction. The amount of rock excavation will depend on the elevation of spread footing. Due to differential weathering patterns, the depth to top of rock is anticipated to vary considerably and rock could be encountered at locations where borings were not drilled.

The excavation of rock/decomposed rock, if encountered, may require special equipment, such as hoe-ram or heavy excavator. If controlled blasting is used to as a method of excavation, then, utilities and/or other structures adjacent to the site should be monitored during the blasting operations. Pre-construction and post-construction surveys of adjacent buildings and/or utilities will also be required.

Groundwater should be anticipated at the depths indicated on the boring logs, and in general above the weathered rock stratum (i.e. Stratum III). Localized pockets of groundwater could be encountered at higher elevations. The excavation will need to be kept dewatered at all times. Ponding of water in the excavation should be avoided by properly grading the site.

For temporary excavations less than 4 feet deep, the cuts can be as steep as possible. For temporary excavations more than 4 feet deep the excavations should be no steeper than 1H:1V. A 10-foot wide bench should be provided for every 20 feet of vertical excavation. In some areas where the surficial soils are soft or loose, or if perched water or groundwater is encountered in the excavation, the sides of the temporary excavations should be no steeper than 1.5H:1V.

If an open excavation is not feasible due to area limitations or due to economic considerations, then a temporary lateral support system should be designed and installed to support the sides of the excavation. The design requirements of a temporary lateral support system should be addressed on a case-by-case basis. All excavation and trenching operations should comply with OSHA and local health and safety regulations.

For fill placed against sloping grounds steeper than 4H:1V, the fill should be benched into the existing slope.

All permanent slopes should be sloped at 3H:1V for maintenance purposes.

7.7 Site Seismic Characteristics

Based on the boring data, and on Section 1615 of the International Building Code (IBC, 2006), the site would classify as seismic site class D. For this classification, the following seismic design parameters are recommended:

Site Coefficient, F_v	=	2.4
Site Coefficient, F_a	=	1.6
Spectral Response Acceleration at 1 second period, S_1	=	0.06
Spectral Response Acceleration at short period, S_s	=	0.19

The potential for liquefaction is minimal since there are minimal loose sands. The fill, which could be loose in pockets is too heterogeneous to be of concern.

8.0 REMARKS

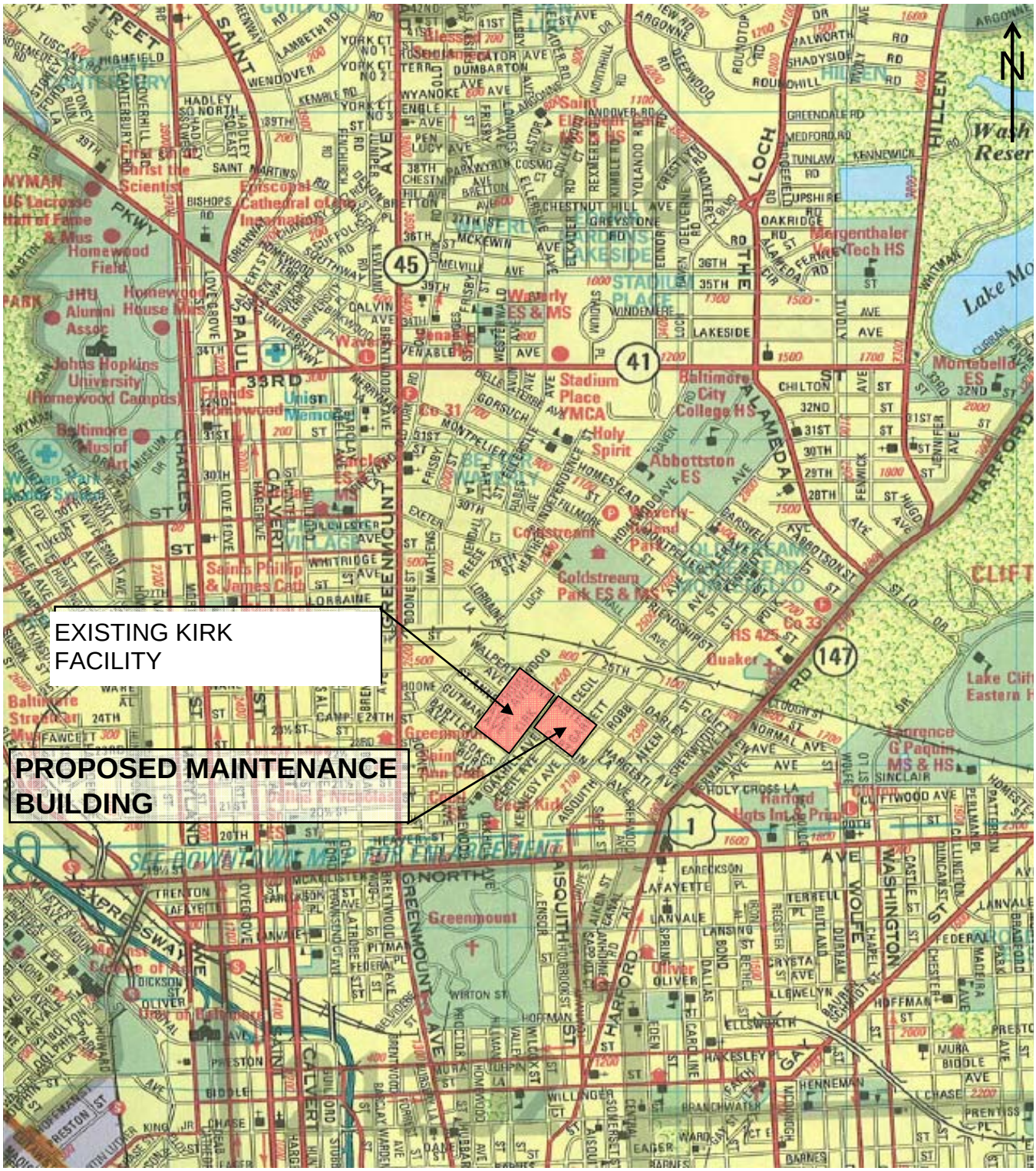
This report has been prepared to aid in the evaluation of the site for the construction of the proposed MTA Bus Storage and Maintenance Facility. These recommendations are based on information provided to us and the subsurface conditions encountered in the borings.

E2CR inc.

Site Vicinity Map

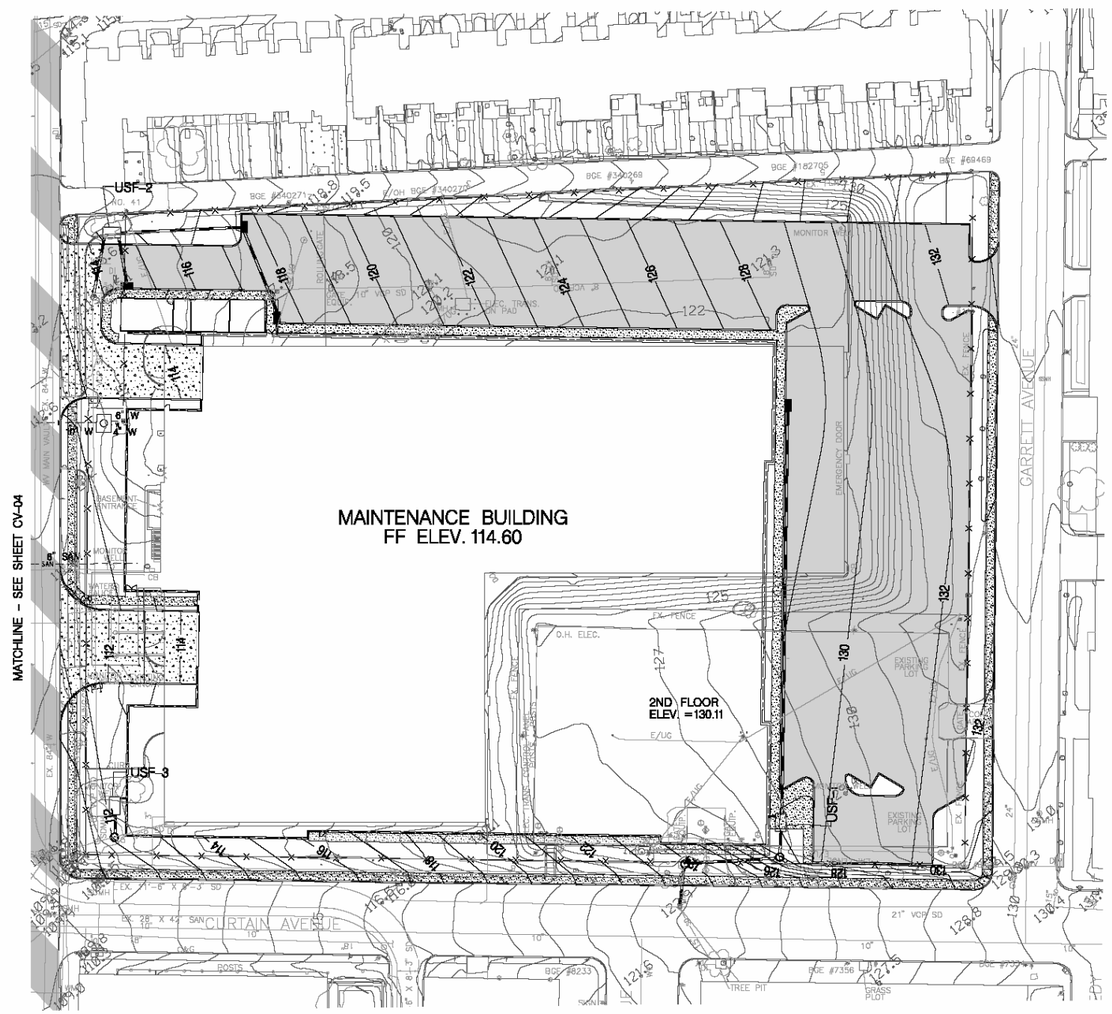
Kirk Avenue Bus Maintenance and Storage Facilities
Baltimore, Maryland

FIGURE:	DRAWN BY:	CHECKED BY:
1	NS	
DATE:	JOB NO.:	SCALE:
Aug-10	09548-04	NTS



E2CR Site Location Plan

Maintenance Building
Figure – 2B

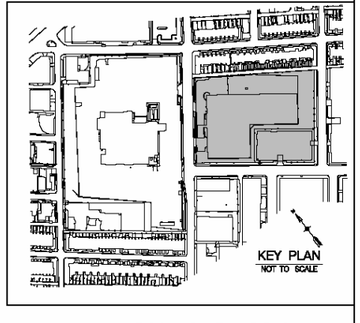


NOTES

1. ALL DESIGN POINT LOCATIONS ARE TO THE FLOWLINE OF CURB UNLESS OTHERWISE NOTED.
2. ALL PROPOSED CURBS ARE TYPE 'C' COMBINATION 6" CURB WITH 12" x 8" GUTTER UNLESS OTHERWISE NOTED.

LEGEND

- 6" COMBINATION CURB AND GUTTER (GUTTER NOT SHOWN)
- EXISTING CONTOUR
- PROPOSED CONTOUR
- FULL DEPTH HMA PAVEMENT
- MILL AND RESURFACE HMA PAVEMENT
- P.C. CONCRETE PAVEMENT AND SIDEWALK



40' 0 40' 80'
SCALE: 1" = 40'

30% SUBMISSION
NOT FOR CONSTRUCTION

MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND TRANSIT ADMINISTRATION
MTA Maryland

Gannett Fleming
JMT JOHNSON, MIRMIRAN & THOMPSON
Engineering A Brighter Future

PROFESSIONAL CERTIFICATION
I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland
License No. Expiration Date

NO.	DESCRIPTION	BY	DATE
	REVISIONS		

DESIGN
DRAWN
CHECK
APPR

BALTIMORE MD
KIRK AVENUE BUS MAINTENANCE AND STORAGE FACILITIES

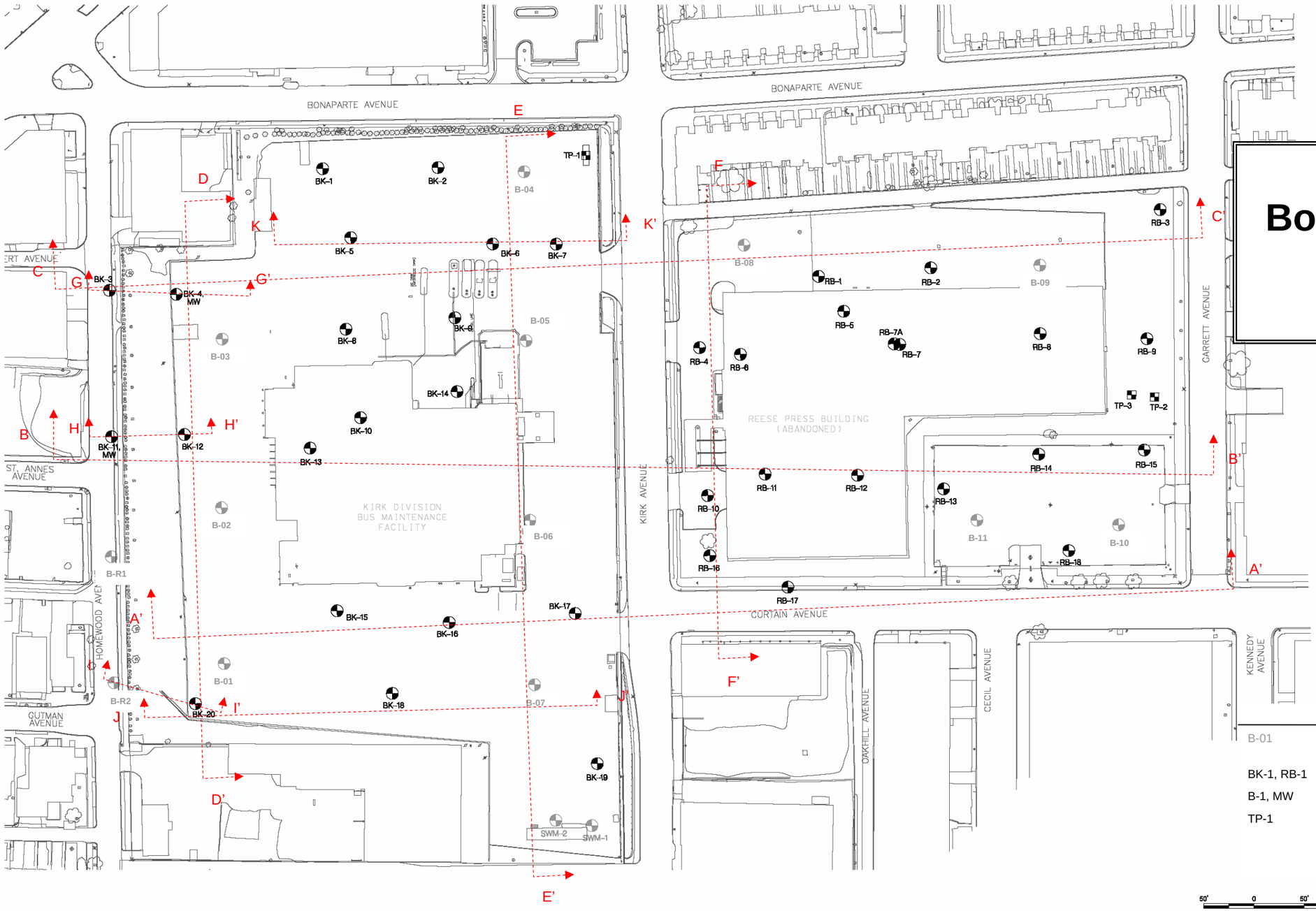
MAINTENANCE BUILDING - GRADING PLAN

DATE: JUNE 14, 2010 SCALE: 1"=40'

CONTRACT NO. XXXXX
DRAWING NO. CV-07
SHEET NO. 11 OF 272

E2CR Boring Location Plan

Figure – 3



LEGEND

B-01	PLANNING PHASE BORING LOCATIONS BY AB CONSULTANTS
BK-1, RB-1	BORING LOCATIONS BY E2CR
B-1, MW	BORING + MONITORING WELL BY E2CR
TP-1	TEST PIT BY E2CR

50' 0 50' 100'
SCALE: 1" =50'

30% SUBMISSION
NOT FOR CONSTRUCTION

MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND TRANSIT ADMINISTRATION
MTA Maryland

Gannett Fleming
JMT
JOHNSON, MIRMIRAN & THOMPSON
Engineering A Brighter Future

PROFESSIONAL CERTIFICATION
I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland

License No. Expiration Date

NO.	DESCRIPTION	BY	DATE

REVISIONS

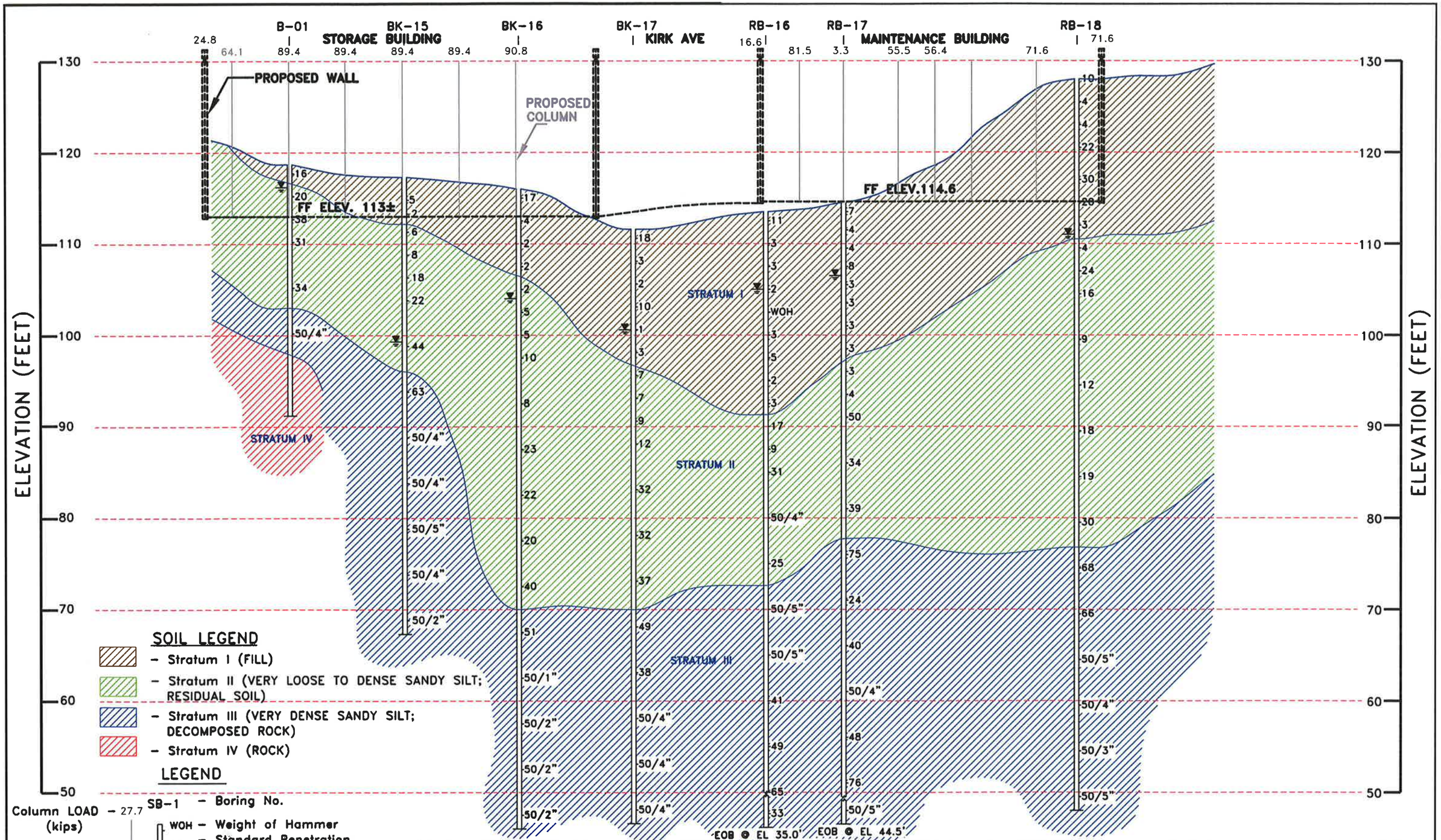
DESIGN
DRAWN
CHECK
APPR

BALTIMORE MD
KIRK AVENUE BUS MAINTENANCE AND STORAGE FACILITIES

EXISTING CONDITIONS AND BORING LOCATION PLAN

DATE: JUNE 14, 2010 SCALE: 1"=50'

CONTRACT NO. XXXXX
DRAWING NO. CV-01
SHEET NO. 5 OF 272



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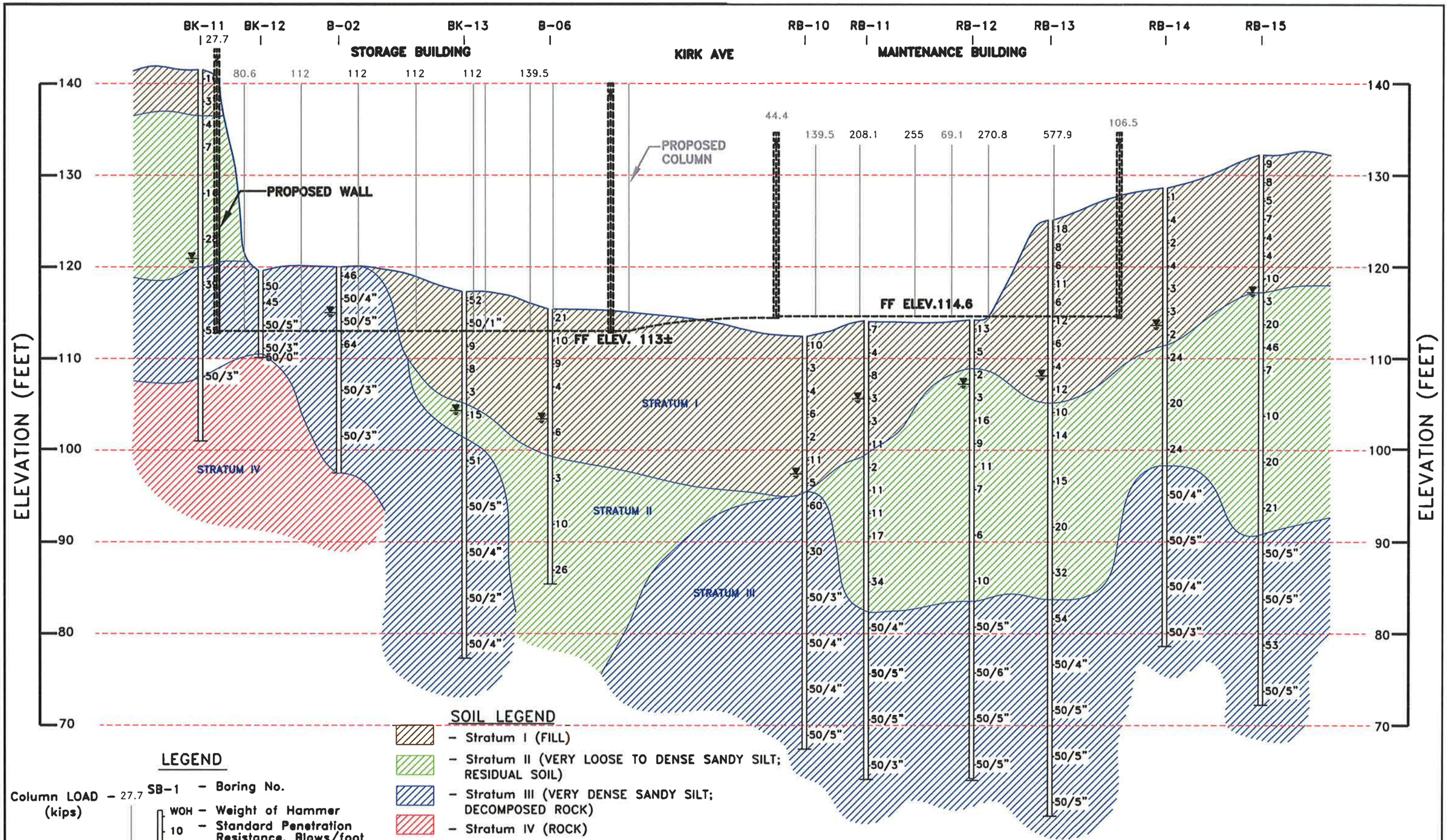
MTA KIRK AVENUE BUS FACILITY
SUBSURFACE PROFILE A-A'

FIGURE: 5A	DRAWN BY: KH	CHECKED BY: NS
DATE: AUG, 2010	JOB NO.: 09548-04	SCALE: H: 1" = 100' V: 1" = 10'



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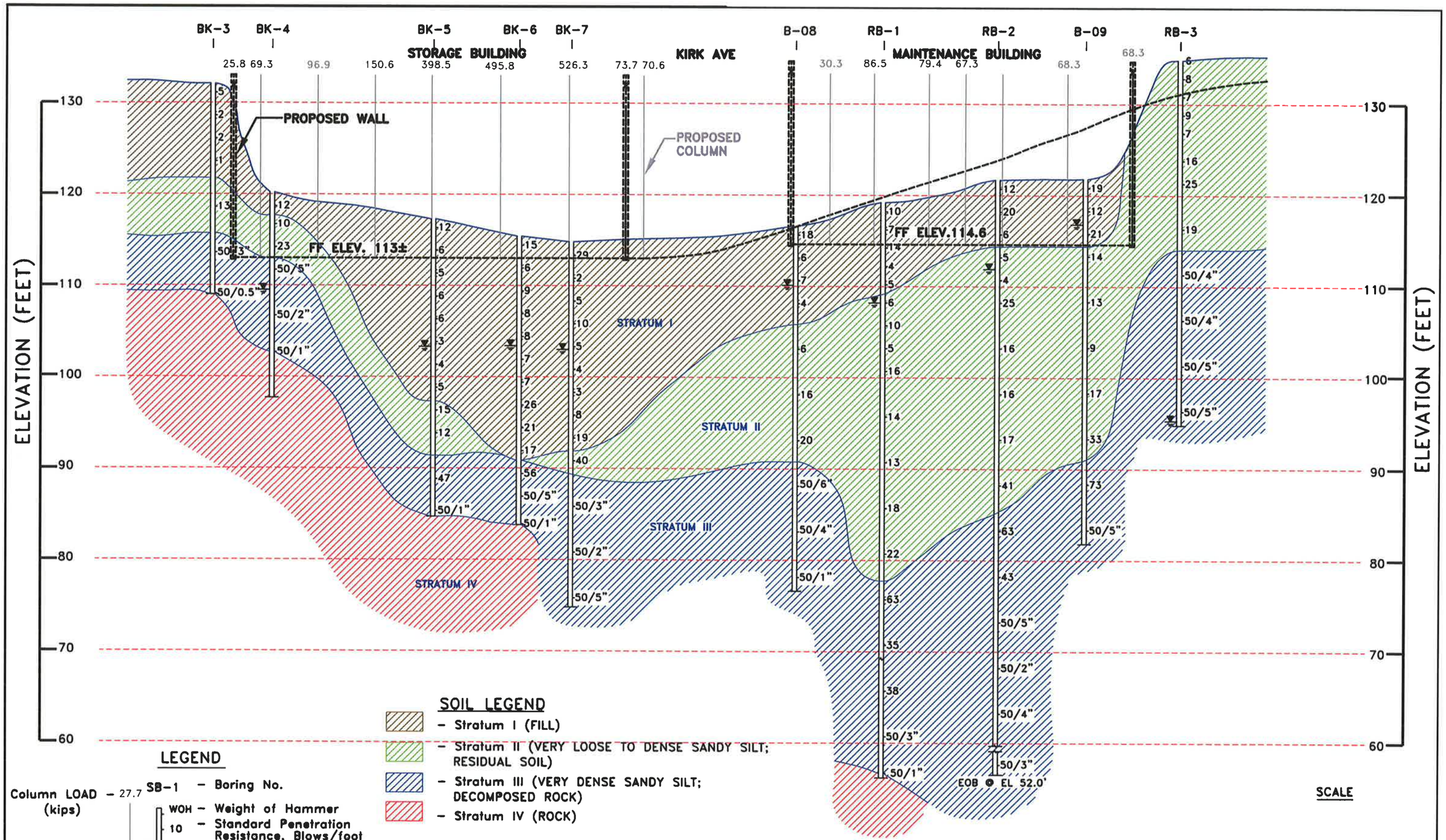
MTA KIRK AVENUE BUS FACILITY
SUBSURFACE PROFILE B-B'

FIGURE: 5B	DRAWN BY: KH	CHECKED BY: NS
DATE: AUG, 2010	JOB NO.: 09548-04	SCALE: H: 1" = 100' V: 1" = 10'



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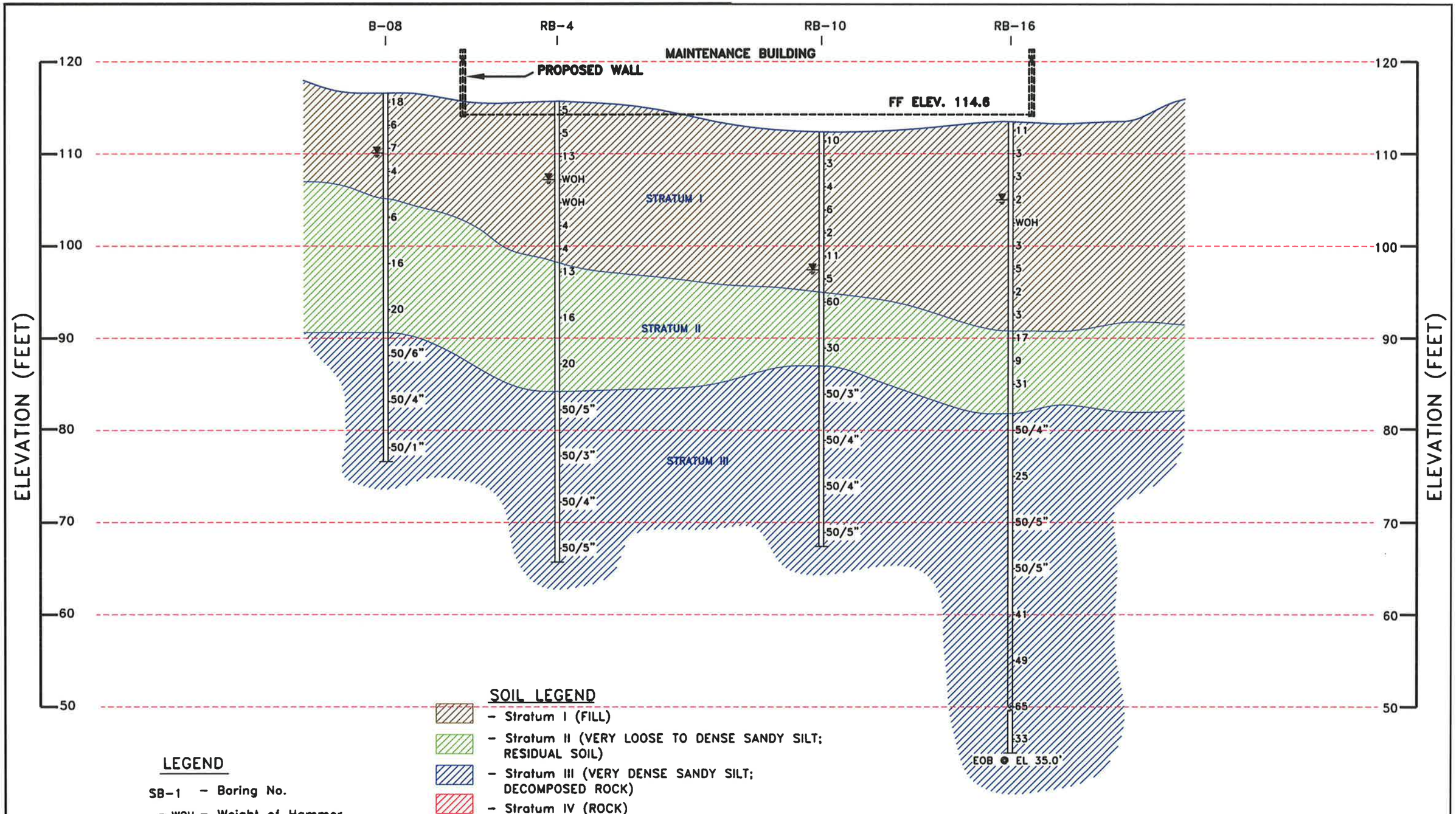
MTA KIRK AVENUE BUS FACILITY
SUBSURFACE PROFILE C-C'

FIGURE: 5C	DRAWN BY: KH	CHECKED BY: NS
DATE: AUG, 2010	JOB NO.: 09548-04	SCALE: H: 1" = 100' V: 1" = 10'



SOIL LEGEND

- Stratum I (FILL)
- Stratum II (VERY LOOSE TO DENSE SANDY SILT; RESIDUAL SOIL)
- Stratum III (VERY DENSE SANDY SILT; DECOMPOSED ROCK)
- Stratum IV (ROCK)

LEGEND

SB-1 – Boring No.

WOH – Weight of Hammer

10 – Standard Penetration Resistance, Blows/foot

– Water surface elevation

50% – RQD

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MTA KIRK AVENUE BUS FACILITY
SUBSURFACE PROFILE F-F'

FIGURE: 5F	DRAWN BY: KH	CHECKED BY: NS
DATE: AUG, 2010	JOB NO.: 09548-04	SCALE: H: 1" = 50' V: 1" = 10'

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TABLE 1. SUMMARY OF BORING DATA
MTA - KIRK AVENUE BUS FACILITY
E2CR PROJECT NO. 09548-04

Boring Number	Coordinates		Existing Grade	Boring Depth	Fill	Decomposed Rock		Bedrock		Groundwater	Groundwater Elev.	Caved Depth	Remarks
						Depth	Elev.	Depth	Elev.				
	Northing	Easting	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
MAINTENANCE BUILDING													
RB-1	601095.4	1424655.3	119.2	62.6	11.0	42.0	77.2	62.6	56.6	11.0	108.2	15.0	refusal
RB-2	601031.7	1424747.5	121.7	68.8	8.0	47.0	74.7	n/a	n/a	9.8	111.9	9.8	no ref
RB-3	600933.0	1424961.5	134.8	39.0	0.0	22.0	112.8	n/a	n/a	39.5	95.3	15.0	no ref
RB-4	601114.8	1424518.5	115.7	49.0	18.0	32.0	83.7	n/a	n/a	8.5	107.2	10.0	no ref
RB-5	601052.6	1424652.9	116.7	54.5	10.5	37.0	79.7	n/a	n/a	16.0	100.7	15.0	no ref
RB-6	601084.0	1424545.9	116.7	59.0	15.5	42.0	74.7	n/a	n/a	8.5	108.2	12.0	no ref
RB-7	600995.8	1424671.4	116.9	48.8	5.5	32.0	84.9	n/a	n/a	33.0	83.9	15.0	no ref
RB-8	600912.2	1424790.8	117.1	59.4	3.0	42.0	75.1	n/a	n/a	11.0	106.1	18.0	no ref
RB-9	600841.4	1424870.3	132.8	28.5	8.0	27.0	105.8	28.5	104.3	14.0	118.8	10.8	refusal
RB-10	600995.3	1424432.0	112.4	43.9	18.0	27.0	85.4	n/a	n/a	15.0	97.4	10.0	no ref
RB-11	600975.9	1424489.9	114.1	49.5	15.5	32.0	82.1	n/a	n/a	8.5	105.6	15.0	no ref
RB-12	600917.0	1424560.7	114.2	50.0	5.5	32.0	82.2	n/a	n/a	7.0	107.2	12.0	no ref
RB-13	600852.5	1424618.8	126.4	64.0	21.0	42.0	84.4	n/a	n/a	17.0	109.4	18.0	no ref
RB-14	600819.7	1424714.1	128.6	50.0	19.0	32.0	96.6	n/a	n/a	15.0	113.6	6.0	no ref
RB-15	600756.9	1424798.4	132.2	59.5	15.5	42.0	90.2	n/a	n/a	15.0	117.2	18.0	no ref
RB-16	600947.4	1424396.0	113.5	80.0	23.0	42.0	71.5	n/a	n/a	8.5	105.0	10.0	no ref
RB-17	600874.0	1424436.6	114.5	70.0	18.0	52.0	62.5	n/a	n/a	8.0	106.5	27.0	no ref
RB-18	600726.3	1424676.9	128.0	79.0	18.0	57.0	71.0	n/a	n/a	17.0	111.0	9.0	no ref
TP-1	601327.0	1424549.0	115.3	12.5	12.5	n/a	n/a	n/a	n/a	12.5	102.8	n/a	no ref
TP-2	600791.4	1424839.7	132.4	12.0	5.0	n/a	n/a	n/a	n/a	DRY	DRY	n/a	no ref
TP-3	600807.5	1424823.3	128.3	8.5	2.5	n/a	n/a	n/a	n/a	DRY	DRY	n/a	no ref
Borings by others in March 2008													
B-08	601166.3	1424617.1	118.2	40.0	13.0	27.0	91.2	n/a	n/a	6.5	111.7	n/a	no ref
B-09	600965.3	1424833.5	123.6	40.0	8.0	32.0	91.6	n/a	n/a	5.0	118.6	n/a	no ref
B-10	600715.0	1424731.6	132.0	50.0	17.0	n/a	n/a	n/a	n/a	18.0	114.0	n/a	no ref
B-11	600807.4	1424624.9	127.5	45.0	22.0	n/a	n/a	n/a	n/a	17.0	110.5	n/a	no ref

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TABLE-2: SUMMARY OF LABORATORY TEST RESULTS
MTA- KIRK AVENUE BUS FACILITY
E2CR PROJECT NO. 09548-04

BORING NO	SAMPLE NO	DEPTH* (FEET)	SPT N_m-Value (bpf)	NATURAL MOISTURE CONTENT(%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	GRAIN SIZE DISTRIBUTION				MODIFIED PROCTOR		CBR	USCS CLASSIFICATION
								GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	MAX. DRY DENSITY,PCF	OPTIMUM MOISTURE(%)		
	S-4	8.5 - 10.0	2	31.6											FILL-SM
RB-1	S-1	1.0 - 3.0	10	12.0											FILL-ML
	S-3	5.0 - 7.0	14	22.9											FILL-SM
	S-7	13.5 - 15.0	10	24.9											ML
	S-9	18.5 - 20.0	16	24.0											ML
	S-11	28.5 - 30.0	13	16.0	NV	NP	NP								SM
	S-13	38.5 - 40.0	22	29.8											ML
	S-15	48.5 - 50.0	35	34.0	NV	NP	NP								SM
RB-2	BULK	2.0 8.5		12.0	24	16	8	6	50	44		133	7		SC
RB-3	S-1	0.0 - 2.0	6	4.9											SM
	S-3	4.0 - 6.0	7	9.3				0	56	44					SM
	S-5	8.0 - 10.0	7	14.4											SM
RB-7	S-1	1.0 - 2.5	18	10.8											FILL-SM
	S-3	6.0 - 7.5	13	13.6											ML
	S-5	11.0 - 12.5	5	27.1											ML
	S-8	23.5 - 25.0	5	32.3	NV	NP	NP	1	57	42					SM
	S-10	33.5 - 34.9	50/5"	9.3											GM
	S-12	43.5 - 44.1	50/1"	12.1	NV	NP	NP	4	74	22					SM
RB-8	S-1	1.0 - 2.5	15	13.8											FILL-SM
	S-3	6.0 - 7.5	2	20.4											ML
	S-5	11.0 - 12.5	8	11.5											ML
	S-8	18.5 - 20.0	9	21.0											ML
	S-10	28.5 - 30.0	16	17.9											ML
	S-12	38.5 - 40.0	33	15.2											ML

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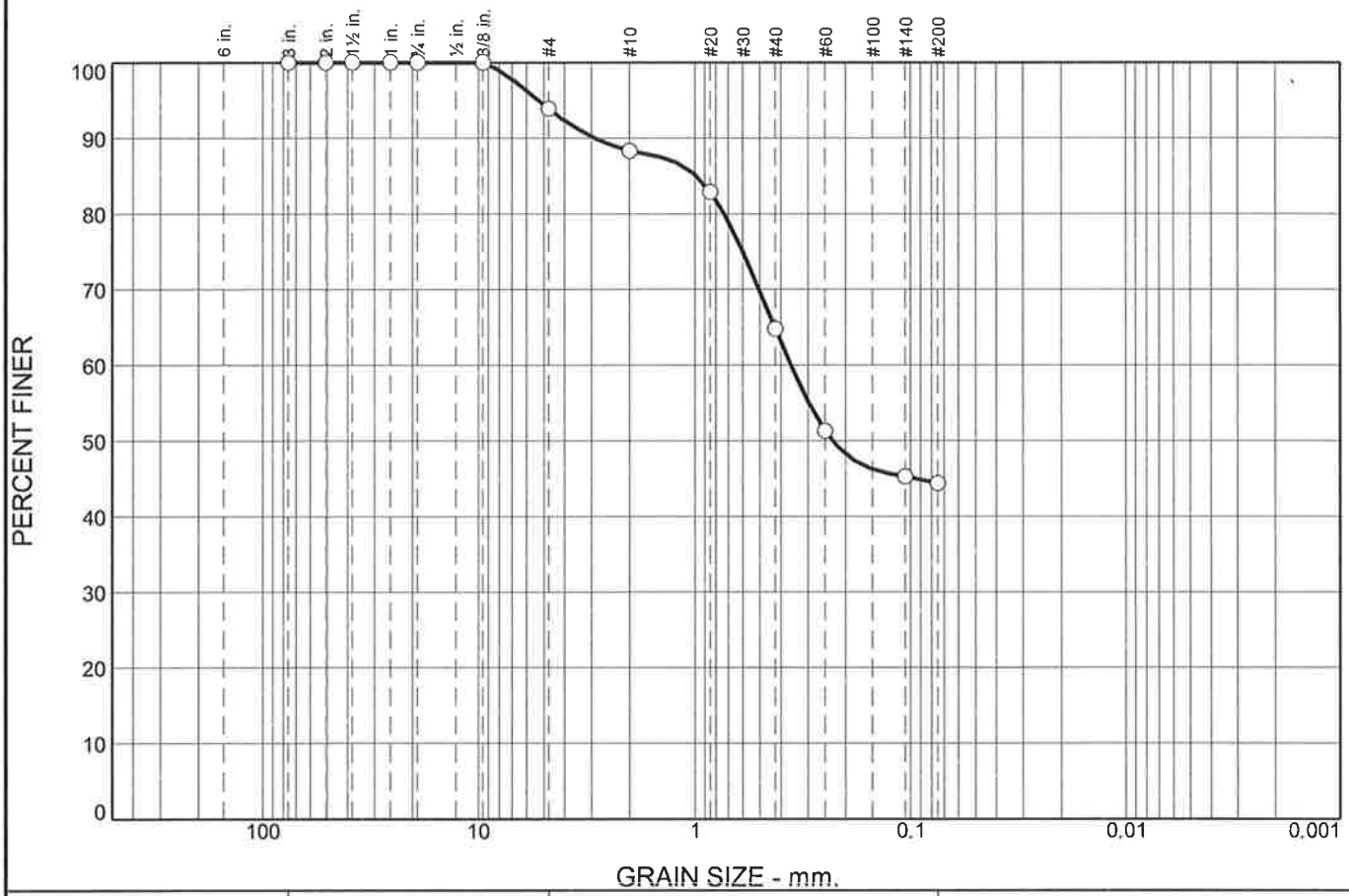
TABLE-2: SUMMARY OF LABORATORY TEST RESULTS
MTA- KIRK AVENUE BUS FACILITY
E2CR PROJECT NO. 09548-04

BORING NO	SAMPLE NO	DEPTH* (FEET)	SPT N_m-Value (bpf)	NATURAL MOISTURE CONTENT(%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	GRAIN SIZE DISTRIBUTION				MODIFIED PROCTOR		CBR	USCS CLASSIFICATION
								GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	MAX. DRY DENSITY,PCF	OPTIMUM MOISTURE(%)		
RB-9	S-1	1.0 - 2.5	11	12.0											FILL-SM
	S-2	3.5 - 5.0	11	28.0	47	31	16								FILL-ML
	S-4	8.5 - 10.0	6	12.8											SM
RB-14	S-1	1.0 - 2.5	1	16.0											FILL-SM
	S-3	6.0 - 7.5	2	17.0											FILL-ML
	S-5T	11.0 - 12.5	3	14.2											FILL-ML
	S-5B	11.0 - 12.5	3	35.3											FILL-ML
	S-7	16.0 - 17.5	2	88.1											FILL-GM
	S-9	23.5 - 25.0	20	24.9	52	36	16								MH
	S-11	33.5 - 35.0	50/4"	16.2	NV	NP	NP								SM
RB-15	S-1	1.0 - 3.0	9	14.0											FILL-SM
RB-18	S-1	1.0 - 2.5	10	11.8											FILL-SM
	S-3	6.0 - 7.5	4	16.5											FILL-ML
	S-5	11.0 - 12.5	30	14.6											FILL-SM
	S-7	16.0 - 17.5	3	43.9											FILL-SM
	S-9	21.0 - 22.5	24	8.8											SM
	S-11	28.5 - 30.0	9	33.2											ML
	S-13	38.5 - 40.0	18	17.2	NV	NP	NP								SM
	S-15	48.5 - 50.0	30	10.9											ML
	S-17	58.5 - 60.0	66	17.1											ML
TP-2	BULK	1.0 - 4.0			20	14	6	34	46	20		136	6	14.6	SM-GM

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	6	6	23	21	44	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	94		
#10	88		
#20	83		
#40	65		
#60	51		
#140	45		
#200	44		

* (no specification provided)

Soil Description

Brown, Clayey f-c SAND, little Silt, trace Gravel

Atterberg Limits

PL= 16 LL= 24 PI= 8

Coefficients

D_{85}= 0.9873 D_{60}= 0.3601 D_{50}= 0.2302
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO= A-4(0)

Remarks

Natural Moisture : 12.0%

Sample No.: BULK **Source of Sample:** RB-2 **Date:**
Location: **Elev./Depth:** 2.0'-8.5'

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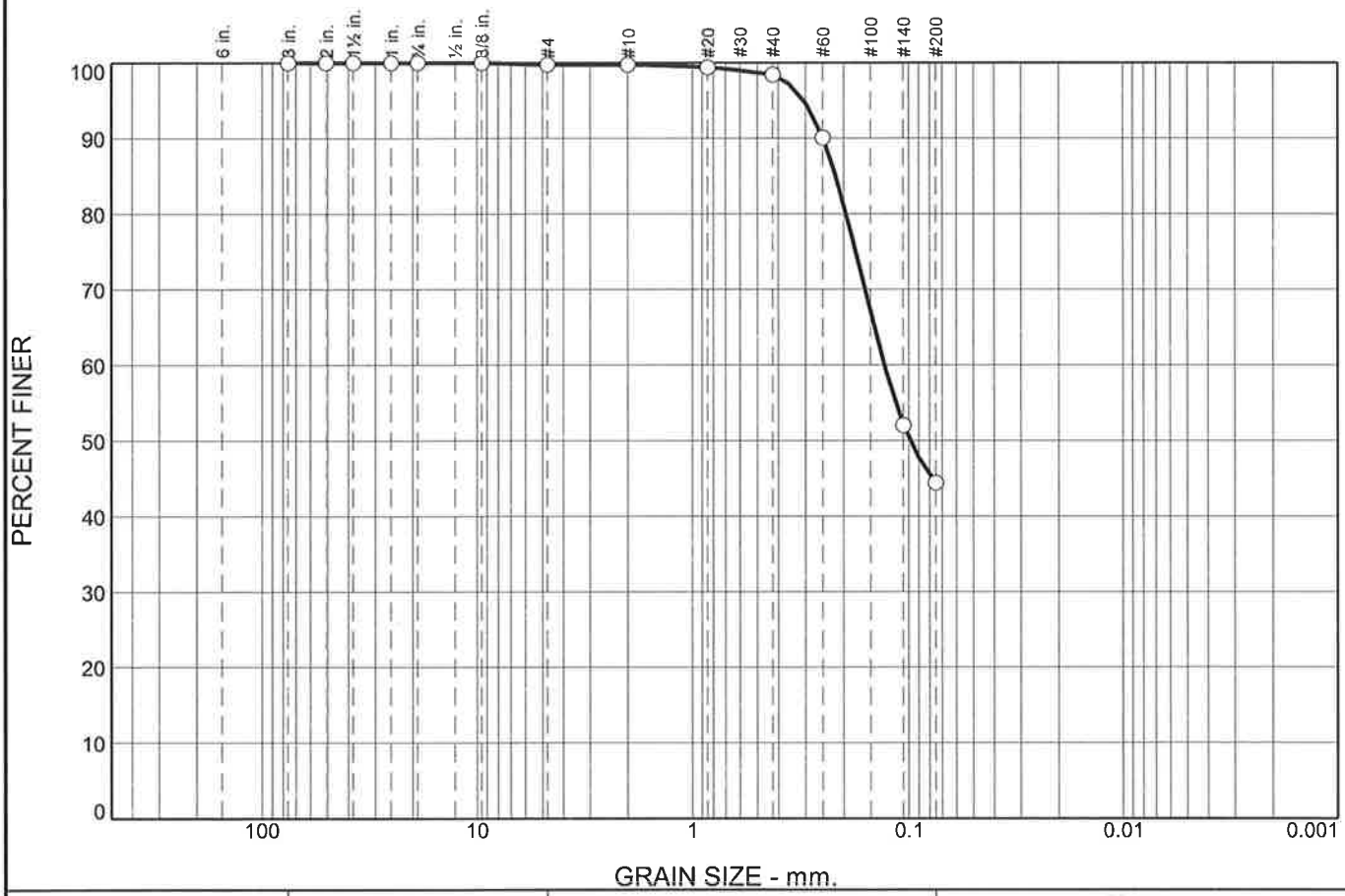
Client: GF-JMT Joint Venture
Project: MTA - Kirk Avenue Bus Facility
Project No: 09548-04 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	0	0	2	54	44	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	100		
#10	100		
#20	99		
#40	98		
#60	90		
#140	52		
#200	44		

* (no specification provided)

Soil Description

Light brown, gray, f-m SAND and SILT

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 0.2184 D_{60}= 0.1299 D_{50}= 0.0989
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Natural Moisture : 9.3%

Sample No.: S-3 **Source of Sample:** RB-3 **Date:**
Location: **Elev./Depth:** 4.0'-6.0'

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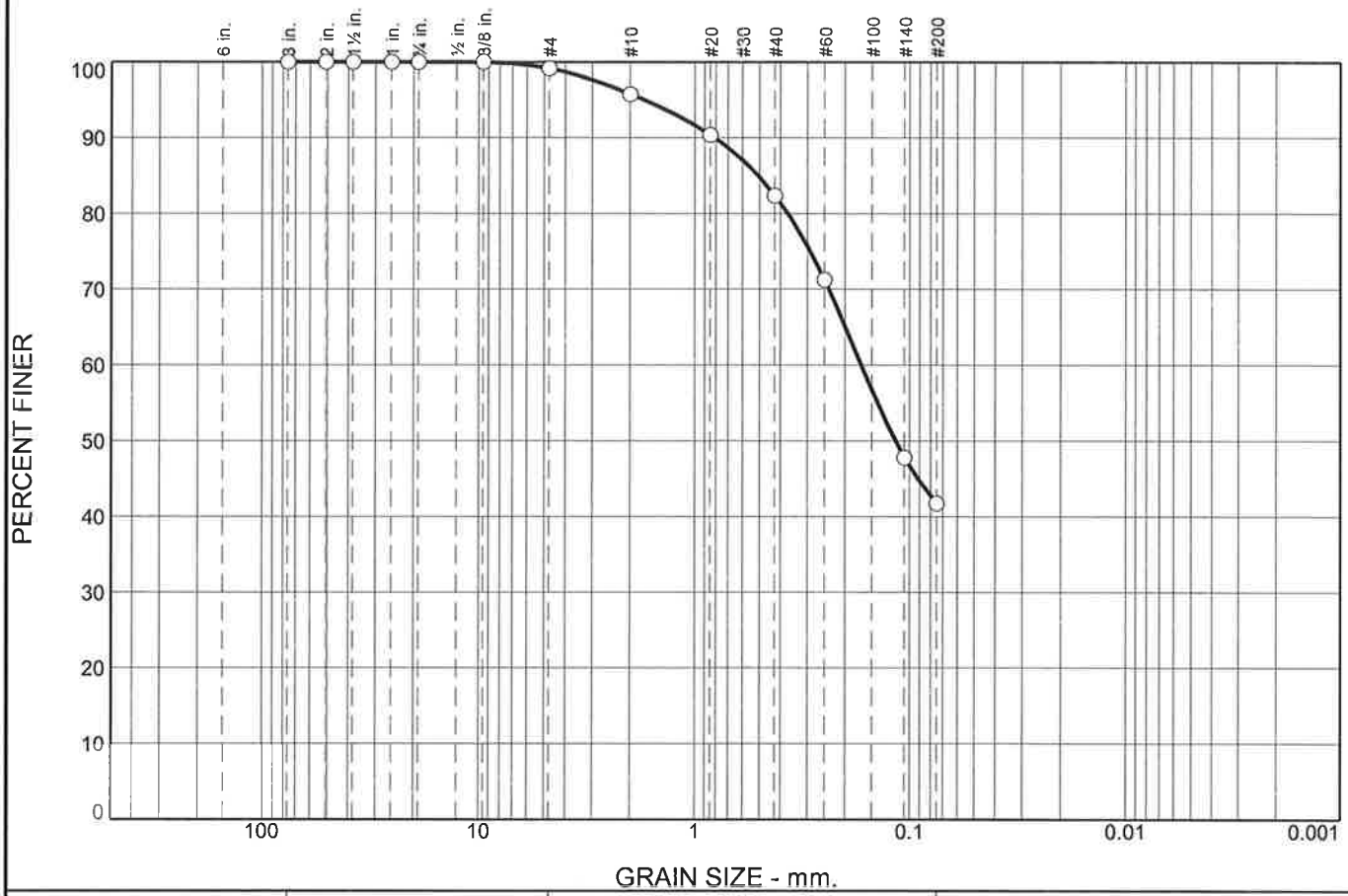
Client: GF-JMT Joint Venture
Project: MTA - Kirk Avenue Bus Facility
Project No: 09548-04 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	1	3	14	40	42	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	99		
#10	96		
#20	90		
#40	82		
#60	71		
#140	48		
#200	42		

* (no specification provided)

Soil Description

Tan, gray f-c SAND and SILT, trace Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 0.5079 D_{60}= 0.1683 D_{50}= 0.1168
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-4(0)

Remarks

Natural Moisture : 32.3%

Sample No.: S-8 **Source of Sample:** RB-7 **Date:**
Location: **Elev./Depth:** 23.5'-25.0'

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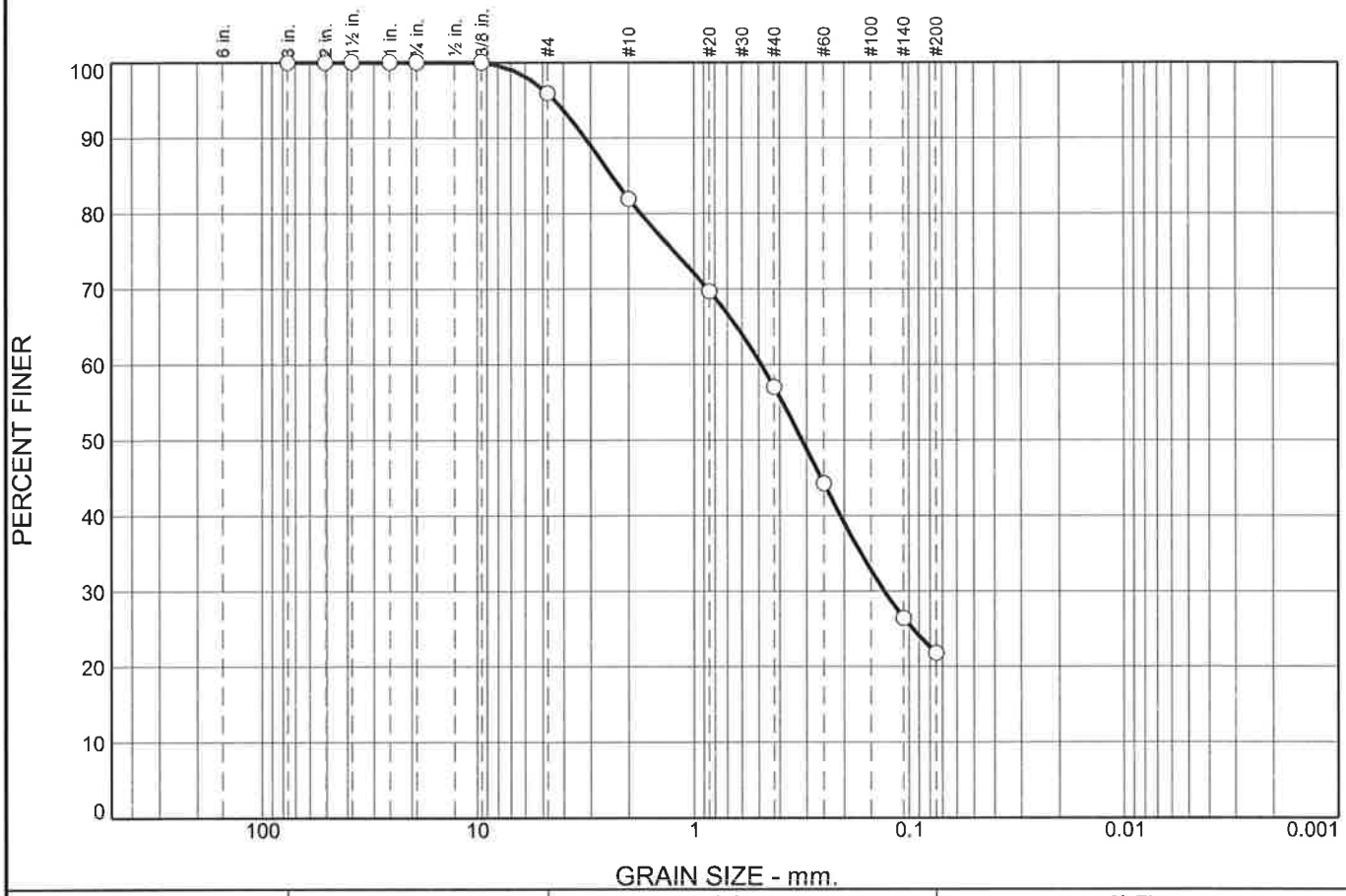
Client: GF-JMT Joint Venture
Project: MTA - Kirk Avenue Bus Facility
Project No: 09548-04 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	0	4	14	25	35	22	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
2	100		
1.5	100		
1	100		
.75	100		
.375	100		
#4	96		
#10	82		
#20	70		
#40	57		
#60	44		
#140	26		
#200	22		

* (no specification provided)

Soil Description

Gray, f-c SAND, some Silt, trace Gravel

Atterberg Limits

PL= NP LL= NV PI= NP

Coefficients

D_{85}= 2.3956 D_{60}= 0.4879 D_{50}= 0.3152
D_{30}= 0.1309 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO= A-2-4(0)

Remarks

Natural Moisture : 12.1%

Sample No.: S-12 **Source of Sample:** RB-7 **Date:**
Location: **Elev./Depth:** 43.5'-45.0'

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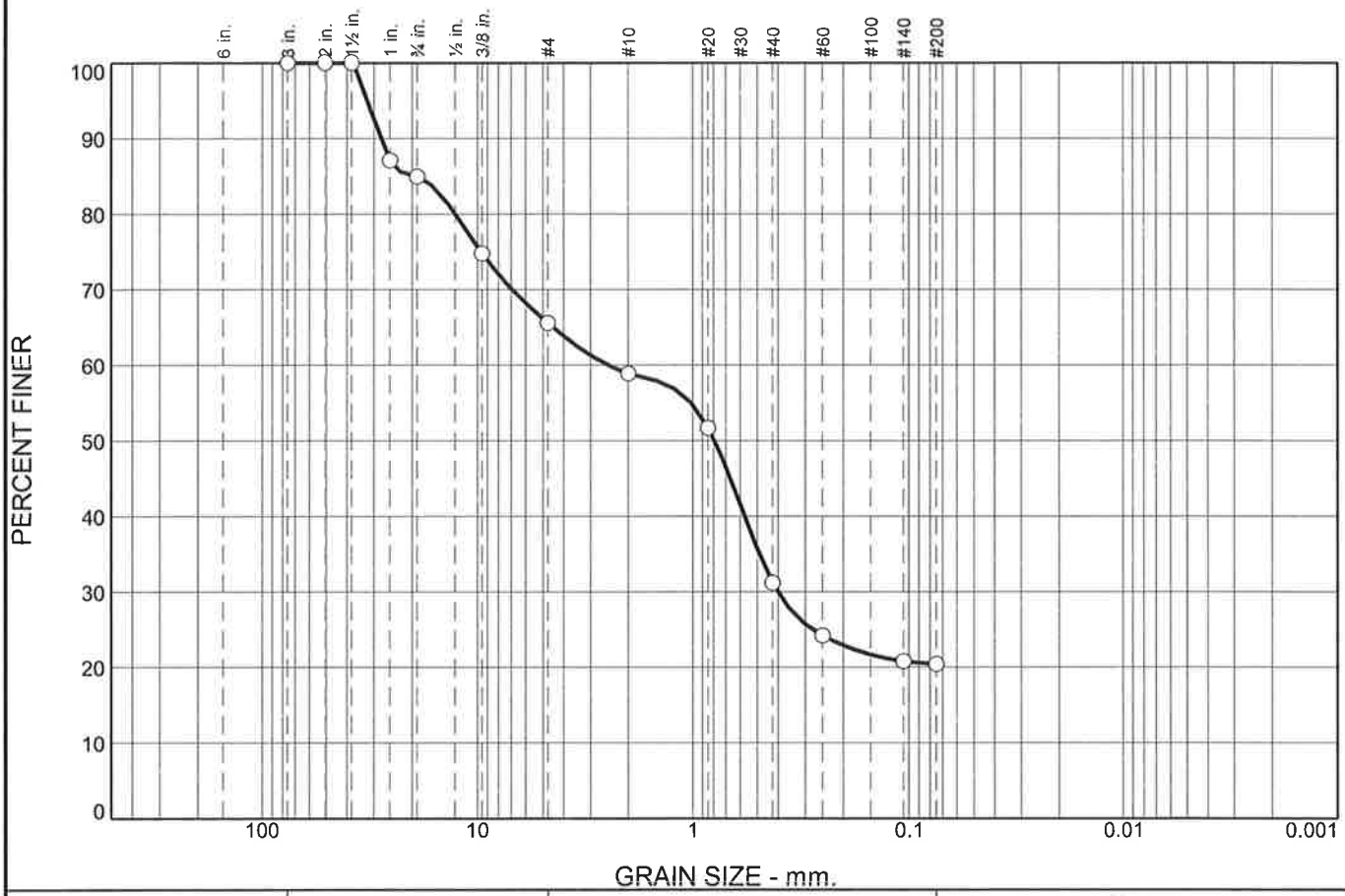
Client: GF-JMT Joint Venture
Project: MTA - Kirk Avenue Bus Facility
Project No: 09548-04 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0	15	19	7	28	11	20	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3	100		
2	100		
1.5	100		
1	87		
.75	85		
.375	75		
#4	66		
#10	59		
#20	52		
#40	31		
#60	24		
#140	21		
#200	20		

* (no specification provided)

Soil Description

Tan, orange Silty f-c SAND and f-c GRAVEL

Atterberg Limits

PL= 14 LL= 20 PI= 6

Coefficients

D_{85}= 19.0639 D_{60}= 2.4891 D_{50}= 0.7933
D_{30}= 0.4028 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC-SM AASHTO= A-1-b

Remarks

Sample No.: Bulk **Source of Sample:** TP-2 **Date:**
Location: **Elev./Depth:** 1.0'-4.0'

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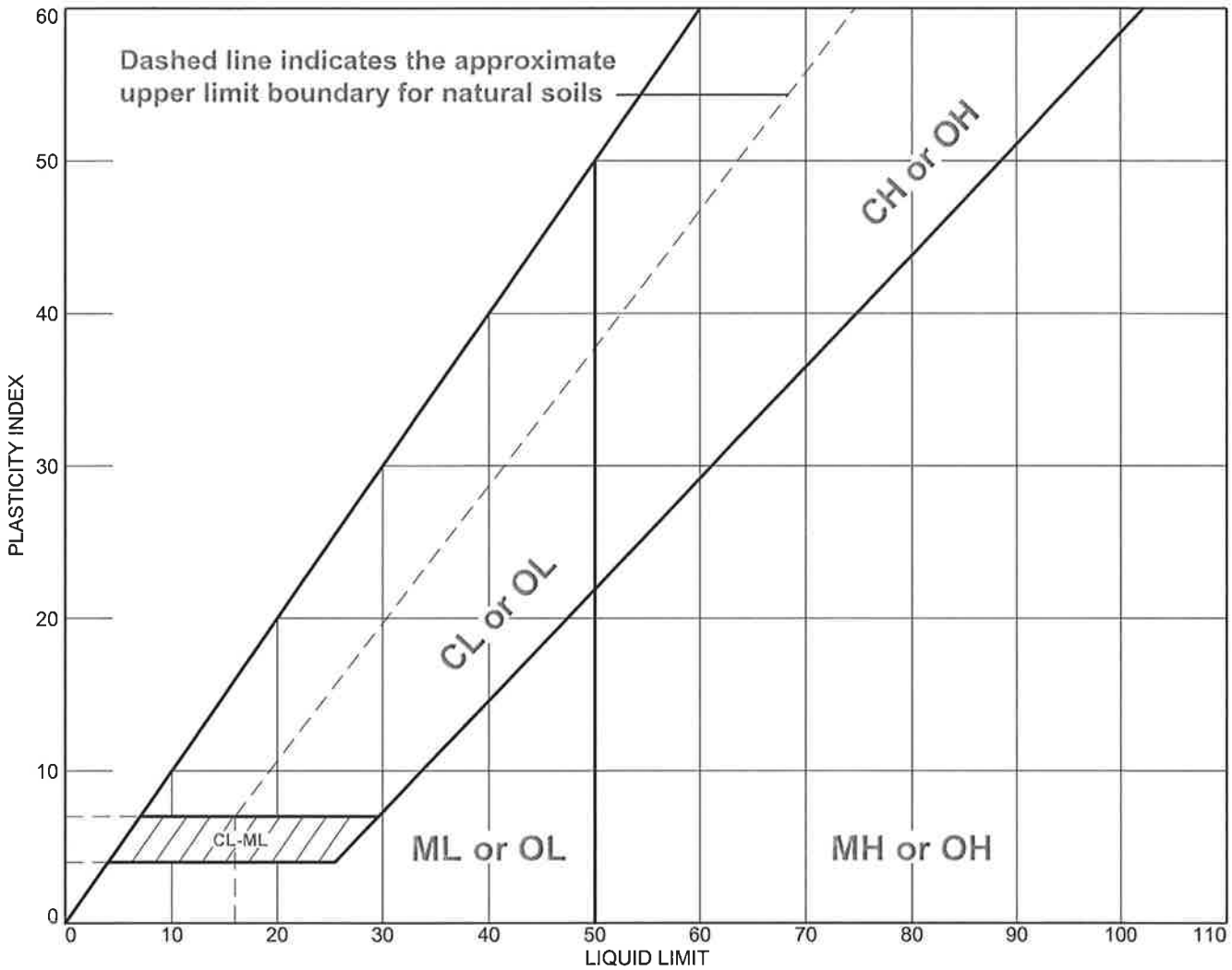
Client: GF-JMT Joint Venture
Project: MTA - Kirk Avenue Bus Facility
Project No: 09548-04 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray, black, Silty SAND	NV	NP	NP		21.9	SM
■	Greenish gray, Silty SAND	NV	NP	NP		17.5	SM

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** RB-1 **Depth:** 28.5'-30.0' **Sample Number:** S-11

■ **Source of Sample:** RB-1 **Depth:** 48.5'-50.0' **Sample Number:** S-15

Remarks:

● Natural Moisture : 16.0%

■ Natural Moisture : 34.0%

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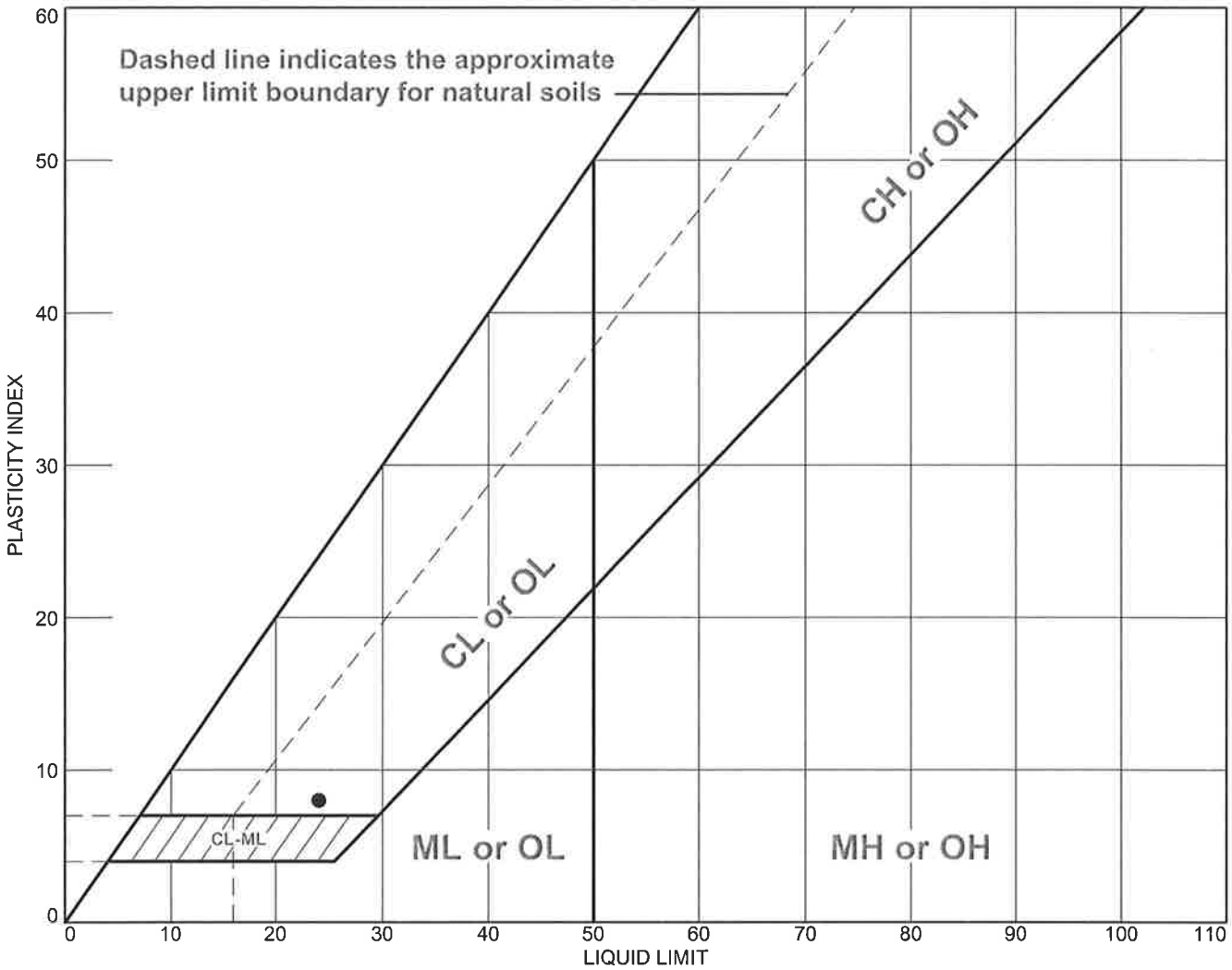
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown, Clayey f-c SAND, little Silt, trace Gravel	24	16	8	65	44	SC

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** RB-2 **Depth:** 2.0'-8.5' **Sample Number:** BULK

Remarks:

● Natural Moisture : 12.0%

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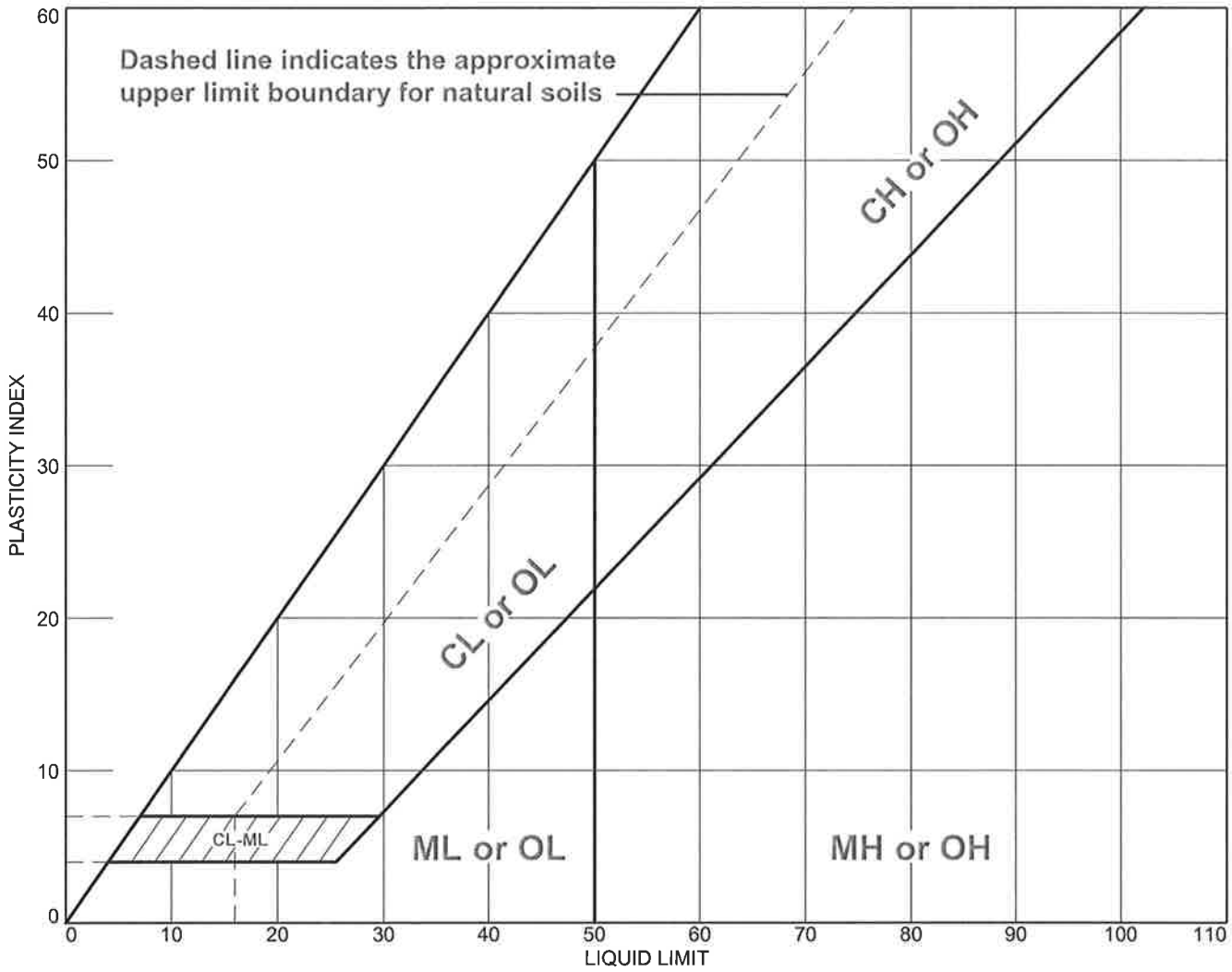
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light brown, gray, f-m SAND and SILT				98	44	SM

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** RB-3 **Depth:** 4.0'-6.0' **Sample Number:** S-3

Remarks:

● Natural Moisture : 9.3%

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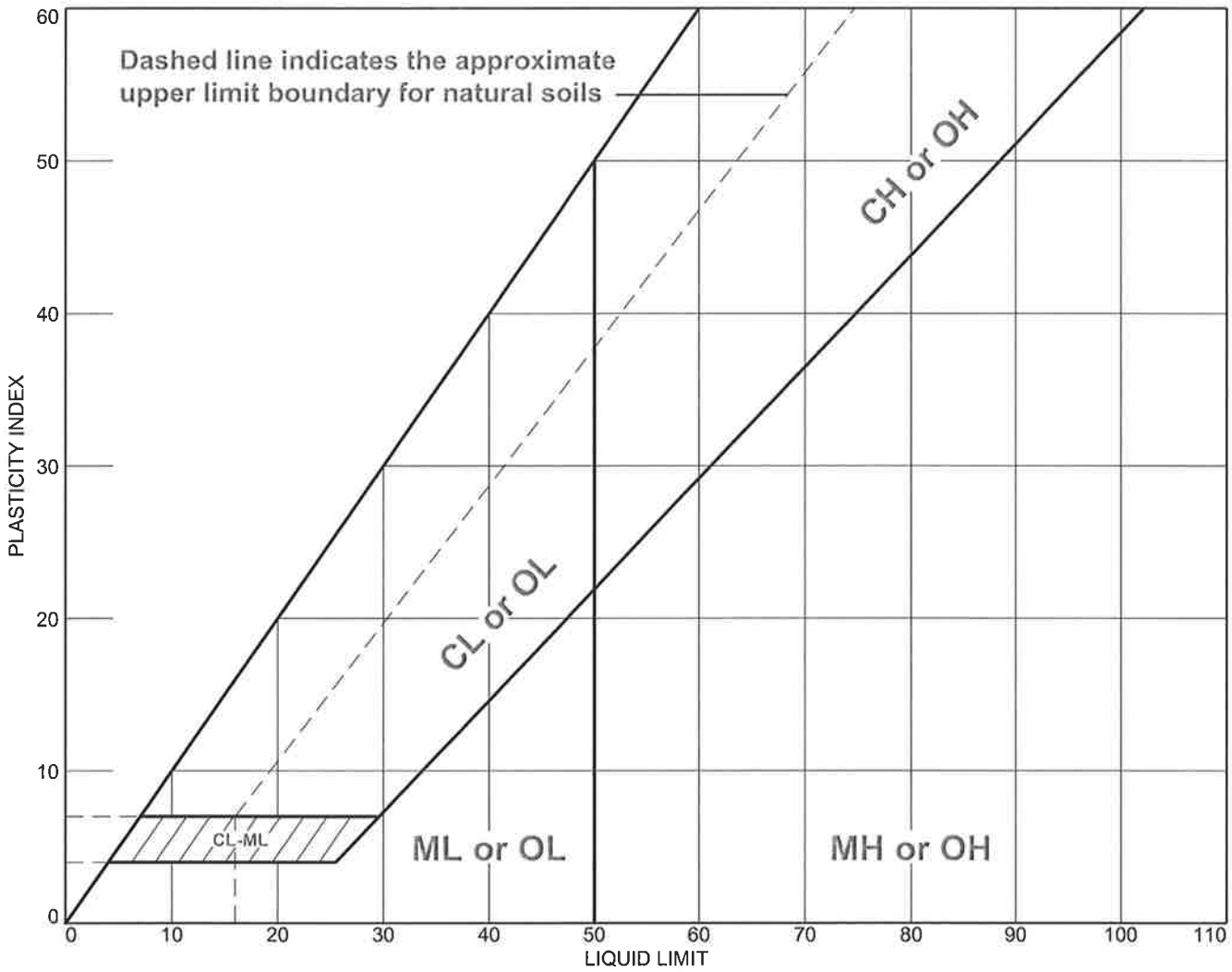
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Tan, gray f-c SAND and SILT, trace Gravel	NV	NP	NP	82	42	SM
■	Gray, f-c SAND, some Silt, trace Gravel	NV	NP	NP	57	22	SM

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** RB-7 **Depth:** 23.5'-25.0' **Sample Number:** S-8

■ **Source of Sample:** RB-7 **Depth:** 43.5'-45.0' **Sample Number:** S-12

Remarks:

● Natural Moisture : 32.3%

■ Natural Moisture : 12.1%

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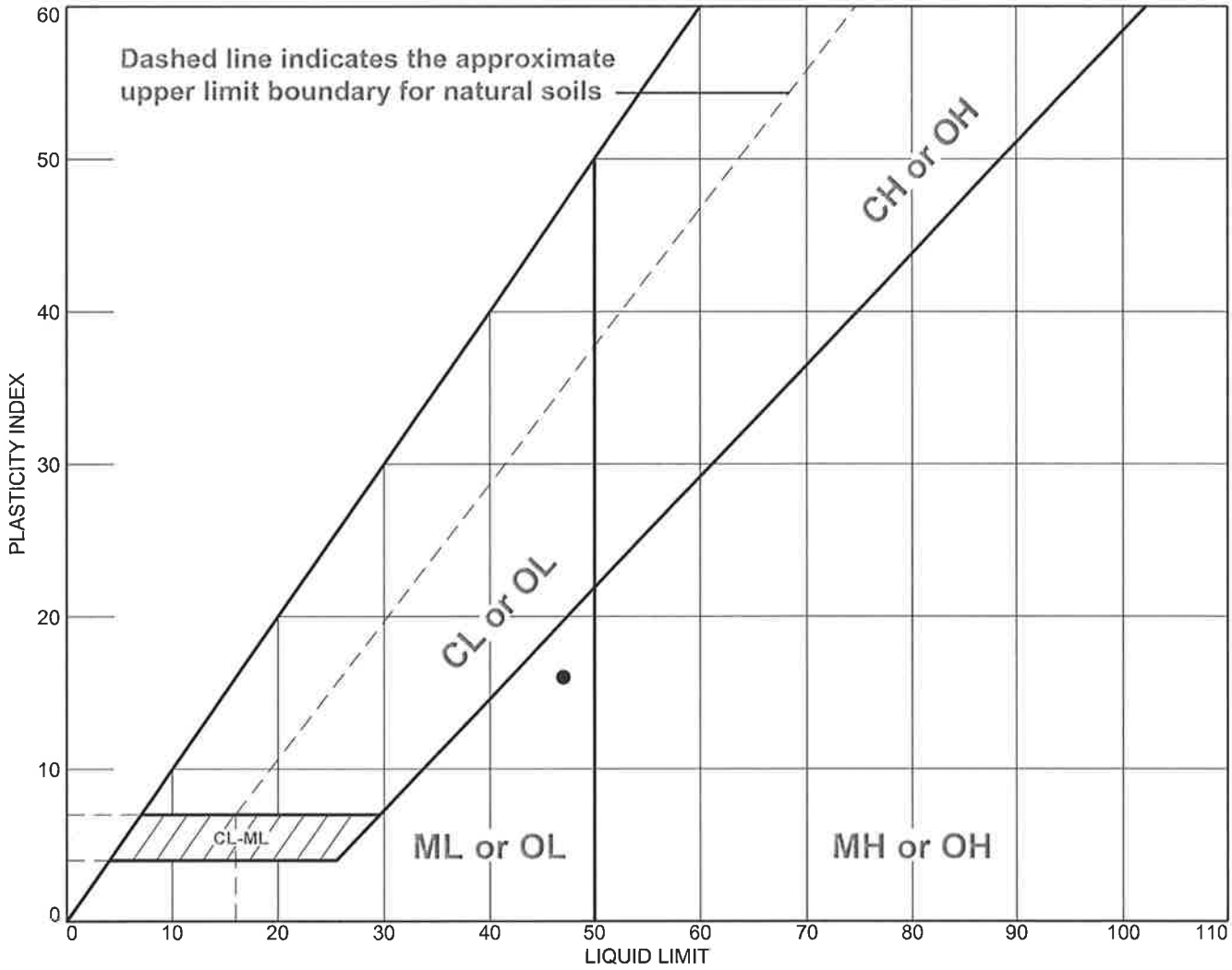
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Orange, gray, Clayey SILT, some Sand	47	31	16		71.6	ML

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** RB-9 **Depth:** 3.5'-5.0' **Sample Number:** S-2

Remarks:

● Natural Moisture : 28.0%

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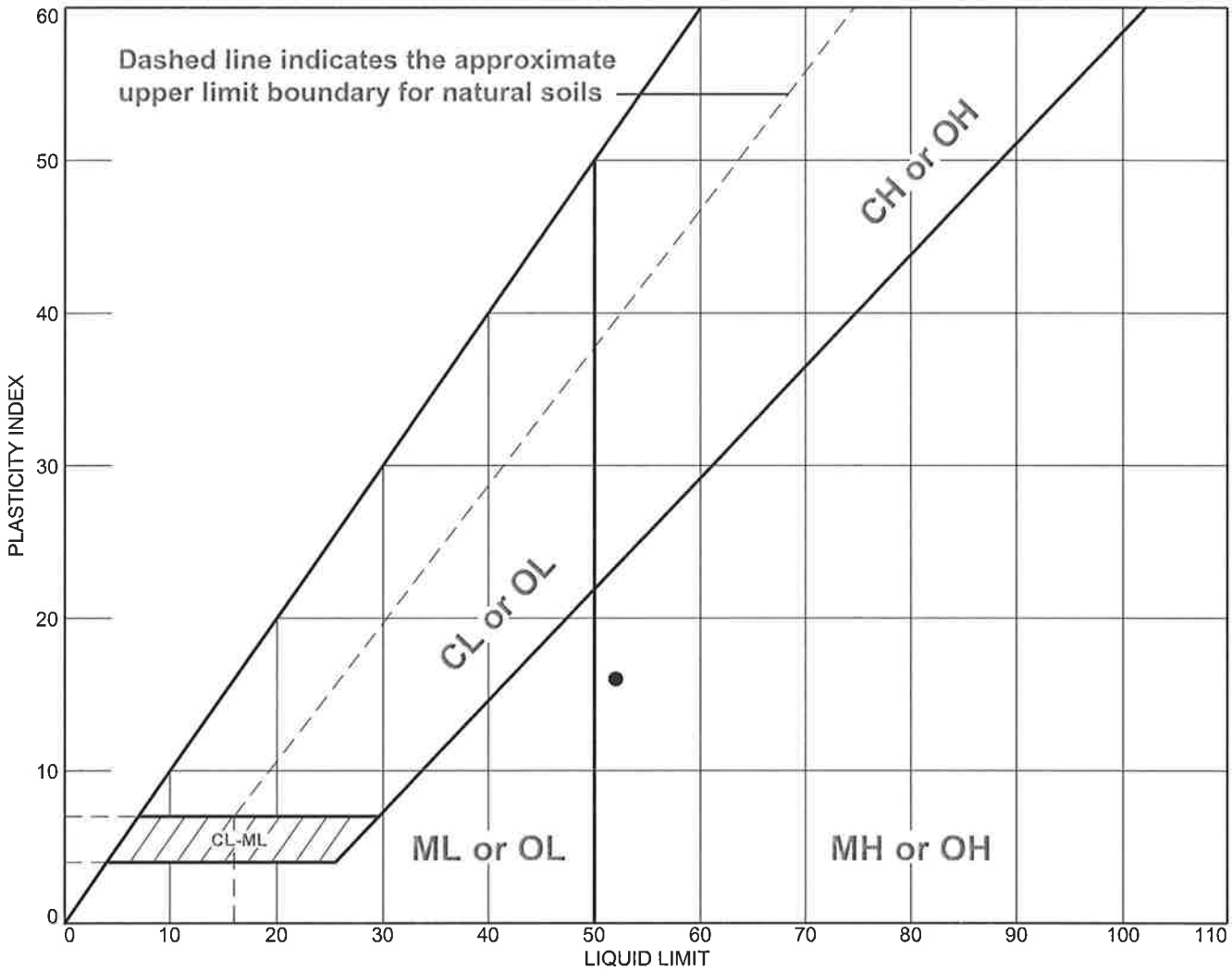
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	White, orange, brown, Clayey SILT and SAND	52	36	16		61.6	MH
■	Gray, Silty SAND	NV	NP	NP		27.0	SM

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** RB-14 **Depth:** 23.5'-25.0' **Sample Number:** S-9

■ **Source of Sample:** RB-14 **Depth:** 33.5'-35.0' **Sample Number:** S-11

Remarks:

● Natural Moisture : 24.9%

■ Natural Moisture : 16.2%

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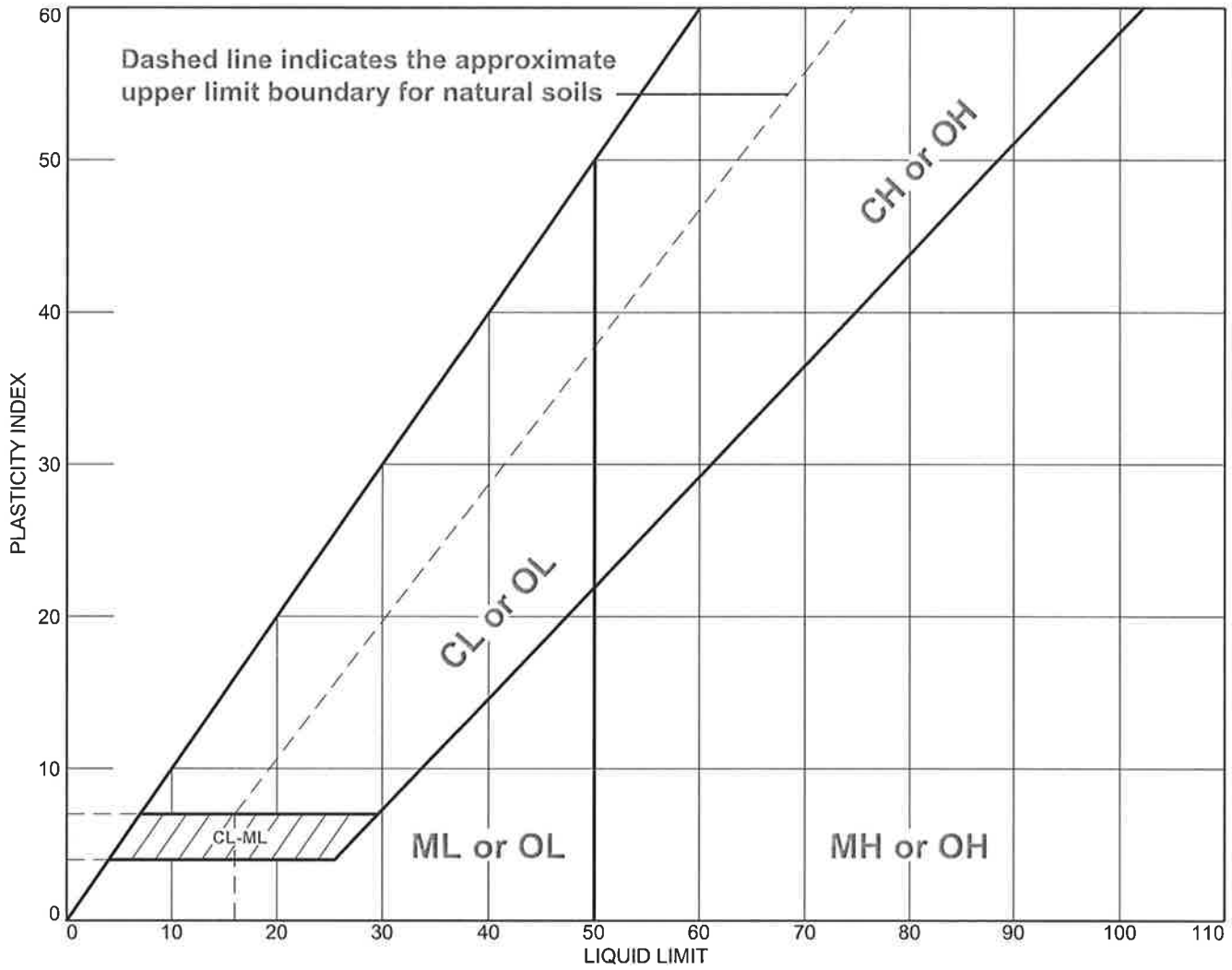
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Orange brown, gray, Silty SAND	NV	NP	NP		21.6	SM

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** RB-18 **Depth:** 38.5'-40.0' **Sample Number:** S-13

Remarks:

● Natural Moisture : 17.2%

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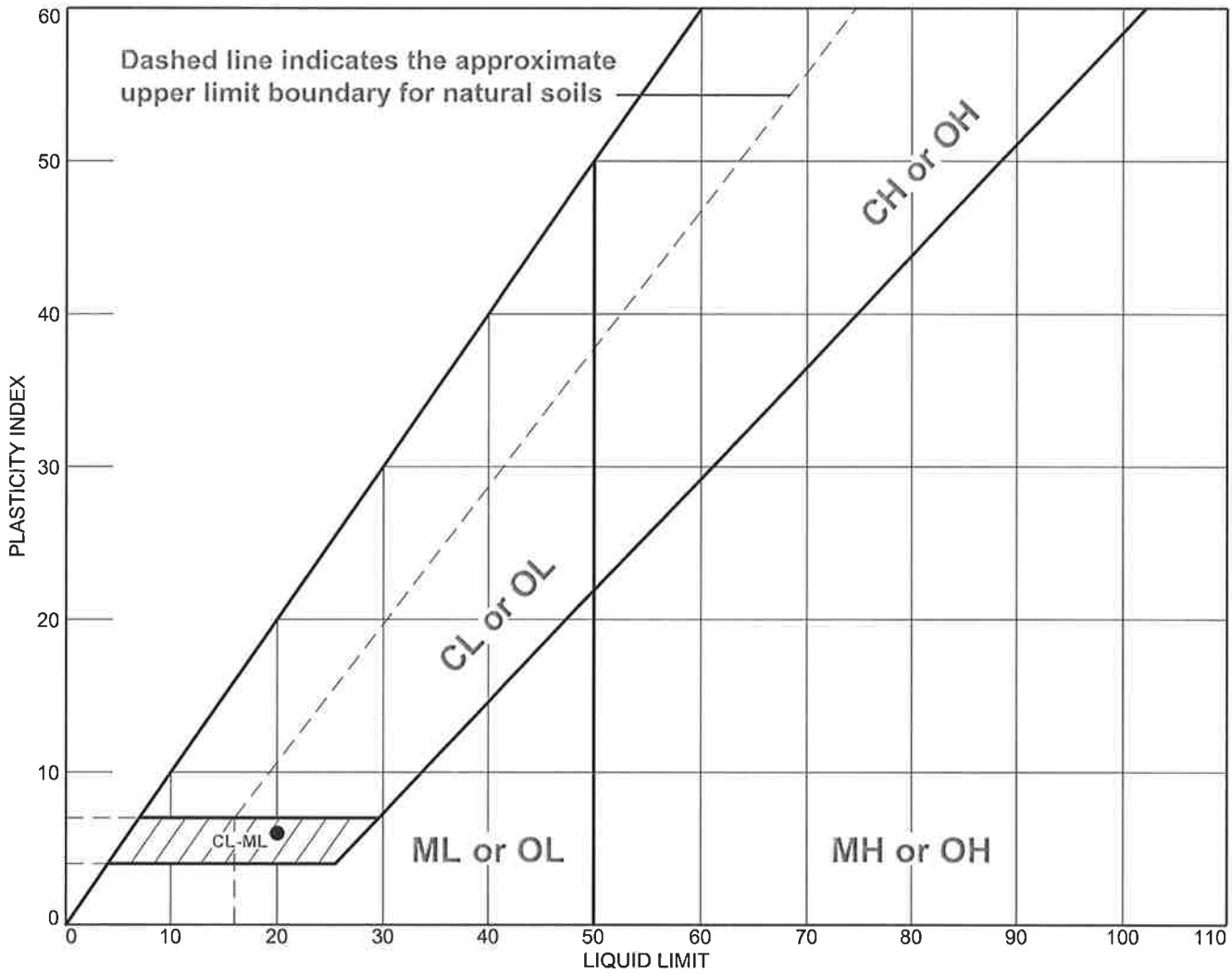
Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Tan, orange Silty f-c SAND and f-c GRAVEL	20	14	6	31	20	SC-SM

Project No. 09548-04 **Client:** GF-JMT Joint Venture

Project: MTA - Kirk Avenue Bus Facility

● **Source of Sample:** TP-2 **Depth:** 1.0'-4.0' **Sample Number:** Bulk

Remarks:

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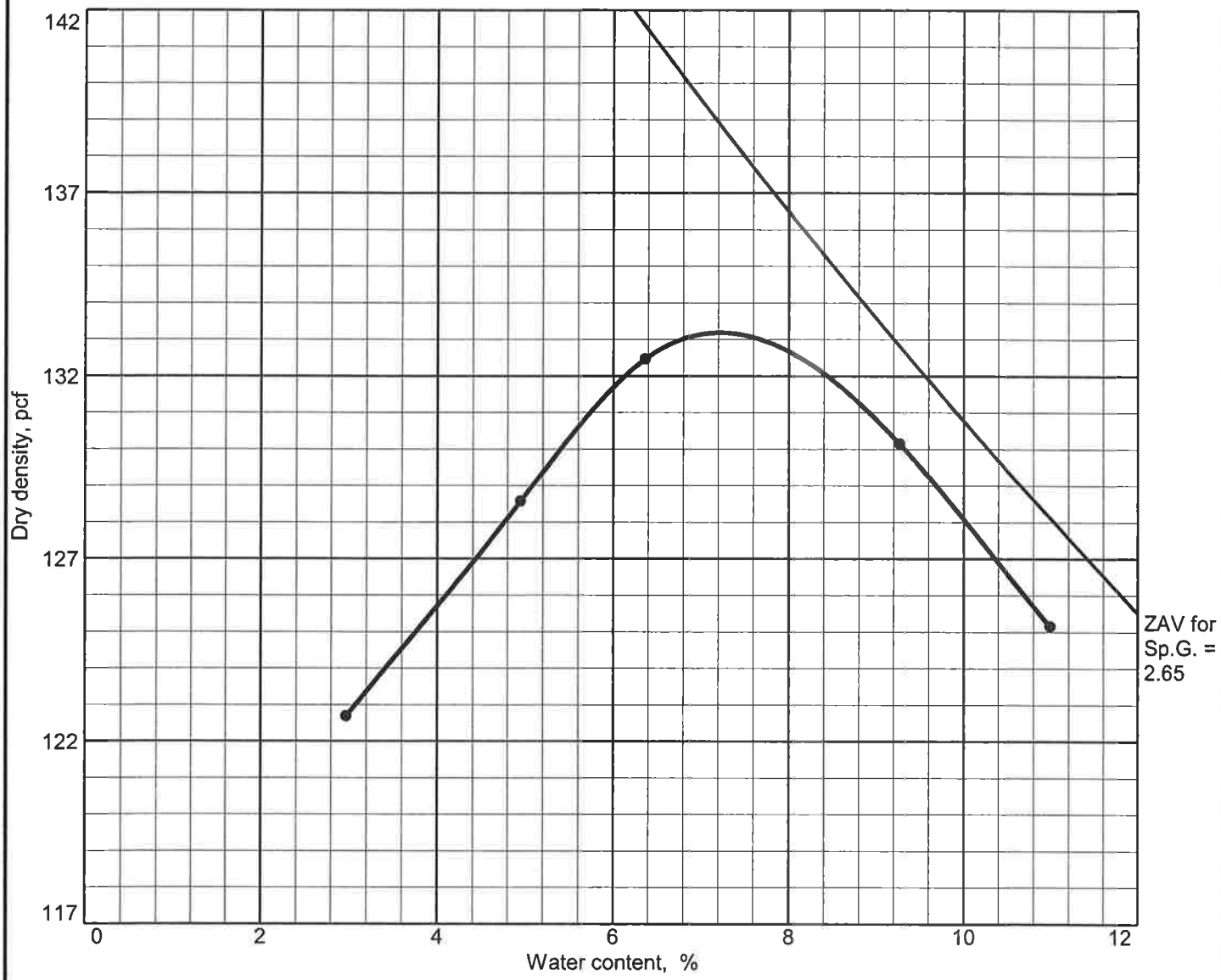
Figure

COMPACTION TEST REPORT



Test specification: AASHTO T 180 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2.0'-8.5'	SC	A-4(0)	12.0		24	8	0.0	44

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 133 pcf Optimum moisture = 7 %	Brown, Clayey f-c SAND, little Silt, trace Gravel

Project No. 09548-04 **Client:** GF-JMT Joint Venture
Project: MTA - Kirk Avenue Bus Facility

● **Source:** RB-2 **Sample No.:** BULK **Elev./Depth:** 2.0'-8.5'

Remarks:

E2CR, Inc.
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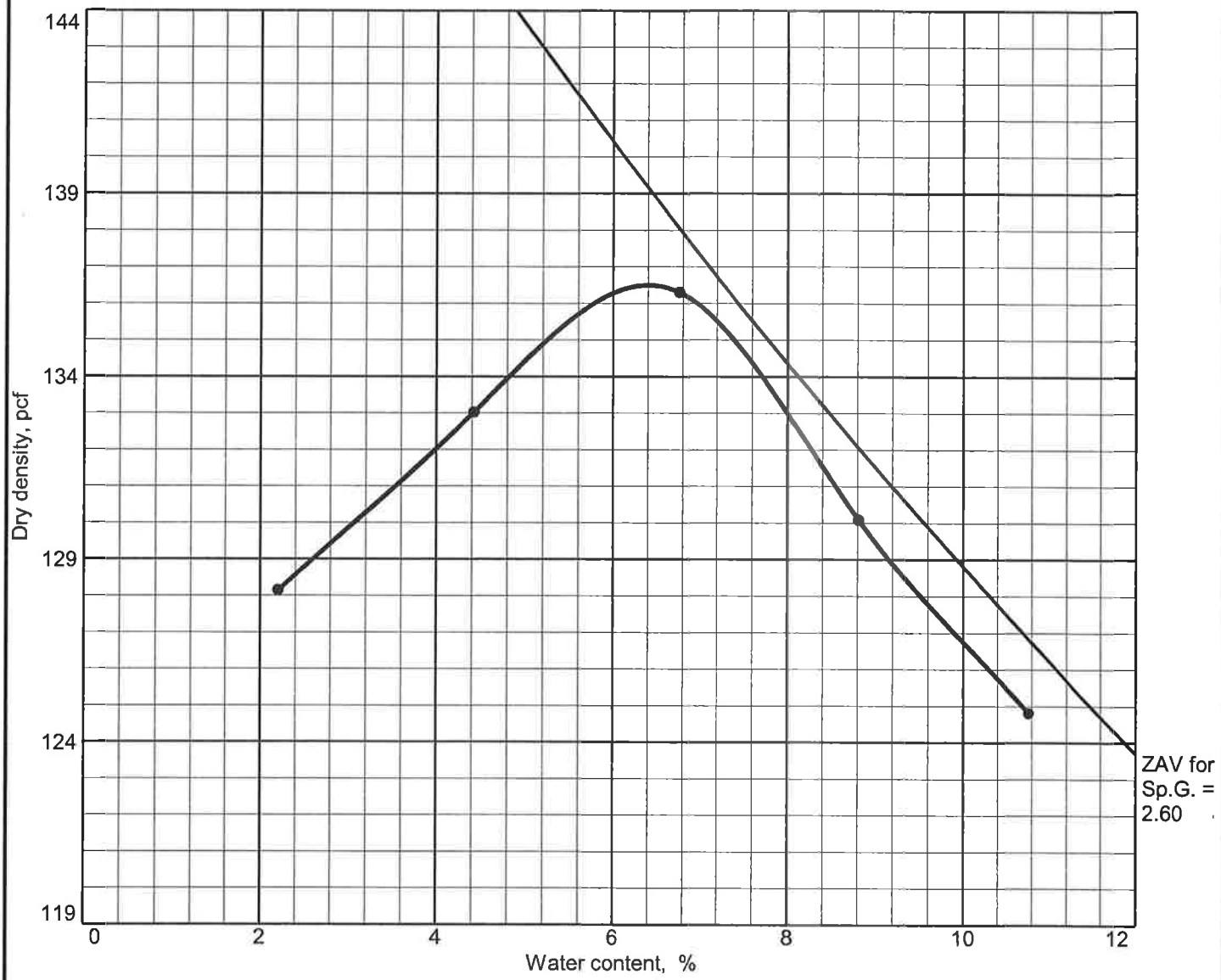
Figure

COMPACTION TEST REPORT



Test specification: AASHTO T 180 Method C Modified

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
1.0'-4.0'	SC-SM	A-1-b			20	6	15.0	20

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 136 pcf Optimum moisture = 6 %	Tan, orange Silty f-c SAND and f-c GRAVEL

Project No. 09548-04 **Client:**

Project: MTA - Kirk Avenue Bus Facility

● **Source:** TP-2 **Sample No.:** Bulk **Elev./Depth:** 1.0'-4.0'

Remarks:

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Figure

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CALIFORNIA BEARING RATIO TEST

PROJECT NAME: Kirk Ave. Bus Facility **PROJECT NO:** 09548-04 **LAB SAMPLE ID:** BULK

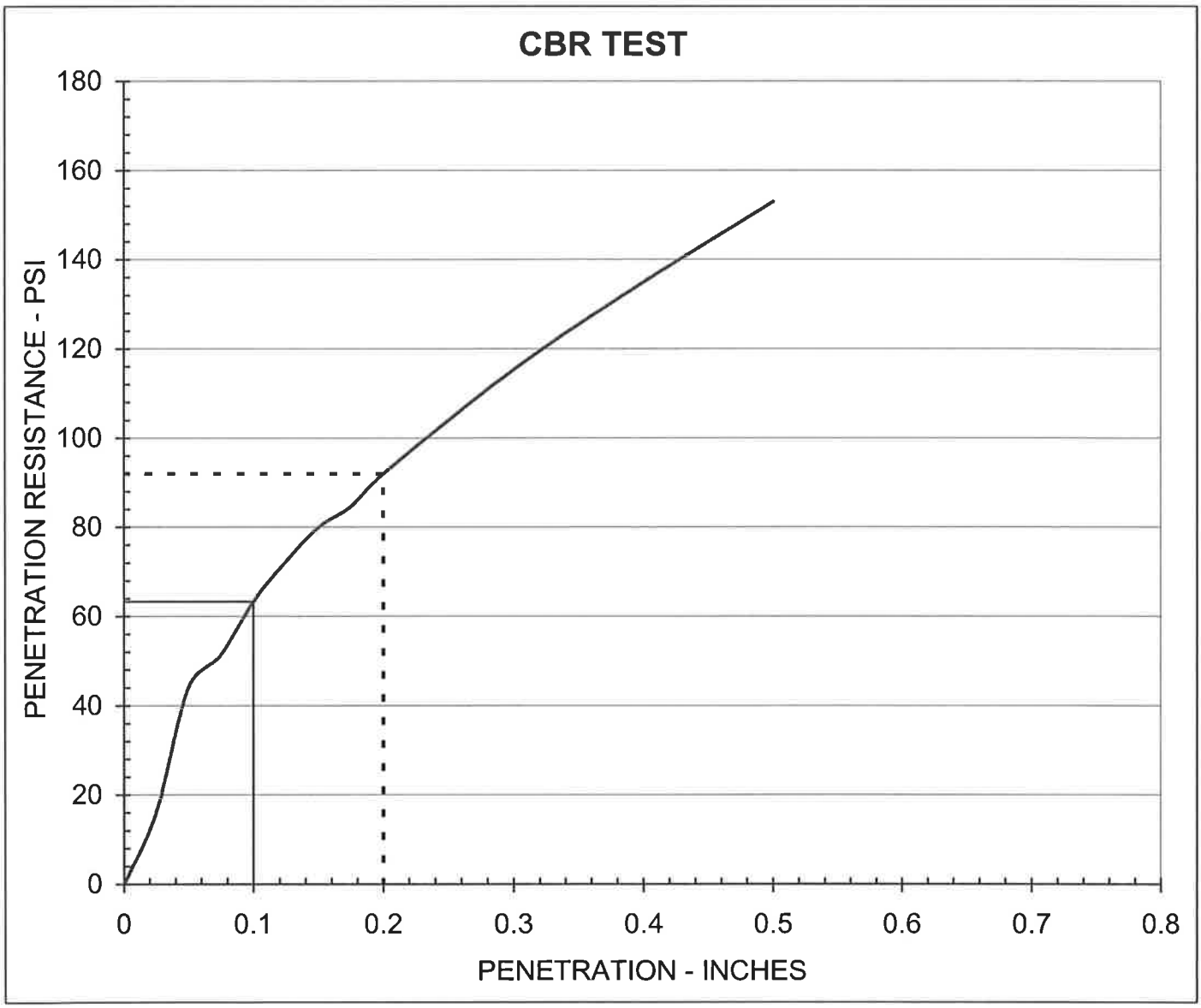
SAMPLE DESCRIPTION: **BORING NUMBER:** TP-2

MAX. DRY DENSITY (pcf): 136.5 **OPT. MOISTURE CONTENT:** 6.4% **DEPTH, (FT):** 1.0'-4.0'
(AASHTO T-180)

DRY DENSITY (pcf): 124.1 **MOISTURE CONTENT:** 5.8% **% SWELL:** 0.6%

CBR @ 0.1: 6.3 **CBR @ 0.2:** 6.1

METHOD: ASTM D1883, 96 Hours Soaked **% COMPACTION OF MODIFIED PROCTOR (T-180):** 90.9%



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CALIFORNIA BEARING RATIO TEST

PROJECT NAME: Kirk Ave. Bus Facility **PROJECT NO:** 09548-04 **LAB SAMPLE ID:** BULK

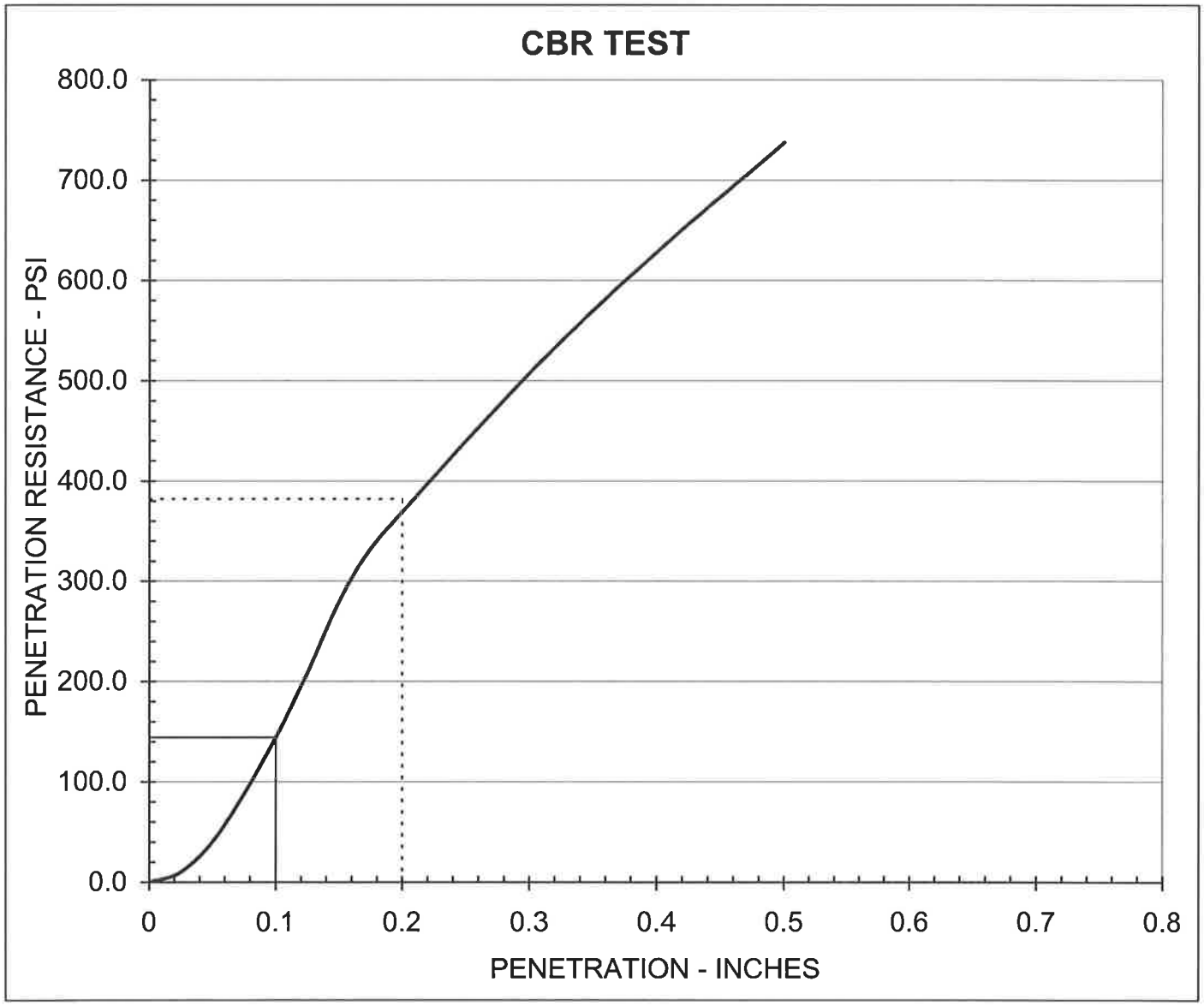
SAMPLE DESCRIPTION: 0 **BORING NUMBER:** TP-2

MAX. DRY DENSITY (pcf): 136.5 **OPT. MOISTURE CONTENT:** 6.4% **DEPTH, (FT):** 1.0'-4.0'
(AASHTO T-180)

DRY DENSITY (pcf): 129.6 **MOISTURE CONTENT:** 5.9% **% SWELL:** 0.8%

CBR @ 0.1: 14.4 **CBR @ 0.2:** 25.5

METHOD: ASTM D1883, 96 Hours Soaked **% COMPACTION OF MODIFIED PROCTOR (T-180):** 94.9%



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CALIFORNIA BEARING RATIO TEST

PROJECT NAME: Kirk Ave. Bus Facility **PROJECT NO:** 09548-04 **LAB SAMPLE ID:** BULK

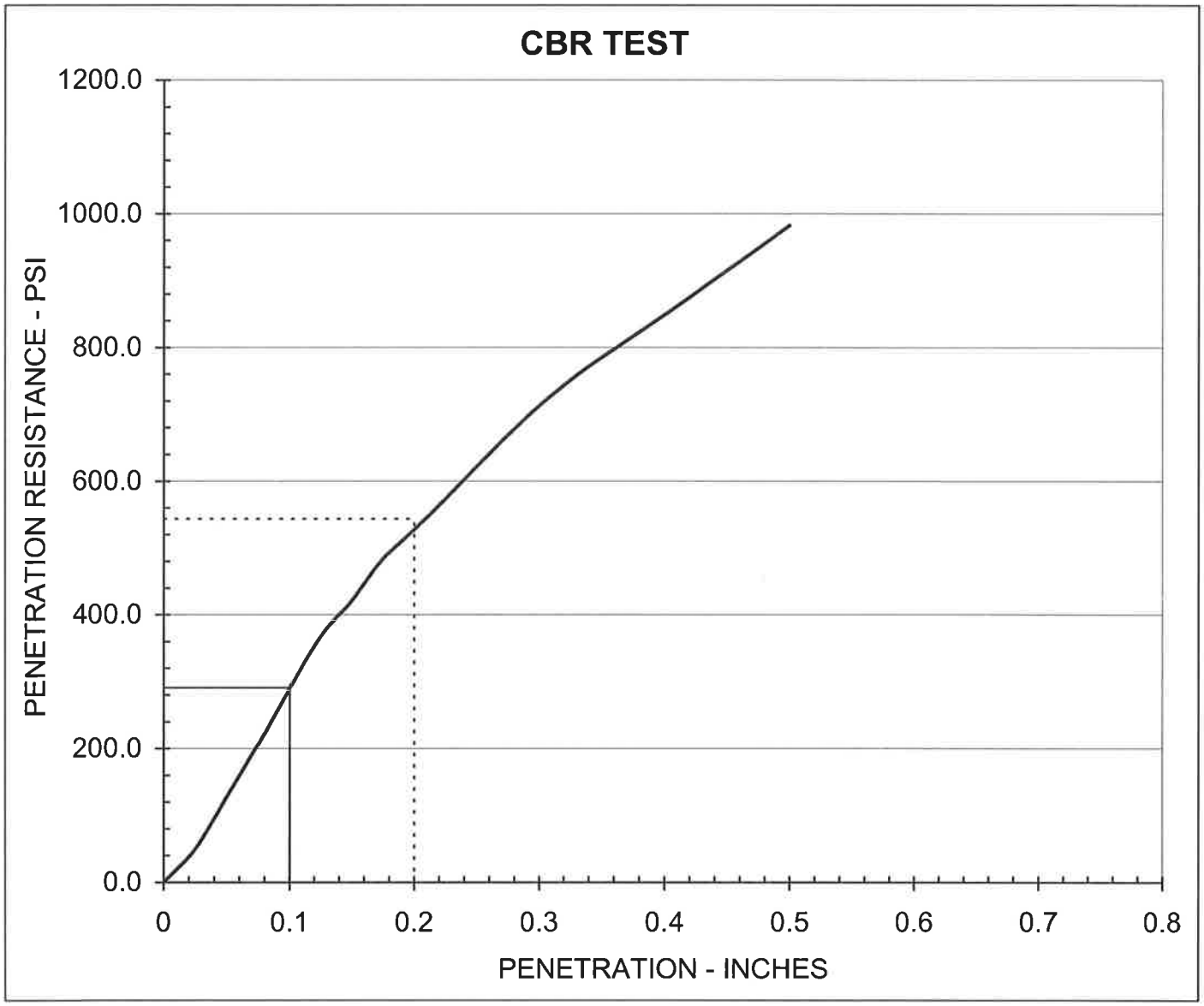
SAMPLE DESCRIPTION: 0 **BORING NUMBER:** TP-2

MAX. DRY DENSITY (pcf): 136.5 **OPT. MOISTURE CONTENT:** 6.4% **DEPTH, (FT):** 1.0'-4.0'
(AASHTO T-180)

DRY DENSITY (pcf): 133.5 **MOISTURE CONTENT:** 10.2% **% SWELL:** 11.4%

CBR @ 0.1: 29.1 **CBR @ 0.2:** 36.3

METHOD: ASTM D1883, 96 Hours Soaked **% COMPACTION OF MODIFIED PROCTOR (T-180):** 97.8%



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CALIFORNIA BEARING RATIO TEST

PROJECT NAME: Kirk Ave. Bus Facility **PROJECT NO:** 09548-04 **LAB SAMPLE ID:** BULK

SAMPLE DESCRIPTION: 0 **BORING NUMBER:** TP-2

METHOD: ASTM D1883, 96 Hours Soaked

MAX. DRY DENSITY (pcf): 136.5 **OPT. MOISTURE CONTENT:** 6.4% **DEPTH, (FT):** 1.0'-4.0'

TEST-1

DRY DENSITY (pcf): 124.1 **MOISTURE CONTENT:** 5.8% **% SWELL:** 0.6%

% COMPACTION OF MODIFIED PROCTOR (T-180): 90.9%

CBR @ 0.1: 6.3 **CBR @ 0.2:** 6.1

TEST-2

DRY DENSITY (pcf): 129.6 **MOISTURE CONTENT:** 5.9% **% SWELL:** 0.8%

% COMPACTION OF MODIFIED PROCTOR (T-180): 94.9%

CBR @ 0.1: 14.4 **CBR @ 0.2:** 25.5

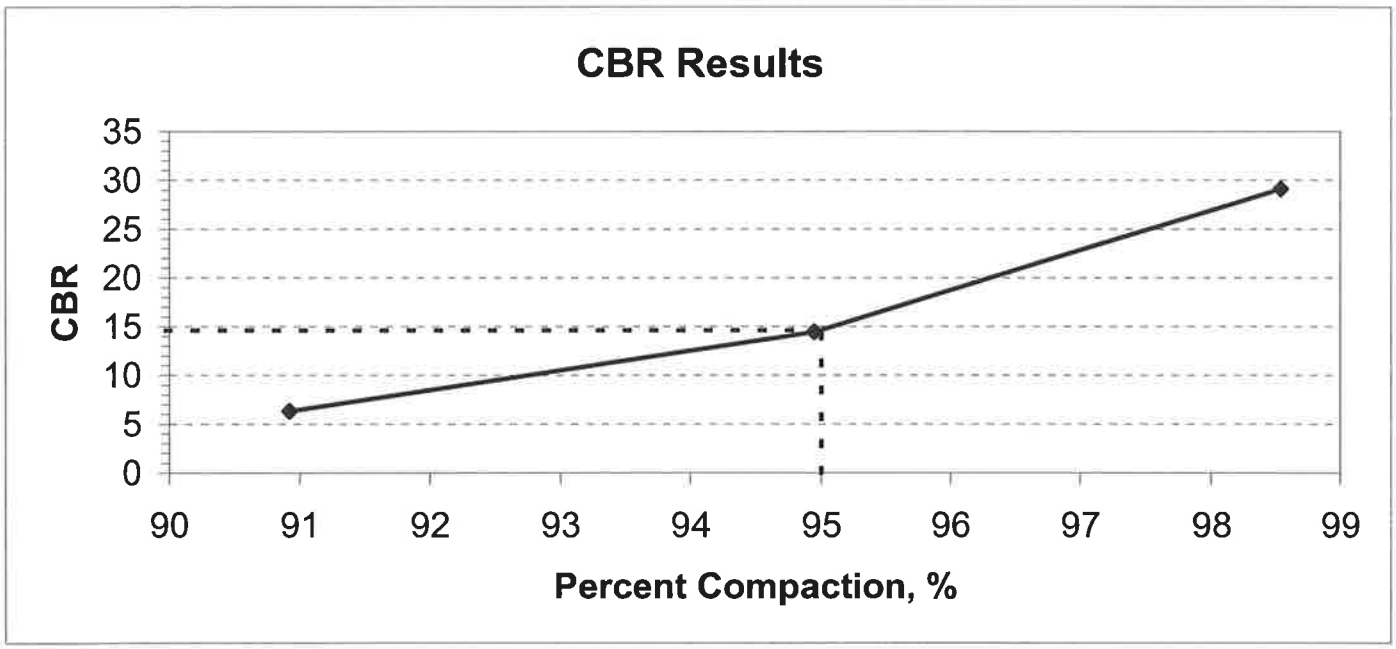
TEST-3

DRY DENSITY (pcf): 134.5 **MOISTURE CONTENT:** 10.2% **% SWELL:** 11.4%

% COMPACTION OF MODIFIED PROCTOR (T-180): 98.5%

CBR @ 0.1: 29.1 **CBR @ 0.2:** 36.3

CBR at 95% Compaction = 14.6



E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-1**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/12/10	05/12/10		119.2
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N601095.4 E1424655.3	11'	12.0'		15.0'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		62.6
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	62.6'	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	119.2		Pavement						4" Asphalt 3" Gravel Base
	118.6		Brown, gray, black, moist, Sandy SILT, little Gravel, trace Asphalt (Fill) (ML)	S-1	24"	8-5-5-7	DS	12"	
	116.2		Light brown, tan, red, moist, Sandy SILT, little Gravel, trace Brick (Fill) (ML)	S-2	24"	3-3-4-4	DS	14"	
5	114.2		Black, light brown, moist, Silty SAND, little Gravel, trace Coal (Fill) (SM)	S-3	24"	2-5-9-9	DS	18"	
				S-4	24"	3-2-2-2	DS	8"	
10	108.2			S-5	24"	2-3-2-2	DS	0"	
			Light brown, wet, micaceous, Sandy SILT (ML)	S-6	18"	3-3-3	DS	11"	
				S-7	18"	5-5-5	DS	18"	
15	103.7		Gray, orange brown, moist, micaceous, SILT and SAND (ML)	S-8	18"	2-2-3	DS	18"	
	101.2		Orange brown, black, moist, micaceous, Sandy SILT (ML)	S-9	18"	4-6-10	DS	14"	
20	97.2		Gray, black, moist, micaceous, Silty SAND, trace Gravel (SM)						
				S-10	18"	5-7-7	DS	12"	
25									
				S-11	18"	5-5-8	DS	16"	
30									
				S-12	18"	6-9-9	DS	0"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-1**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
	82.2		Dark green, light green, moist, micaceous, SILT and SAND (ML)						
				S-13	18"	6-10-12	DS	18"	
40									
				S-14	18"	15-28-35	DS	18"	
45									
	72.2		Greenish gray, moist, micaceous, Silty SAND (SM)						
				S-15	18"	9-14-21	DS	18"	
50									
				S-16	18"	20-18-20	DS	18"	
55									
	62.2		White, gray, moist, Silty GRAVEL, trace Sand (Decomposed Rock) (GM)						
				S-17	3"	50/3"	DS	3"	Auger refusal at 62.5 feet. Spoon refusal at 62.6 feet.
60									
	56.6		Bottom of boring at 62.6 feet	S-18	1"	50/1"	DS	1"	
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-2**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/04/10	05/04/10		121.7
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N601031.7 E1424747.5	12.5'	Dry		9.8'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		68.8
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	121.7		Pavement						4" Asphalt
	121.1		Brown, black, moist, Silty SAND, trace Gravel, Glass (Fill) (SM)	S-1	18"	4-6-6	DS	15"	3" Gravel Base
	118.7		Dark brown, white, moist, Clayey SAND, trace Gravel, Quartz (Fill) (SC)	S-2	18"	4-12-8	DS	10"	
5	116.7		Brown, moist, SAND and CLAY, trace Gravel (Fill) (SC)	S-3	18"	7-3-3	DS	12"	
	113.7		White, orange brown, moist, micaceous, SILT, trace to little Sand (ML)	S-4	18"	2-2-3	DS	18"	
10				S-5	18"	2-2-2	DS	18"	
	108.7		Tan, white, wet, micaceous, SILT, some Sand, trace Gravel (ML)	S-6	18"	8-14-11	DS	18"	
15	104.7		Tan, gray, moist, micaceous, SILT, trace to little Sand, trace Gravel (ML)	S-7	18"	5-7-9	DS	18"	
20	99.7		Orange brown, tan, moist, micaceous SILT, little Sand (ML)	S-8	18"	4-7-9	DS	10"	
25				S-9	18"	6-7-10	DS	18"	
30				S-10	18"	19-20-21	DS	18"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-2**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-11	18"	20-20-43	DS	18"	
40									
	79.7		Gray, tan, moist, micaceous, SILT, little Sand (ML)						
				S-12	18"	24-21-22	DS	18"	
45									
	74.7		Gray, moist, micaceous, SILT, little Sand (Decomposed Rock) (ML)						
				S-13	11"	30-50/5"	DS	11"	
50									
				S-14	8"	38-50/2"	DS	8"	
55									
				S-15	4"	50/4"	DS	4"	
60									
	59.7		White, gray, moist, Silty GRAVEL and SAND (Decomposed Rock) (GM)						
				S-16	3"	50/3"	DS	3"	
65									
	52.9			S-17	3"	50/3"	DS	3"	
70			Bottom of boring at 68.8 feet						
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-3**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/13/10	05/13/10		134.8
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600933.0 E1424961.5	39.5'	Dry		15'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		39
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	134.8		Topsoil						6" Topsoil
	134.3		Light brown, gray, tan, moist, f-m SAND and SILT (SM)	S-1	24"	1-3-3-4	DS	15"	
				S-2	24"	3-3-5-8	DS	16"	
5				S-3	24"	3-3-4-5	DS	18"	
				S-4	18"	3-4-5-5	DS	18"	
				S-5	24"	4-4-3-4	DS	18"	
10									
				S-6	18"	5-7-9	DS	18"	
	121.8		Orange brown, gray, moist, SILT, trace to little Sand (ML)	S-7	18"	5-11-14	DS	18"	
15									
	117.8		Orange brown, gray, moist, micaceous, SILT and SAND (ML)	S-8	18"	6-9-10	DS	14"	
20									
	112.8		Gray, orange brown, moist, micaceous, SILT and SAND (Decomposed Rock) (ML)	S-9	16"	6-16-50/4"	DS	16"	
25									
				S-10	16"	16-24-50/4"	DS	16"	
30									
				S-11	5"	50/5"	DS	5"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-3**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE DATA: SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
	95.8			S-12	5"	50/5"	DS	5"	
40			Bottom of boring at 39 feet						
45									
50									
55									
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-4**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/17/10	05/17/10		115.7
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N601114.8 E1424518.5	8.5'	DRY		10.0'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		49
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	115.7		Pavement						3" Asphalt
	114.9		Gray, moist, Silty SAND, some Gravel (Fill) (SM)	S-1	18"	2-3-2	DS	10"	7" Gravel Base
				S-2	18"	2-3-2	DS	8"	
5	110.2		Light brown, moist to wet, Silty SAND, trace to little Gravel (Fill) (SM)	S-3	18"	3-3-10	DS	12"	
				S-4	18"	WOH/18"	DS	6"	
10				S-5	18"	WOH/18"	DS	6"	
	102.7		Gray, wet, Silty SAND, trace Gravel, Brick (Fill) (SM)	S-6	18"	2-2-2	DS	12"	
15				S-7	18"	5-2-2	DS	14"	
	97.7		Gray, moist, micaceous, SILT and SAND (ML)	S-8	18"	5-6-7	DS	15"	
20	93.7		Orange brown, white, moist, Silty GRAVEL (GM)	S-9	18"	4-8-8	DS	18"	
25	88.7		Greenish gray, moist, SILT and SAND (ML)	S-10	18"	8-9-11	DS	18"	
30	83.7		Gray, moist, SAND and SILT, trace Gravel (Decomposed Rock) (SM)	S-11	5"	50/5"	DS	5"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-4**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
	78.7		White, moist, Silty GRAVEL (Decomposed Rock) (GM)						
				S-12	9"	28-50/3"	DS	9"	
40									
				S-13	4"	50/4"	DS	4"	
45									
	66.7			S-14	5"	50/5"	DS	5"	
50			Bottom of boring at 49 feet						
55									
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-5**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/10/10	05/11/10		116.7
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N601052.6 E1424652.9	16'	DRY		15.0'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
Jim	140 lbs	30 In.		54.5
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV track short tower/ HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	116.7		Concrete Slab						6" Concrete
	116.2		Brown, black, moist, Silty SAND, little Gravel (Fill) (SM)	S-1	18"	5-3-2	DS	6"	
				S-2	18"	4-6-9	DS	2"	
5	111.2		Brown, black, moist, Clayey SAND, little Gravel, trace Bricks (Fill) (SM)	S-3	18"	1-2-2	DS	10"	
				S-4	18"	4-5-6	DS	1"	
10	106.2		Gray, moist, Clayey SAND, little Gravel (SC)	S-5	18"	4-4-4	DS	3"	
	103.7		Orange brown, gray, moist, micaceous, SILT and SAND (ML)	S-6	18"	3-2-2	DS	18"	
15				S-7	18"	2-2-2	DS	10"	
	98.7		Orange brown, tan, moist, micaceous, SILT, little Sand (ML)	S-8	18"	4-5-5	DS	8"	
20				S-9	18"	3-5-4	DS	8"	
	93.7		Tan, gray, moist, micaceous, SILT, little Sand (ML)	S-10	18"	4-4-5	DS	10"	
25									
				S-11	18"	4-5-8	DS	13"	
30	84.7		Gray, moist, micaceous, SILT, some Sand (Decomposed Rock) (ML)						
				S-12	18"	9-10-20	DS	16"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-5**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE DATA: SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-13	17"	10-22-50/5"	DS	17"	
40									
				S-14	15"	40-40-50/3"	DS	15"	
45									
				S-15	9"	15-50/3"	DS	8"	
50									
	62.2			S-16	10"	13-50/4"	DS	10"	
55			Bottom of boring at 44.5 feet						
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-6**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/07/10	05/10/10		116.7
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N601084.0 E1424545.9	8.5'	8.0'		12.0'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
Jim	140 lbs	30 In.		59
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV track short tower/ HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	116.7		Concrete Slab						7" Concrete
	116.1		Tan, moist, SAND and SILT, little Gravel (Fill) (SM)	S-1	18"	5-4-3	DS	16"	
	113.7		Tan, brown, black, moist, SILT and SAND, little Gravel, trace Bricks (Fill) (ML)	S-2	18"	2-1-2	DS	8"	
5				S-3	18"	3-2-1	DS	11"	
	108.7		Gray, black, wet, Silty f-c SAND and GRAVEL; odor (Fill) (SM)	S-4	18"	3-2-1	DS	9"	
10	106.2		Gray, black, wet, Sandy SILT, little Gravel; odor (Fill) (ML)	S-5	18"	2-2-2	DS	8"	
	103.7		Gray, red, moist, Silty SAND, little Gravel, Brick; odor (Fill) (SM)	S-6	18"	1-2-3	DS	8"	
15	101.2		Gray, brown, moist, SILT and SAND (ML)	S-7	18"	3-8-9	DS	15"	
	98.7		Orange brown, gray, moist, micaceous, SILT, little Sand (ML)	S-8	18"	4-3-5	DS	12"	
20				S-9	18"	3-7-14	DS	1"	
	93.7		White, gray, moist, micaceous, SILT, trace to little Sand (ML)	S-10	18"	3-8-13	DS	14"	
25				S-11	18"	6-11-16	DS	11"	
	88.7		Greenish gray, moist, micaceous, SILT, some Sand (ML)	S-12	17"	11-14-50/5"	DS	17"	
30									
	84.7		Greenish gray, moist, SAND and SILT (SM)						
				S-13	18"	14-19-14	DS	18"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-6**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-14	18"	13-18-23	DS	17"	
40									
	74.7		Greenish gray, moist, micaceous, SAND and SILT (Decomposed Rock) (SM)						
				S-15	9"	12-50/3"	DS	9"	
45									
				S-16	16"	15-18-50/4"	DS	14"	
50									
				S-17	16"	15-23-50/4"	DS	16"	
55									
	59.7								
	57.7		Dark gray, moist, micaceous, SILT and SAND (Decomposed Rock) (ML)	S-18	5"	50/5"	DS	5"	
60			Bottom of boring at 59 feet						
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-7**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/13/10	05/13/10		116.9
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600995.8 E1424671.4	33'	Dry		15'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
Jim	140 lbs	30 In.		48.8
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV track short tower/ HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	116.9		Concrete Slab						7" Concrete
	116.3		Brown, moist, Silty SAND, little Gravel, trace Brick (Fill) (SM)	S-1	18"	7-10-8	DS	18"	
				S-2	18"	1-2-1	DS	10"	
5	111.4		Brown, moist, SILT, trace to little Sand (ML)	S-3	18"	4-6-7	DS	13"	
	108.9		Light brown, moist, micaceous, SILT and SAND (ML)	S-4	18"	2-2-2	DS	8"	
10	106.4		Orange brown, gray, moist, micaceous, SILT and SAND (ML)	S-5	18"	2-3-2	DS	16"	
				S-6	18"	2-3-2	DS	10"	
15									
				S-7	18"	2-4-7	DS	11"	
20	94.9		Tan, gray, moist, f-c SAND and SILT, trace Gravel (SM)						
				S-8	18"	1-2-3	DS	10"	
25									
				S-9	18"	3-8-9	DS	14"	
30	84.9		Tan, wet, Silty GRAVEL and SAND (Decomposed Rock) (GM)						
				S-10	17"	9-18-50/5"	DS	15"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-7**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-11	16"	13-32-50/4"	DS	5"	
40									
	74.9		Gray, moist, micaceous, SAND and SILT (Decomposed Rock) (SM)						
				S-12	7"	37-50/1"	DS	6"	
45									
	68.1			S-13	3"	50/3"	DS	3"	
			Bottom of boring at 48.8 feet						
50									
55									
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-8**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/12/10	05/12/10		117.1
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600912.2 E1424790.8	0'	11'		18'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
Jim	140 lbs	30 In.		59.4
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV track short tower/ HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	117.1		Concrete Slab						7" Concrete
	116.5		Brown, wet, Silty SAND, trace Gravel (Fill) (SM)	S-1	18"	5-7-8	DS	18"	Standing water near ground surface. No water on rods.
	114.1		Tan, brown, moist, micaceous, SILT and SAND, trace Gravel (ML)	S-2	18"	7-6-3	DS	9"	
5	111.6		Light brown, gray, moist, micaceous, SILT, little Sand (ML)	S-3	18"	1-1-1	DS	12"	
	109.1		Light brown, gray, moist, micaceous, SILT, trace Sand (ML)	S-4	18"	1-2-3	DS	18"	
10	106.6		Light brown, Orange brown, gray, moist, micaceous, SILT, some Sand, trace Gravel (ML)	S-5	18"	4-4-4	DS	9"	
	104.1		Gray, moist, micaceous, SILT, trace Sand (ML)	S-6	18"	2-3-4	DS	13"	
15				S-7	18"	2-3-4	DS	13"	
				S-8	18"	2-4-5	DS	13"	
20	95.1		Tan, gray, moist, SILT, little Sand, trace Gravel (ML)						
				S-9	18"	6-8-9	DS	12"	
25				S-10	18"	8-8-8	DS	13"	
30	85.1		Tan, orange brown, gray, moist, micaceous, SILT and SAND, trace Gravel (ML)						
				S-11	18"	6-18-21	DS	12"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-8**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-12	18"	9-14-19	DS	10"	
40									
	75.1		Gray, moist, micaceous, SILT, little Sand (Decomposed Rock) (ML)						
				S-13	17"	11-22-50/5"	DS	16"	
45									
				S-14	9"	20-50/3"	DS	8"	
50									
				S-15	15"	17-32-50/3"	DS	11"	
55									
	57.7			S-16	10"	19-50/4"	DS	7"	
60			Bottom of boring at 59.4 feet						
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-9**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/13/10	05/13/10		132.8
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600841.4 E1424870.3	14'	Dry		10.8'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		28.6
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	28.6'	K. Habib		1 OF 1

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	132.8		Topsoil						4" Topsoil
	132.5		Tan, black, moist, Silty SAND, little Gravel (Fill) (SM)	S-1	18"	3-5-6	DS	12"	
	129.8		Orange, gray, moist, Clayey SILT, some Sand, trace Gravel (Fill) (ML)	S-2	18"	5-5-6	DS	12"	
5	127.3		Tan, orange brown, moist, SAND and SILT, little Gravel (Fill) (SM)	S-3	18"	2-2-2	DS	8"	
	124.8		Brown, moist to wet, Silty SAND, trace Gravel (SM)	S-4	18"	3-4-2	DS	18"	
10				S-5	18"	1-1-2	DS	14"	
				S-6	18"	2-2-3	DS	18"	
15				S-7	18"	1-2-3	DS	18"	
	113.8		Brown, wet, Silty GRAVEL and SAND (GM)	S-8	18"	4-9-9	DS	18"	
20				S-9	18"	14-11-11	DS	10"	Auger refusal at 28.5 feet.
25	105.8								
	104.2		Brown, moist to wet, Decomposed Rock Fragments (Decomposed Rock)	S-10	0.5"	50/0.5"	DS	0.5"	
30			Bottom of boring at 28.6 feet						
35									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-10**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/05/10	05/05/10		112.4
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600995.3 E1424432.0	15'	DRY		10.0'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		43.9
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	112.4		Pavement						3" Asphalt 6" Concrete 4" Gravel Base
	111.3		Borwn, moist, Silty SAND, trace Gravel (Fill) (SM)	S-1	18"	2-3-7	DS	12"	
	109.4		Brown, moist, Silty SAND, little Gravel, trace Wood, Mica (Fill) (SM)	S-2	18"	1-1-2	DS	15"	
5				S-3	18"	1-2-2	DS	18"	
	104.4		Black, gray, wet, Silty SAND, little Gravel, trace Wood: strong odor (Fill) (SM)	S-4	18"	4-4-2	DS	18"	
10				S-5	18"	1-1-1	DS	10"	
15				S-6	18"	12-5-6	DS	8"	
	94.4		Tan, red, white, wet, Silty SAND and GRAVEL (SM)	S-7	18"	3-3-2	DS	1"	
20	90.4		Green, white, moist, micaceous, SILT and SAND (ML)	S-8	18"	12-30-30	DS	8"	
25	85.4		White, moist, SILT and SAND, some Gravel (Decomposed Rock) (ML)	S-9	18"	8-16-14	DS	15"	
30	80.4		White, moist, SILT and GRAVEL, some Sand (Decomposed Rock) (ML)	S-10	9"	17-50/3"	DS	9"	
35				S-11	16"	26-48-50/4"	DS	16"	

E2CR, Inc.

BORING LOG

BORING NO. **RB-10**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO.: 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-12	4"	50/4"	DS	4"	
40									
	68.5			S-13	5"	50/5"	DS	5"	
			Bottom of boring at 43.9 feet						
45									
50									
55									
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-11**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/17/10	05/17/10		114.1
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600975.9 E1424489.9	8.5'	10.0'		15.0'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
Stetson	140 lbs	30 In.		49.5
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV track short tower/ HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	114.1		Concrete Slab						6" Concrete
	113.6		Black, moist, Silty SAND, little Gravel (Fill) (SM)	S-1	18"	3-4-3	DS	13"	
	111.1		Brown, moist, Silty SAND, little Gravel (Fill) (SM)	S-2	18"	5-2-2	DS	13"	
5	108.6		Brown, red, moist, SILT and SAND (Fill) (ML)	S-3	18"	3-3-5	DS	6"	
	106.1		Gray, wet, Sandy SILT; odor (Fill) (ML)	S-4	18"	3-2-1	DS	15"	
10				S-5	18"	1-1-2	DS	10"	
	101.1		Black, gray, wet, Silty SAND, little Gravel, trace Brick; Odor (Fill) (SM)	S-6	18"	3-6-5	DS	12"	
15	98.6		Gray, wet, SILT and SAND (ML)	S-7	18"	3-1-1	DS	8"	
20				S-8	18"	3-5-6	DS	15"	
	92.1		Gray, moist, micaceous, SILT and SAND (ML)	S-9	18"	3-4-7	DS	8"	
25				S-10	18"	5-8-9	DS	12"	
	87.1		Gray, white, moist, Clayey SILT (ML)						
30				S-11	18"	14-15-19	DS	16"	
	82.1		White, moist, Silty GRAVEL, some Sand (Decomposed Rock) (GM)						
35				S-12	18"	41-40-50/4"	DS	16"	

E2CR, Inc.

BORING LOG

BORING NO. **RB-11**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO.: 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE DATA: SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-13	5"	50/5"	DS	4"	
40									
				S-14	5"	50/5"	DS	5"	
45									
	64.6			S-15	9"	28-50/3"	DS	9"	
50			Bottom of boring at 49.5 feet						
55									
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-12**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/13/10	05/13/10		114.2
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600917.0 E1424560.7	7'	7'		12'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
Jim	140 lbs	30 In.		50
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV track short tower/ HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	114.2		Concrete Slab						8" Concrete
	113.5		Dark brown, black, moist, Silty f-c SAND, little Gravel (Fill) (SM)	S-1	18"	4-4-9	DS	12"	
				S-2	18"	6-3-2	DS	6"	
5	108.7		Brown, moist, SAND and SILT (SM)	S-3	18"	2-1-1	DS	16"	
				S-4	18"	2-1-2	DS	15"	
10				S-5	18"	6-7-9	DS	16"	
				S-6	18"	2-5-4	DS	0"	
15				S-7	18"	6-4-7	DS	7"	
	96.2		Orange brown, gray, moist, micaceous SILT, some Sand (ML)	S-8	18"	3-4-3	DS	12"	
20									
				S-9	18"	3-3-3	DS	1"	
25									
				S-10	18"	2-4-6	DS	12"	
30									
	82.2								
	82.2		Orange brown, moist, SILT and SAND (Decomposed Rock) (ML)						
			Orange brown, gray, moist, SILT, some Sand, Mica (Decomposed Rock) (ML)	S-11	5"	50/5"	DS	0"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-12**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE DATA: SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-12	18"	18-24-50/6"	DS	1"	
40									
				S-13	17"	26-42-50/5"	DS	17"	
45									
				S-14	17"	17-30-50/5"	DS	17"	
50	64.2		Bottom of boring at 50 feet						
55									
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-13**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/10/10	05/10/10		126.4
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600852.5 E1424618.8	17'	Dry		18'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		64
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	126.4		Pavement						3" Asphalt
	125.7		Black, brown, moist, Silty SAND, some Gravel; odor (Fill) (SM)						5" Gravel Base
				S-1	24"	12-9-9-8	DS	12"	
				S-2	24"	7-4-4-4	DS	18"	
5	121.4		Brown, red, moist, Silty SAND, some Gravel, Brick (Fill) (SM)	S-3	24"	3-2-4-8	DS	24"	
	119.4		Tan, black, brown, moist, Silty SAND, some Gravel, Quartz, Coal (Fill) (SM)	S-4	24"	4-5-6-6	DS	24"	
	117.4		Light brown, moist, Silty SAND, trace Gravel (Fill) (SM)	S-5	24"	3-3-3-4	DS	20"	
10	115.4		Dark brown, black, red, moist, SAND and SILT, some Gravel, Brick, Wood; Odor (Fill) (SM)	S-6	18"	3-6-6	DS	9"	
				S-7	18"	3-4-2	DS	18"	
15	110.9		Brown, red, wet, SILT and SAND, some Gravel, Brick (Fill) (ML)	S-8	18"	3-2-2	DS	10"	
				S-9	18"	4-5-7	DS	6"	
20	105.4		Orange brown, moist, micaceous, SILT and SAND (ML)	S-10	18"	4-5-5	DS	18"	
				S-11	18"	4-6-8	DS	18"	
25									
				S-12	18"	5-7-8	DS	6"	
30	94.4		Orange brown, tan, moist, micaceous, SILT, some Sand (ML)						
				S-13	18"	9-9-11	DS	18"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-13**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
	89.4		Gray, tan, moist, micaceous, SILT and SAND (ML)						
				S-14	18"	12-14-18	DS	18"	
40									
				S-15	18"	12-20-34	DS	18"	
45									
	79.4		Gray, moist, micaceous, SILT and SAND (Decomposed Rock) (ML)						
				S-16	16"	14-21-50/4"	DS	16"	
50									
				S-17	11"	12-50/5"	DS	11"	
55									
				S-18	5"	50/5"	DS	5"	
60									
	62.4			S-19	5"	50/5"	DS	5"	
65			Bottom of boring at 64 feet						
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-14**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/06/10	05/06/10		128.6
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600819.7 E1424714.1	15'	Dry		6'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		50
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	128.6		Pavement						3" Asphalt 5" Gravel Base
	127.9		Black, dark brown, moist, Silty SAND, little Gravel (Fill) (SM)	S-1	18"	3-1/12"	DS	12"	
	125.6		Light brown, moist, f-c SAND, trace Silt and Gravel (Fill) (SM)	S-2	18"	1-2-2	DS	15"	
5	123.1		Red, tan, moist, Sandy SILT, little Gravel (Fill) (ML)	S-3	18"	2-1-1	DS	15"	
	120.6		Light brown, moist, f-c SAND, trace Silt and Gravel (Fill) (SM)	S-4	18"	1-2-2	DS	14"	
10	116.6			S-5	18"	1-1-2	DS	18"	
	115.6		White, tan, moist, Sandy SILT, trace to little Gravel (Fill) (ML)						
			Black, gray, wet, Silty GRAVEL, some Sand, Glass; odor (Fill) (GM)	S-6	18"	1-1-2	DS	6"	
15				S-7	18"	1-1-1	DS	9"	
	109.6		White, light gray, wet Silty f-c SAND, some Gravel (SM)	S-8	18"	11-12-12	DS	8"	
20	106.6		White, orange brown, moist, Clayey SILT and SAND, Mica (MH)						
25				S-9	18"	6-9-11	DS	18"	
30				S-10	18"	6-9-15	DS	18"	
	96.6		Gray, moist, micaceous, Silty SAND (Decomposed Rock) (SM)						
35				S-11	18"	21-50/4"	DS	10"	

E2CR, Inc.

BORING LOG

BORING NO. **RB-14**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE DATA: SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-12	11"	35-50/5"	DS	11"	
40									
				S-13	16"	14-25-50/4"	DS	16"	
45									
				S-14	15"	30-42-50/3"	DS	15"	
50	78.6		Bottom of boring at 50 feet						
55									
60									
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-15**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/06/10	05/06/10		132.2
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600756.9 E1424798.4	15'	Dry		6'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		59.5
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	132.2								3" Asphalt
	131.5		Black, brown, red, moist, Silty SAND, little Gravel, Brick, Coal (Fill) (SM)	S-1	24"	7-5-4-4	DS	24"	5" Gravel Base
				S-2	24"	7-4-4-4	DS	20"	
5				S-3	24"	3-2-3-2	DS	1"	
	125.2		Light brown, black, red, moist, SILT and SAND, trace Gravel (Fill) (ML)	S-4	24"	1-2-5-6	DS	10"	
10	121.2			S-5	24"	1-2-2-3	DS	1"	
	119.2		Light brown, moist, Silty fine SAND (Fill) (SM)	S-6	18"	2-2-2	DS	8"	
15	116.7		Light brown, red, wet, Silty f-c SAND, little Gravel, trace Bricks (Fill) (SM)	S-7	18"	2-4-6	DS	12"	
	114.2		Gray, black, moist, Sandy SILT, some Gravel (ML)	S-8	18"	2-2-1	DS	18"	
20	109.2		Tan, brown, wet, Silty SAND, little Gravel (SM)	S-9	18"	4-6-14	DS	15"	
				S-10	18"	12-23-23	DS	12"	
25			White, moist, micaceous, Sandy SILT (ML)	S-11	18"	3-3-4	DS	12"	
30				S-12	18"	3-4-6	DS	18"	
35				S-13	18"	6-8-12	DS	18"	

E2CR, Inc.

BORING LOG

BORING NO. **RB-15**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
	95.2		Orange brown, gray, moist, micaceous, SILT, little Sand (ML)						
				S-14	18"	8-10-11	DS	14"	
40									
	90.2		Gray, moist, micaceous, SILT, little Sand (Decomposed Rock) (ML)						
				S-15	11"	15-50/5"	DS	11"	
45									
				S-16	17"	15-25-50/5"	DS	16"	
50									
				S-17	18"	23-23-30	DS	18"	
55									
	72.7			S-18	11"	28-50/5"	DS	11"	
60			Bottom of boring at 59.5 feet						
65									
70									
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-16**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/06/10	05/06/10		113.5
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600947.4 E1424396.0	8.5'	Dry		10'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
Jim	140 lbs	30 In.		80
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV track short tower/ HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	113.5		Dark browm, black, moist, Silty SAND, little Gravel (Fill) (SM)						4" Topsoil
				S-1	18"	5-6-5	DS	3"	
				S-2	18"	1-2-1	DS	5"	
5	108.0		Dark brown, tan, moist, Silty f-c SAND, little Gravel (Fill) (SM)						
				S-3	18"	2-1-2	DS	11"	
				S-4	18"	1-1-1	DS	4"	
10	103.0		Tan, wet, Silty SAND, little Gravel (Fill) (SM)						
				S-5	18"	WOH-WOH-WOH	DS	14"	
	100.5		Light brown, gray, wet, SAND and SILT, little Gravel; odor (Fill) (SM)						
15				S-6	18"	7-2-1	DS	9"	
				S-7	18"	2-2-3	DS	1"	
	95.5		Gray, black, moist, Sandy SILT; odor (Fill) (ML)						
20				S-8	18"	1-1-1	DS	9"	
				S-9	18"	1-2-1	DS	12"	
	90.5		Dark gray, brown, wet, Silty SAND and Quartz GRAVEL (SM-GM)						
25				S-10	18"	3-10-7	DS	5"	
	86.5		White, moist, micaceous, SILT, some Gravel, little Sand (ML)	S-11	18"	5-4-5	DS	7"	
				S-12	18"	6-11-20	DS	17"	
30									
	81.5		White, moist, micaceous, SILT and SAND, little Gravel (Decomposed Rock) (ML)						
				S-13	16"	12-7-50/4"	DS	16"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-16**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
	76.5		Light brown, white, moist, micaceous, SILT, little fine Sand (ML)						
				S-14	18"	6-12-13	DS	13"	
40									
	71.5		Light gray, orange brown, moist, SAND and SILT (SM)						
				S-15	17"	19-31-50/5"	DS	16"	
45									
	66.5		White, gray, moist, SILT, some Gravel, little Sand (ML)						
				S-16	17"	8-21-50/5"	DS	15"	
50									
				S-17	18"	8-16-25	DS	18"	
55									
				S-18	18"	12-23-26	DS	18"	
60									
				S-19	18"	20-25-40	DS	18"	
65									
	46.5		White, black, moist, SILT and SAND, some Gravel (ML)						
				S-20	18"	10-19-17	DS	15"	
70									
				S-21	18"	8-16-18	DS	18"	
75									
	36.5		Dark gray, moist, micaceous, SILT, trace to little Sand (ML)						
	33.5			S-22	18"	8-15-18	DS	16"	
80			Bottom of boring at 80 feet						

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-17**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/14/10	05/14/10		114.5
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600874.0 E1424436.6	8'	9'		27'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		70
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	114.5		Pavement						6" Concrete
	113.8		Dark brown, moist, Silty SAND, some Gravel, Brick (Fill) (SM)	S-1	24"	3-4-3-2	DS	20"	
				S-2	24"	2-2-2-3	DS	0"	
5	109.5		Light brown, moist, Silty SAND, trace Gravel (Fill) (SM)	S-3	24"	8-3-1-2	DS	24"	
	107.5		Brown, red, moist, f-c SAND, little Gravel, trace Silt, Brick (Fill) (SM)	S-4	24"	2-3-5-1	DS	12"	
	105.5		Dark gray, brown, wet, Sandy SILT, little Gravel (Fill) (ML)	S-5	24"	1-1-2-6	DS	10"	
10	103.5		Dark gray, black, wet, Silty SAND and GRAVEL; odor (Fill) (SM)	S-6	18"	1-2-1	DS	12"	
				S-7	18"	3-2-1	DS	10"	
15				S-8	18"	1-2-1	DS	18"	
	96.5		Gray, black, wet, SILT and SAND, trace Wood (ML)	S-9	18"	1-2-1	DS	18"	
20				S-10	18"	1-1-3	DS	0"	
	91.5		Tan, wet, Silty f-c SAND and GRAVEL (SM)	S-11	18"	38-38-12	DS	18"	
25	87.5		Gray, moist, micaceous, SILT and SAND, trace Gravel (ML)						
				S-12	18"	10-16-18	DS	12'	
30									
				S-13	18"	16-18-20	DS	18"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-17**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-14	18"	10-50-25	DS	18"	
40									
				S-15	18"	5-10-14	DS	18"	
45									
				S-16	18"	8-16-24	DS	18"	
50									
	62.5								
			White, gray, moist, Sandy SILT, some Gravel (Decomposed Rock) (ML)	S-17	10"	15-50/4"	DS	10"	
55									
				S-18	18"	10-18-30	DS	18"	
60									
				S-19	18"	12-44-32	DS	18"	
65									
	47.5								
			Orange brown, gray, moist, micaceous, SILT and SAND, little Gravel (Decomposed Rock) (ML)	S-20	17"	19-34-50/5"	DS	16"	
70	44.5								
			Bottom of boring at 70 feet						
75									
80									

E2CR, Inc.

BORING LOG

PROJECT	PROJECT NO.	BORING NO.
MTA - Kirk Avenue Bus Facility	09548-04	**RB-18**

SITE	BEGUN	COMPLETED	HOLE SIZE	GROUND ELEVATION
Baltimore, Maryland	05/06/10	05/07/10		128.0
COORDINATES	**DEPTH WATER ENC.**	**AT END DRILL**	**AT 24 HRS**	**CAVED DEPTH**
N600726.3 E1424676.9	17'	DRY	23.0'	9.0'
DRILLER	**WEIGHT OF HAMMER**	**HEIGHT OF FALL**	**TYPE OF CORE**	**DEPTH OF BORING**
J. Sies	140 lbs	30 In.		79
TYPE OF DRILL RIG & METHOD	**DEPTH TO ROCK**	**LOGGED BY:**		**PAGE NO.**
CME 550 ATV / HSA	-	K. Habib		1 OF 2

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
0	128.0		Pavement						2.5" Asphalt
	127.4		Brown, black, moist, Silty SAND, trace Gravel (Fill) (SM)	S-1	18"	3-5-5	DS	12"	4" Gravel Base
	125.0		Tan, brown, moist, Silty SAND, trace Gravel (Fill) (SM)	S-2	18"	2-2-2	DS	10"	
5	122.5		Brown, black, moist, SILT and SAND (Fill) (ML)	S-3	18"	2-2-2	DS	15"	
	120.0		Dark brown, black, moist, Silty SAND, little Gravel (Fill) (SM)	S-4	18"	26-8-14	DS	14"	
10	117.5		Dark brown, black, red, moist, Silty SAND, little Gravel, Brick (Fill) (SM)	S-5	18"	6-9-21	DS	12"	
	115.0		Black, gray, moist, Silty SAND, some Gravel, Coal; odor (Fill) (SM)	S-6	18"	7-9-11	DS	18"	
15				S-7	18"	3-1-2	DS	9"	
	110.0		Gray, moist, Sandy SILT (ML)	S-8	18"	1-1-3	DS	10"	
20	107.5		Gray, wet, Silty SAND, little Gravel (SM)	S-9	18"	6-7-17	DS	8"	
	105.0		Gray, wet, micacaous, SILT, some Sand (ML)	S-10	18"	7-9-7	DS	12"	
25				S-11	18"	3-4-5	DS	15"	
30	96.0		Orange brown, gray, moist, micaceous, Silty SAND (SM)	S-12	18"	3-5-7	DS	18"	
35									

E2CR, Inc.

BORING LOG

BORING NO. **RB-18**

PROJECT: MTA - Kirk Avenue Bus Facility

PROJECT NO. 09548-04

DEPTH	STRATA ELE./ DEPTH	GRAPHIC LOG	DESCRIPTION	SAMPLE NO.	SAMPLE LENGTH	N-VALUE/ RQD (%)	SAMPLE TYPE AND DIAMETER	SAMPLE RECOVERY	REMARKS:
				S-13	18"	5-8-10	DS	18"	
40									
				S-14	18"	6-7-12	DS	18"	
45									
	81.0								
			Gray, moist, micaceous, SILT, trace to little Sand (ML)						
				S-15	18"	10-15-15	DS	18"	
50									
				S-16	18"	15-28-40	DS	18"	
55									
	71.0								
			Purplish gray, moist, SILT and SAND (Decomposed Rock) (ML)						
				S-17	18"	18-28-38	DS	18"	
60									
				S-18	17"	16-28-50/5"	DS	15"	
65									
				S-19	18"	28-34-50/4"	DS	16"	
70									
				S-20	9"	32-50/3"	DS	9"	
75									
	49.0			S-21	5"	50/5"	DS	5"	
80			Bottom of boring at 79 feet						

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Boring Log

PROJECT:	**MTA-Kirk Ave Bus Facility**	**BORING No. :**	**TP-1**
PROJECT NO:	**09548-04**	WATER DEPTH (ft):	12.5'
LOCATION:	Baltimore, MD	DATE:	
CLIENT:	GF/JMT	CAVED (ft):	
DATE STARTED:	5/13/2010	ELEV:	
DATE COMPLETED:	5/13/2010	INSPECTOR:	
DRILLER:	Butch	E2CR INSPECTOR:	K. Habib

Elev.	Description	Depth	Sample No.	Notes
0.0				10" Concrete
	Concrete + Base			8" Base
1.5		1.5		
2.5	Gray, black, wet, Silty GRAVEL, some Sand, strong odor (FILL) (GM)	2.5	S-1	
3.5	Lt gray, lt brown, moist, SILT, some Sand, trace Gravel (FILL) (ML)	3.5	S-2	
4.5	Lt gray, lt brown, moist, SILT and SAND, some Gravel (FILL) (ML)	4.5	S-3	
	Orange, gray, moist, Silty SAND, some Gravel (FILL) (SM)	5.5	S-4	
		6.5	S-5	*Full and half bricks Approx. 1sqft concrete slabs
		7.5	S-6	Whole glass bottles Rubber shoes
8.5		8.5	S-7	
9.5	Dark brown, moist, Silty SAND and GRAVEL, bricks, rubber, glass, metal, wood (FILL) (SM-GM)	9.5	S-8	
	Brown, moist, Silty SAND and GRAVEL, bricks, rubber, glass, metal, concrete slabs, wood, metal mesh (FILL) (SM-GM)	10.5	S-9	Water @ 12.5ft
11.5		11.5	S-10	
12.5	Brown, moist, Silty SAND and GRAVEL, layer of bricks. (FILL) (SM-GM)	12.5	S-11	
	Bottom of pit @ 12.5ft			

Remarks:

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Boring Log

PROJECT:	**MTA-Kirk Ave Bus Facility**	**BORING No. :**	**TP-2**
PROJECT NO:	**09548-04**	WATER DEPTH (ft):	DRY
LOCATION:	Baltimore, MD	DATE:	
CLIENT:	GF/JMT	CAVED (ft):	
DATE STARTED:	5/13/2010	ELEV:	
DATE COMPLETED:	5/13/2010	INSPECTOR:	
DRILLER:	Butch	E2CR INSPECTOR:	K. Habib

Elev.	Description	Depth	Sample No.	Notes
0.0		0.0		4" Topsoil
1.0	Dark brown, moist, Silty SAND and GRAVEL, roots (FILL) (SM-GM)	1.0	S-1	
	Tan, orange, moist, Silty SAND and GRAVEL*Rock pieces 10"-12"; Pottery pieces 6". (FILL) (SM-GM)	2.0	S-2	
		3.0	S-3	
4.0		4.0	S-4	
5.0	Black, brown, moist, Silty SAND, some Gravel, Coal pieces 4"-6" (FILL) (SM)	5.0	S-5	Natural layer starts @ 5.0ft
	Orange, gray, moist, SILT and SAND, little Gravel (ML)	6.0	S-6	Red Sandy SILT @ 7.0ft
7.0		7.0	S-7	
	Gray, orange, moist, SILT and SAND, trace Gravel (ML)	8.0	S-8	
9.0		9.0	S-9	
10.0	Brown, very moist, Silty SAND and Gravel (SM-GM)	10.0	S-10	
11.0	Gray, orange, red, moist, SILT and SAND, trace to little Gravel (ML)	11.0	S-11	
12.0	Brown, very moist, Silty SAND and Gravel (SM-GM)	12.0	S-12	
	Bottom of pit @ 12.0ft			

Remarks:

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Boring Log

PROJECT:	**MTA-Kirk Ave Bus Facility**	**BORING No. :**	**TP-3**
PROJECT NO:	**09548-04**	WATER DEPTH (ft):	DRY
LOCATION:	Baltimore, MD	DATE:	
CLIENT:	GF/JMT	CAVED (ft):	
DATE STARTED:	5/14/2010	ELEV:	
DATE COMPLETED:	5/14/2010	INSPECTOR:	
DRILLER:	Butch	E2CR INSPECTOR:	K. Habib

Elev.	Description	Depth	Sample No.	Notes
0.0				6" Topsoil
0.5	Topsoil	0.5		
	Brown, moist, Silty SAND, little Gravel, Bricks (1/2 size) and concrete slab (1sqft) (FILL) (SM)	1.5	S-1	
2.5		2.5	S-2	
3.5	Gray, brown, moist, SILT and SAND, trace Gravel (ML)	3.5	S-3	Was caving in as digging was being done @ 3.5'-5.5'
	Tan, orange, black, gray, moist, SILT and SAND, trace Gravel (ML)	4.5	S-4	
5.5		5.5	S-5	
	Gray, brown, wet, Silty SAND, little Gravel (SM)	6.5	S-6	
7.5		7.5	S-7	
8.5	Gray, orange, moist, Sandy SILT, trace Gravel (ML)	8.5	S-8	
	Bottom of pit @ 8.5ft			

Remarks:

Project No. 07-167

LOG OF BOREHOLE B-08

CLIENT: The Wilson T. Ballard Company

PROJECT: **MTA Kirk Ave Bus Facility**

ARCHITECT/ENGINEER:

SITE: **Baltimore City, Maryland**

SURFACE ELEV.: **118.2** ft.

Depth (FT)	Description	Elev.	BLOWS/6" N - VALUE RQD	NUMBER	TYPE	IN. DRIVEN IN. RECOVERED	MOISTURE (%)	DRY DENSITY (PCF)	Qu (TSF)	% PASSING #200 SIEVE	REMARKS/ ADDITIONAL DATA
0.5	6.5" Concrete	117.7									
	Medium dense to loose brown and gray CLAYEY SAND (SC) with cinders and glass debris (Possible Fill)		3-9 9 N=18	1	SS	7/18 39%	13				
			3-3 3 N=6	2	SS	3/18 17%	15				
5			6-2 5 N=7	3	SS	3/18 17%	22				
			1-2 2 N=4	4	SS	10/18 56%	40				
10											
13.0		105.2									
	Loose to medium dense reddish brown to brown and gray SILTY SAND (SM)		3-2 4 N=6	5	SS	14/18 78%	16				
15											
			3-7 9 N=16	6	SS	13/18 72%	25				
20											
			5-9 11 N=20	7	SS	14/18 78%	20			33	
25											
27.0		91.2									
	Very dense reddish brown to brown and greenish gray micaceous SANDY SILT (ML) with trace of rock fragments (Decomposed Rock)		20-51/6"	8	SS	12/12 100%	21				
30											

Continued Next Page

WATER LEVEL OBSERVATIONS			
WL	▽	9	@ Drilling
WL	▼	8	@ 0 Hr
WL	▼	6.5	@ 24 Hr

AB Consultants, Inc.
9450 Annapolis Road
Lanham, MD 20706
Phone: 301-306-3091
Fax: 301-306-3092

STARTED:	3/19/08	FINISHED:	3/19/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASS'T DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB CONS.GDT 4/15/08

Project No. 07-167	LOG OF BOREHOLE B-08	Sheet 2 of 2

CLIENT: The Wilson T. Ballard Company

PROJECT: **MTA Kirk Ave Bus Facility**

ARCHITECT/ENGINEER:

SITE: **Baltimore City, Maryland**

(continued)	GRAPHIC LOG	DEPTH (FT)	SAMPLES: BLOWS/6" N - VALUE RQD	NUMBER	TYPE	IN. DRIVEN IN. RECOVERED	TESTS: MOISTURE (%)	DRY DENSITY (PCF)	Qu (TSF)	% PASSING #200 SIEVE	REMARKS/ ADDITIONAL DATA
Very dense reddish brown to brown and greenish gray micaceous SANDY SILT (ML) with trace of rock fragments (Decomposed Rock) *(continued)*		35	51/4"	9	SS	4/4 100%	20				
			10-45 51/1"	10	SS	13/13 100%	17				
40.0	78.2	40									
End of Boring @ 40 ft											

WATER LEVEL OBSERVATIONS			
WL	▽	9	@ Drilling
WL	▼	8	@ 0 Hr
WL	▼	6.5	@ 24 Hr

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STARTED:	3/19/08	FINISHED:	3/19/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASS'T DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB CONS.GDT 4/15/08

Project No. 07-167

LOG OF BOREHOLE B-09

CLIENT: The Wilson T. Ballard Company

PROJECT: **MTA Kirk Ave Bus Facility**

ARCHITECT/ENGINEER:

SITE: **Baltimore City, Maryland**

SURFACE ELEV.: **123.6** ft.

Depth (ft)	Description	Elev.	Samples: Blows/6" N-value RQD	Number	Type	In. Driven / In. Recovered	Tests: Moisture (%)	Dry Density (PCF)	Qu (TSF)	% Passing #200 Sieve	Remarks/ Additional Data
0.3	4" Asphalt	123.3									
	Medium dense brown SILTY SAND (SM) with gravel (Possible Fill).		6-7 12 N=19	1	SS	13/18 72%	10				
5			2-5 7 N=12	2	SS	12/18 67%	10				
			8-11 10 N=21	3	SS	6/18 33%	9				
8.0		115.6									
	Medium dense to very dense brown and gray micaceous SANDY SILT (ML) with rock fragments		4-7 7 N=14	4	SS	14/18 78%	17				
15			3-6 7 N=13	5	SS	16/18 89%	17			55	
20			3-4 5 N=9	6	SS	16/18 89%	24				LL = 50 PL = 32 PI = 18
25			4-7 10 N=17	7	SS	15/18 83%	20				
30			5-14 19 N=33	8	SS	14/18 78%	17				

Continued Next Page

WATER LEVEL OBSERVATIONS			
WL	▽	5	@ Drilling
WL	▼	18	@ 0 Hr
WL	▼	5	@ 24 Hr

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Phone: 301-306-3091
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STARTED:	3/20/08	FINISHED:	3/20/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASS'T DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB CONS.GDT 4/14/08

Project No. 07-167

LOG OF BOREHOLE B-09

CLIENT: The Wilson T. Ballard Company

PROJECT: **MTA Kirk Ave Bus Facility**

ARCHITECT/ENGINEER:

SITE: **Baltimore City, Maryland**

(continued)	GRAPHIC LOG	DEPTH (FT)	SAMPLES: BLOWS/6" N - VALUE RQD	NUMBER	TYPE	IN. DRIVEN IN. RECOVERED	TESTS: MOISTURE (%)	DRY DENSITY (PCF)	Qu (TSF)	% PASSING #200 SIEVE	REMARKS/ ADDITIONAL DATA
Medium dense to very dense brown and gray micaceous SANDY SILT (ML) with rock fragments *(continued)*		35	8-30 43 N=73	9	SS	18/18 100%	25				
		40	9-31 51/5"	10	SS	17/17 100%	21				
40.0	83.6										
End of Boring @ 40 ft											

WATER LEVEL OBSERVATIONS			
WL	▽	5	@ Drilling
WL	▼	18	@ 0 Hr
WL	▼	5	@ 24 Hr

AB Consultants, Inc.
9450 Annapolis Road
Lanham, MD 20706
Phone: 301-306-3091
Fax: 301-306-3092

STARTED:	3/20/08	FINISHED:	3/20/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASS'T DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB_CONS.GDT 4/14/08

Project No. 07-167	LOG OF BOREHOLE B-10	Sheet 1 of 2

CLIENT: The Wilson T. Ballard Company

PROJECT: MTA Kirk Ave Bus Facility

ARCHITECT/ENGINEER:

SITE: Baltimore City, Maryland

SURFACE ELEV.: 132.0 ft.

Description	Elev.	Depth (FT)	BLOWS/6" N - VALUE RQD	NUMBER	TYPE	IN. DRIVEN IN. RECOVERED	MOISTURE (%)	DRY DENSITY (PCF)	Qu (TSF)	% PASSING #200 SIEVE	REMARKS/ ADDITIONAL DATA
0.3 3" Asphalt	131.7										
Medium dense brown, gray and black SILTY SAND (SM) with cinder, brick, metal and rock fragments (Possible Fill)			3-3 7 N=10	1	SS	14/18 78%	11				
		5	11-15 25 N=40	2	SS	8/18 44%	11				
			2-3 6 N=9	3	SS	14/18 78%	9				
		10	8-10 13 N=23	4	SS	14/18 78%	24				
		15	3-5 5 N=10	5	SS	12/18 67%	14				
17.0	115.0										
Medium dense brown SANDY SILT (ML) with some mica ▼		20	8-12 15 N=27	6	SS	16/18 89%	15			89	
22.0	110.0										
Medium dense light gray micaceous SILTY SAND (SM) with some rock fragments		25	4-9 10 N=19	7	SS	18/18 100%	13			49	
26.0	106.0										
Loose to dense light gray micaceous SANDY SILT (ML) with sand seams and rock fragments		30	2-2 4 N=6	8	SS	16/18 89%	29				

Continued Next Page

WATER LEVEL OBSERVATIONS		
WL	▼ 33	@ Drilling
WL	Dry, cave in 18.5	@ 0 Hr
WL	▼ 18	@ 24 Hr

AB Consultants, Inc.
9450 Annapolis Road
Lanham, MD 20706
Phone: 301-306-3091
Fax: 301-306-3092

STARTED:	3/20/08	FINISHED:	3/20/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASST DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB CONS.GDT 4/14/08

Project No. 07-167	LOG OF BOREHOLE B-10	Sheet 2 of 2

CLIENT: The Wilson T. Ballard Company

PROJECT: **MTA Kirk Ave Bus Facility**

ARCHITECT/ENGINEER:

SITE: **Baltimore City, Maryland**

(continued)	GRAPHIC LOG	DEPTH (FT)	SAMPLES: BLOWS/6" N - VALUE RQD	NUMBER	TYPE	IN. DRIVEN IN. RECOVERED	TESTS: MOISTURE (%)	DRY DENSITY (PCF)	Qu (TSF)	% PASSING #200 SIEVE	REMARKS/ ADDITIONAL DATA
Loose to dense light gray micaceous SANDY SILT (ML) with sand seams and rock fragments *(continued)*		35	2-4 3 N=7	9	SS	12/18 67%	42				
		40	3-5 12 N=17	10	SS	15/18 83%	13				
		45	6-20 23 N=43	11	SS	14/18 78%	20				
50.0	82.0	50	8-12 19 N=31	12	SS	12/18 67%	15				
End of boring @ 50 ft											

WATER LEVEL OBSERVATIONS		
WL	▽ 33	@ Drilling
WL	Dry, cave in 18.5	@ 0 Hr
WL	▼ 18	@ 24 Hr

AB Consultants, Inc.
9450 Annapolis Road
Lanham, MD 20706
Phone: 301-306-3091
Fax: 301-306-3092

STARTED:	3/20/08	FINISHED:	3/20/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASST DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB CONS.GDT 4/14/08

Project No. 07-167

LOG OF BOREHOLE B-11

CLIENT: The Wilson T. Ballard Company

PROJECT: MTA Kirk Ave Bus Facility

ARCHITECT/ENGINEER:

SITE: Baltimore City, Maryland

SURFACE ELEV.: 127.5 ft.

Description	Elev.	Depth (FT)	Blows/6" N-Value RQD	Number	Type	In. Driven / In. Recovered	Moisture (%)	Dry Density (PCF)	Qu (TSF)	% Passing #200 Sieve	Remarks/ Additional Data
0.3 3" Asphalt	127.2										
Loose to medium dense brown, gray and black SILTY SAND (SM) with cinders, coal and rock fragments (Possible Fill)			12-12 8 N=20	1	SS	15/18 83%	5				
		5	4-6 5 N=11	2	SS	13/18 72%	5				
			8-4 3 N=7	3	SS	14/18 78%	21				
		10	2-1 2 N=3	4	SS	6/18 33%	22				
		15	7-19 30 N=49	5	SS	15/18 83%	7				
		20	3-11 2 N=13	6	SS	6/18 33%	16				
22.0	105.5										
Medium dense to dense light gray micaceous SANDY SILT (ML) with some rock fragments		25	6-6 3 N=9	7	SS	12/18 67%	12				
		30	2-4 5 N=9	8	SS	5/18 28%	21				

Continued Next Page

WATER LEVEL OBSERVATIONS			
WL	▽	17	@ Drilling
WL	▼	17.5	@ 0 Hr
WL	▼	17.5	@ 24 Hr

AB Consultants, Inc.
9450 Annapolis Road
Lanham, MD 20706
Phone: 301-306-3091
Fax: 301-306-3092

STARTED:	3/21/08	FINISHED:	3/21/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASS'T DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB CONS.GDT 4/14/08

Project No. 07-167

LOG OF BOREHOLE B-11

CLIENT: The Wilson T. Ballard Company

PROJECT: **MTA Kirk Ave Bus Facility**

ARCHITECT/ENGINEER:

SITE: **Baltimore City, Maryland**

(continued)	GRAPHIC LOG	DEPTH (FT)	SAMPLES: BLOWS/6" N - VALUE RQD	NUMBER	TYPE	IN. DRIVEN IN. RECOVERED	TESTS: MOISTURE (%)	DRY DENSITY (PCF)	Qu (TSF)	% PASSING #200 SIEVE	REMARKS/ ADDITIONAL DATA
Medium dense to dense light gray micaceous SANDY SILT (ML) with some rock fragments *(continued)*		35	2-4 4 N=8	9	SS	18/18 100%	24			57	
		40	5-10 14 N=24	10	SS	14/18 78%	18				
45.0	82.5	45	9-13 25 N=38	11	SS	16/18 89%	15				
End of Boring @ 45 ft											

WATER LEVEL OBSERVATIONS			
WL	▽	17	@ Drilling
WL	▼	17.5	@ 0 Hr
WL	▼	17.5	@ 24 Hr

AB Consultants, Inc.
9450 Annapolis Road
Lanham, MD 20706
Phone: 301-306-3091
Fax: 301-306-3092

STARTED:	3/21/08	FINISHED:	3/21/08
DRILL CO.:	PSDA	DRILL RIG:	B-61
DRILLER:	PS	ASST DRILLER:	
LOGGED BY:		APPROVED:	

BORING LOG AB08 07-167.GPJ AB CONS.GDT 4/14/08

E2CR inc.

1405-A Parker Road, Baltimore, MD 21227 Tel. 410-737-9100 Fax 410-737-9101

MEMO via e-mail

To:	Mr. Derek Mostoller, P.E.	From:	Neeraj Singh
Company:	GF – JMT Joint Venture		E2CR, Inc.
Fax:		Pages:	1 of 2
Phone:		Date:	October 5, 2012
Re:	Lateral Loads on Piles – Maintenance Building MTA Kirk Avenue Bus Facility MTA Contract: Number: MTA -1117B E2CR Project No. 09548-04	Copy:	File

● Comments:

Mr. Mostoller,

As discussed, there are three geotechnical design issues to be resolved for the Maintenance Building. The three issues are as follows:

1. Lateral load carrying capacity of the piles.
2. Foundation for the partition walls.
3. Foundation for the floor slab.

Allowable Lateral Loads on the Piles

In our geotechnical report, we had recommended the use of 14 inch auger cast piles or HP10x42 piles. The axial allowable load on these piles is 55 tons when installed as per the recommendations in our Report.

We had recommended that the piles should be battered where the piles would be subjected to lateral loads. It was subsequently brought to our attention that due to space limitations and possible conflict, it may not be possible to batter the piles in some locations. Therefore it was important to determine the allowable lateral load capacity of the vertical piles.

E2CR ran Allpile analyses to determine the allowable lateral loads on 14 inch auger cast piles and also HP10x42 piles. The analyses indicated the following:

- The allowable lateral load was 6 kips for a deflection of about 0.35 inches under fixed head conditions.
- Due to the fixed head conditions, a moment of 40 kp-ft was calculated by the program. The Structural Engineer should check whether the pile has enough capacity to resist the moment with adequate factor of safety.
- The minimum pile spacing should be 3 times diameter of the pile. With 3D spacing the lateral load on the trailing pile has a “shadow effect” and so the lateral load capacity of the trailing pile should be reduced to 4 kips. In order to get full lateral capacity, the piles should be spaced at 5D or greater.

Foundation for Partition Walls

There is variable and miscellaneous fill at the site. The thickness of the fill varies across the site and is generally deeper towards Kirk Avenue, where it is 20+ feet thick. The borings indicate that the SPT N-values of the fill soils within the top 10 feet is approximately 3 blows/foot.

It is not advisable for the partition walls foundation to be bearing directly on the miscellaneous fill since there could differential settlements and possible cracking of the wall.

The site had an existing industrial building with thick floor slabs and partition walls. Considering that the existing floor slab was two feet thick, the soils were subjected to only about 300 psf plus live load. The loads from the proposed partition walls could be up to about 2,000 psf. Therefore, the soils will settle if the wall is founded directly on the existing soils.

There are several options:

1. Remove the existing fill and install the footing on the natural soils. This is possible on the eastern 1/4th or 1/3rd of the building where the fill is not very thick. The undercutting would be zero to less than 5 feet.
2. Install the partition walls on piles and grade beams. Where the fill is deeper (i.e. near Kirk Avenue) and undercutting is not practical, the partition wall could be founded on piles and grade beams.
3. The partition walls could be founded on the floor slab, but thickened floor slabs under the partition walls (minimum 3 feet wide). The load from the partition wall would be spread over a wider area, thereby reducing the contact stresses. Settlements will be reduced with this option.
4. After the demolition is completed, the site could be subjected to dynamic deep compaction (i.e. DDC). The DDC is performed by lifting a large weight and allowing it to drop freely, thereby compacting the subsurface soils. The DDC would only need to be performed along the partition wall line. The DDC will densify the soils and then partition walls could be founded on shallow spread footings, using an allowable bearing capacity of 2,500 psf. With this option pre and post construction survey of neighboring houses along with vibration monitoring will be required.

Foundation for Floor Slab

Subgrade improvement should be performed for the floor slab, as mentioned in our Geotechnical Report. Approximately 2 feet of soil below the subgrade should be removed and the area proof rolled and compacted. Localized undercutting of soft material may be required. Please refer to our geotechnical report for further details.

It is our understanding that environmental sampling and testing was performed at this site, but, we were not provided with the results. If the soils are contaminated then the undercutting option could be expensive. We will then need to look at other in-situ ground improvements.

Please call us if you have any questions,

Neeraj
10/5/12

Hard Copy to follow by Mail: NO

E2CR inc.

1405-A Parker Road, Baltimore, MD 21227 Tel. 410-737-9100 Fax 410-737-9101

MEMO via e-mail

To:	Mr. Derek Mostoller, P.E.	From:	Neeraj Singh
Company:	GF – JMT Joint Venture		E2CR, Inc.
Fax:		Pages:	1 of 2
Phone:		Date:	January 21, 2013
Re:	Lateral Loads on Piles – Maintenance Building MTA Kirk Avenue Bus Facility MTA Contract: Number: MTA -1117B E2CR Project No. 09548-04	Copy:	File

● Comments:

Mr. Mostoller,

As discussed, your structural engineers have brought up two geotechnical design issues that need to be resolved for the Maintenance Building. The two issues are as follows:

1. Lateral load carrying capacity of the piles.
2. Foundation for the partition walls.

Allowable Vertical and Lateral Loads on the Piles

Subsequent to our Memo dated October 5, 2012, it was decided (based on additional discussions and analyses) to use HP 14x89 piles. The HP 14x89 piles should be installed as per the recommendations in our Geotechnical Report dated August 10, 2010, and as follows:

1. The HP14x89 should be driven to refusal on the decomposed rock.
2. The HP14x89 if driven to refusal, the structural capacity will govern. As per SHA guidelines, the load on HP 14x89 should be limited to 115 tons in compression. In tension the allowable load should be limited to 20 tons.
3. The piles will be 40 feet to 55 feet long from below El. 115±, i.e. tip elevation of El. 60 to El. 75. There is a variation in the tip elevations because the decomposed rock profile varies significantly.

Our geotechnical report had recommended that the piles should be battered where the piles would be subjected to lateral loads. It was subsequently brought to our attention that due to space limitations and possible conflict, it may not be possible to batter the piles in some locations. It is our understanding that the Structural Engineer has elected to use vertical piles to carry the lateral loads. Therefore it was important to determine the allowable lateral load capacity of the vertical piles.

E2CR conducted analyses to determine the allowable lateral loads on HP14x89 piles. The analyses indicated the following:

- The allowable lateral load on HP14x89 piles was 14.5 kips for a deflection of about 0.43 inches under fixed head conditions and spacing of 3D.

- Due to the fixed head conditions, a moment of 110 kp-ft was calculated by the program. The Structural Engineer should check whether the pile has enough capacity to resist the moment with adequate factor of safety.
- The minimum pile spacing should be 3 times diameter of the pile. With 3D spacing the lateral load on the trailing pile has a “shadow effect” and so the lateral load capacity of the trailing pile should be reduced to 9 kips. In order to get full lateral capacity, the piles should be spaced at 6D or greater.
- Under free head condition, for a lateral load of 6 kips, the pile deflection is about 0.5 inches and the moment is 43 kip-ft.

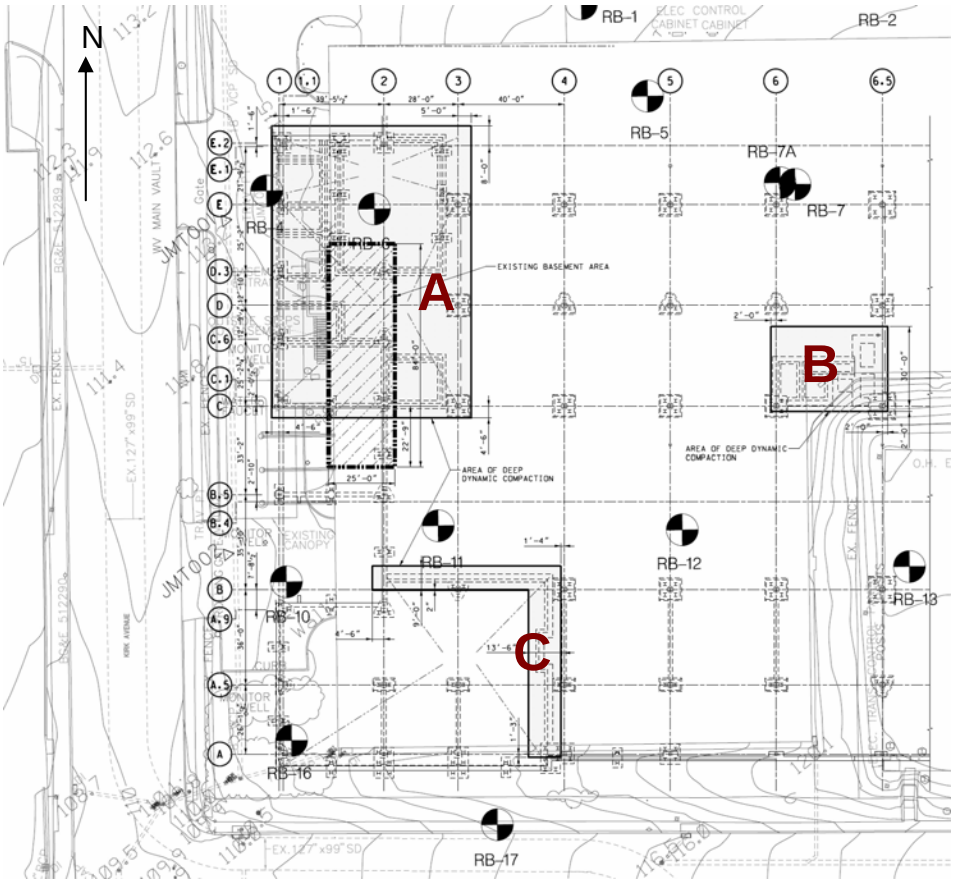
Foundation for Partition Walls

There is variable and miscellaneous fill at the site. The thickness of the fill varies across the site and is generally deeper towards Kirk Avenue, where it is 20+ feet thick. The borings indicate that the SPT N-values of the fill soils within the top 10 feet is approximately 3 blows/foot.

It will not be advisable for the partition walls to be bearing directly on the miscellaneous fill since there could differential settlements and possible cracking of the wall.

The site had an existing industrial building with thick floor slabs and partition walls. Considering that the existing floor slab was two feet thick, the soils were subjected to only about 300 psf plus live load. The loads from the proposed partition walls could be up to about 2,500 psf. Therefore, the soils will settle if the wall is founded directly on the existing soils.

There are three areas, i.e. Areas A, B, and C where partition walls are being considered, as shown below.



Our recommendations for these three areas are as follows:

Area B: This area is about 30± feet by 50± feet in plan. The proposed bottom of footing is at about El. 108±. The closest borings are RB-7 and RB-13. The boring RB-13 indicates that the fill extends to about El. 106. i.e. approximately 2 feet below bottom of proposed footing. Therefore, removal of about 2 feet of the existing miscellaneous fill is anticipated. In addition there could be localized pockets of loose material which will require undercutting. The undercut areas should be backfilled with No. 57 stone.

It is recommended that the existing fill and localized soft areas should be removed to El. 106 in the entire 30 feet by 50 feet area and the area proof compacted. Localized soft soils, if encountered, may require an additional foot or two of undercutting. All the undercutting should be backfilled with No. 57 stone. The footings for the partition walls should be founded on the stone, at about El. 108, using an allowable bearing capacity of 2,500 psf. Since there are several partition walls within close proximity, a combined mat footing for all the partition walls could also be considered.

Area A: This area is about 70 feet by 100 feet in plan. The representative borings are RB-4, RB-6, RB-10 and RB-11. The borings indicate that the fill extends to the following depths:

Boring No.	Ex. Ground El.	Bottom of Fill El.	Ground water Depth (ft.)
RB-4	115.7	98	107
RB-6	116.7	101	108
RB-10	112.4	94	97
RB-11	114.1	98	106

The fill extends to about 16 feet to 18 feet below the existing ground surface and about 7 feet to 14 feet below the proposed bottom of the footing. It will not be cost effective to excavate the entire fill and then backfill the area with suitable select borrow or stone.

Two options were considered:

1. Install the partition walls on piles and grade beams. The partition wall loads are about 2.5k/ft to 3 k/ft. The load on each pile will depend on the spacing of the pile. The HP14x89 piles (that are being used for columns) will not be cost effective and a smaller pile size could be used. The piles should be driven to 120% of the design load using the ENR formula. The piles are anticipated to be 30 feet to 45 feet in length.
2. The partition walls could be supported on geo-piers or rammed aggregate piers (RAP) or approved equal. The RAP should be designed and installed by a specialty contractor such that after the RAP are installed, the finished partition wall subgrade should have an allowable bearing capacity of at least 3,000 psf. As a minimum the RAP should extend to below the fill and bear on the natural soils. The contractor should account for the presence of groundwater and/or perched water during the installation of the RAP.

Area C: This area is about 140 feet by 6 feet in plan. The representative borings are RB-10, RB-11, RB-16 and RB-17. The borings indicate that the fill extends to the following depths:

Boring No.	Ex. Ground El.	Bottom of Fill El.	Ground water Depth (ft.)
RB-10	112.4	94	97
RB-11	114.1	98	106
RB-16	113.5	90	105
RB-17	114.5	91	106

The fill extends to about 16 feet to 24 feet below the existing ground surface and about 10 feet to 18 feet below the proposed bottom of the footing. It will not be cost effective to excavate the entire fill and then backfill the area with suitable select borrow or stone.

Two options were considered:

1. Install the partition walls on piles and grade beams. The partition wall loads are about 2.5k/ft to 3 k/ft. The load on each pile will depend on the spacing of the pile. The HP14x89 piles (that are being used for columns) will not be cost effective and a smaller pile size could be used. The piles should be driven to 120% of the design load using the ENR formula. The piles are anticipated to be 30 feet to 45 feet in length.
2. The partition walls could be supported on geo-piers or rammed aggregate piers (RAP) or approved equal. The RAP should be designed and installed by a specialty contractor such that after the RAP are installed, the finished partition wall subgrade should have an allowable bearing capacity of at least 3,000 psf. As a minimum the RAP should extend to below the fill and bear on the natural soils. The contractor should account for the presence of groundwater and/or perched water during the installation of the RAP.

Please call us if you have any questions,

Neeraj
1/21/13

Hard Copy to follow by Mail: NO

APPENDIX H

CONTRACT NO. T-0705-0140

NOT IN USE

APPENDIX I

EXISTING DRAWINGS – FOR INFORMATIONAL PURPOSES ONLY

T-0705-0140

KIRK BUS DIVISION MODERNIZATION - PHASE 1

TRANSFER STATION
DELIVERY OF BALTIMORE
KIRK & BONAPARTE AVENUES
BALTIMORE, MARYLAND

COPY OF AVAILIBLE PARTIAL SET OF ORIGINAL BUILDING PLANS

INDEX OF PLANS

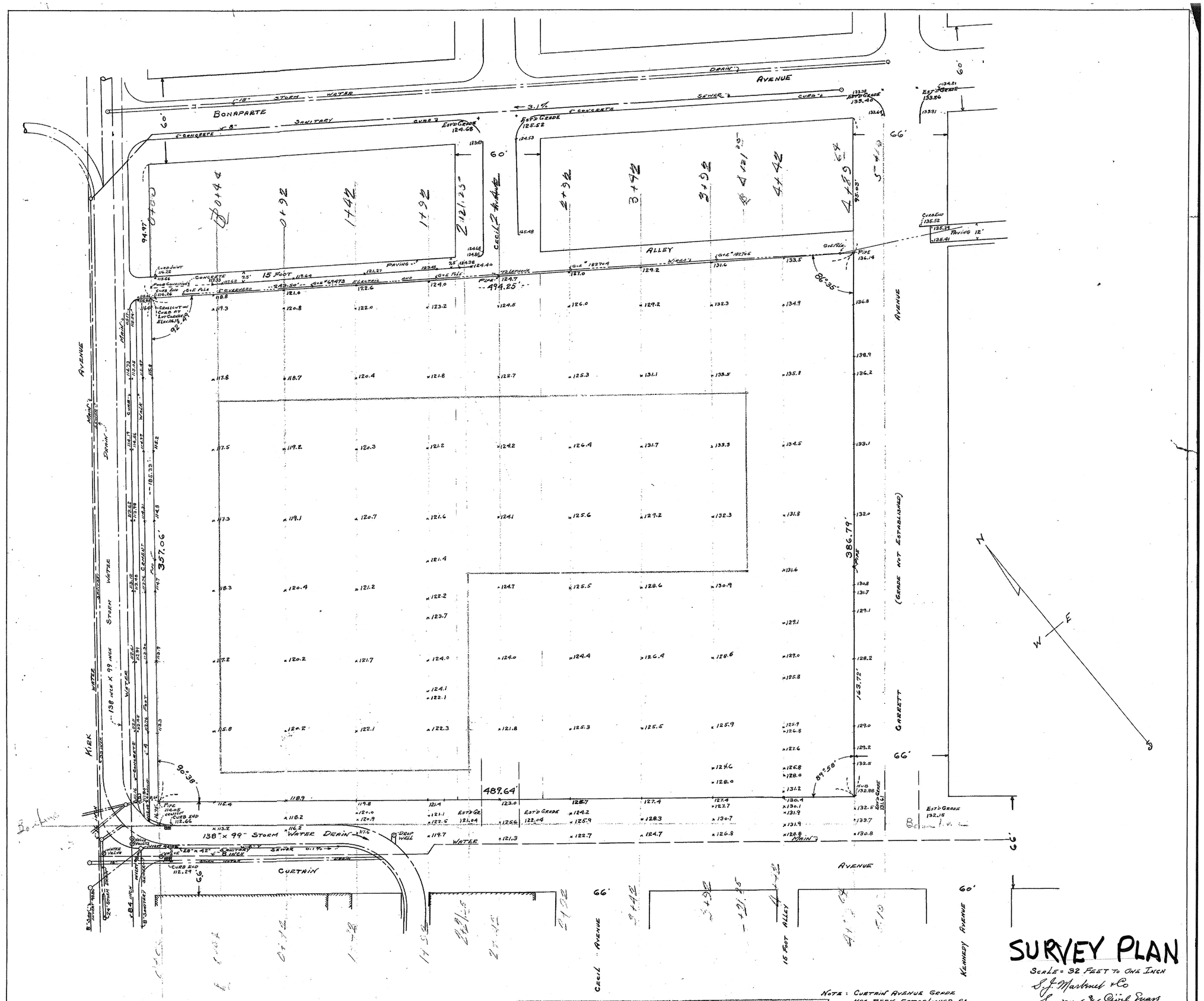
SHEET NO.		DESCRIPTION
		SITE PLANS
1	A-7	SURVEY PLAN
2	–	SITE PLAN
		ARCHITECTURAL PLANS
3	A-2	FIRST FLOOR PLAN
4	A-3	MEZZANINE & ROOF PLANS
5	A-5	DETAILS & SHOP PLAN
6	A-6	ELEVATIONS
7	–	ARCHITECTURAL SECTIONS THROUGH BUILDING
8	–	ARCHITECTURAL FLOOR PLANS MEZZANINE MAIN FLOOR, OFFICE SPACE & BOILER ROOM
9	–	FIRST FLOOR PLAN
		STRUCTURAL PLANS
10	S-3	ROOF FRAMING AND FLOOR PLANS
11	S-4	CROSS SECTIONS
12	S-5	BASEMENT PLAN AND SECTIONS
13	S-6	CANOPY FRAMING PLAN
14	B-1	PARTITION DETAILS
15	B-2	FIRST FLOOR PLAN
		ELECTRICAL PLANS
16	E-2	FIRST FLOOR PLAN & DETAILS
17	E-3	BASEMENT, MEZZANINE & PART FIRST FLOOR PLAN
18	E-4	SCHEDULES & DETAILS
		MECHANICAL PLANS
19	M-2	FIRST FLOOR PLAN, SECTION & DETAILS
20	M-3	BASEMENT, OFFICE & FIRST FLOOR PLANS
21	M-4	PLAN OF SPRINKLERS
		AUTOMATIC SPRINKLER (AS) PLANS
22	* AS-1 OF 5	BASEMENT & FIRST STORY – SYSTEM NO. 1
23	* AS-2 OF 5	ROOF – SYSTEM NO. 1
24	* AS-3 OF 5	SYSTEM NO. 2
25	* AS-4 OF 5	SYSTEM NO. 3
26	* AS-5 OF 5	SYSTEM NO. 4
		* APPROVED SHOP DRAWINGS
27	AS-6	BASEMENT & FIRST STORY (SIMILAR TO AS-1 OF 5 BUT WITH LESS DETAILS)
		CONVEYOR SYSTEM PLANS
28	C-1	CONVEYOR LAYOUT
29	C-2	DETAILS OF CONVEYORS

NOTICE

THE PLANS INCLUDED IN THIS SET OF AVAILABLE PLANS FOR THE ORIGINAL BUILDING AND SITE DO NOT NECESSARILY REPRESENT THE "AS-BUILT OR THE "AS MODIFIED" CONDITIONS WHICH CURRENTLY EXIST AT THE SITE AND WITHIN THE BUILDING.

THE PLANS ARE PROVIDED AS INFORMATION ONLY AND THE M.T.A. WILL NOT BE RESPONSIBLE FOR THE ACCURACY OF THE PLANS. WHICH WERE PREPARED BY OTHERS IN THE 1949-1950 ERA.

U:\MTA_Kirk_Division\WTB DWGS\Dwg002_IndexOfDrawings.dwg
07-11-08 met



NOTE: CURTAIN AVENUE GRADE HAS BEEN ESTABLISHED AS 3.72%, HOWEVER, NO WIDTH BETWEEN CURBS HAS BEEN ESTABLISHED.

SURVEY PLAN

SCALE = 32 FEET TO ONE INCH

S. J. Martenet & Co
Surveyors & Civil Engrs
Balto April 11, 1949
Roy Howard C. Sutton Reg No 758.

CROUT, SNYDER & CHANDLEE
STRUCTURAL ENGINEERS
20 E. LEXINGTON ST.
BALTIMORE, MD.

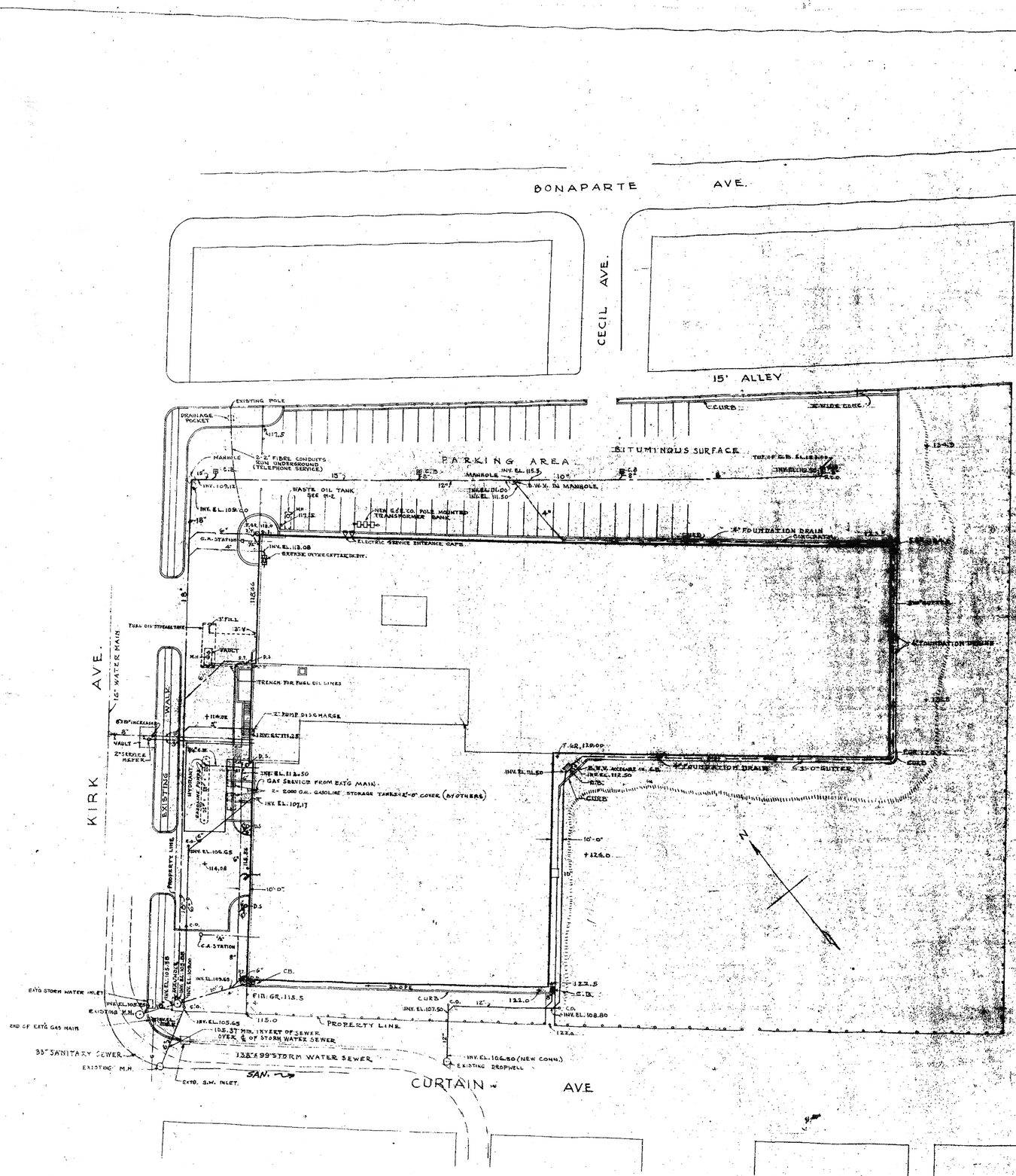
TRANSFER STATION FOR DELIVERY OF BALTIMORE INC.
KIRK AND BONAPARTE AVES., BALTIMORE, MD

SURVEY PLAN

THE OFFICE OF
JAMES R. EDMUNDS, JR.
ARCHITECTS
110 W. HAMILTON STREET
BALTIMORE 1, MARYLAND

JOB NO. 4908
DATE Oct. 17, 1949
DRAWING A7

1 OF 29



PLOT PLAN

SCALE 1/32" = 1'-0"

FIXTURE CONNECTIONS

FIXTURES	WASTE	C.W.	H.W.	GAS
WATER CLOSETS	4"	1"		
URINALS	4"	1"		
LAVATORIES	1¼"	½"	½"	
DRINKING WATER COOLER	1¼"	½"		
SLOP SINKS	3"	1"	½"	
SHOWERS	2"	½"	½"	
WATER FOUNTAIN	1"	½"	½"	
CLEANOUT URINS	1¼"	½"		½"
SINKS	1½"	½"	½"	1¼"
[illegible]	1½"	½"	½"	
[illegible]	1½"	½"	½"	½"
[illegible]	1½"	½"		
[illegible]	1½"	½"		

SYMBOLS

- MH - MANHOLE
- C.O. - CLEANOUT
- F.D. - FLOOR DRAIN
- C.B. - CATCH BASIN
- R.T. - RUNNING TRAP
- D.S. - DOWN SPOUT
- D.W.C. - DRINKING WATER COOLER
- C.W. - COLD WATER
- H.W. - HOT WATER
- H.W.R. - HOT WATER RETURN
- C.W.R. - COLD WATER
- L.P.S. - LOW PRESSURE STEAM
- L.P.R. - LOW PRESSURE RETURN
- S.S. - SANITARY SEWER
- S.W.S. - STORM WATER SEWER
- V - VENT
- C.A. - COMPRESSED AIR
- G.A.S. - GAS
- H.W.H. - HOT WATER HEATING PIPING
- V.C. - VALVE CONTROL
- INTERIOR
- EXTERIOR CONNECTION

FIXTURE CONNECTIONS

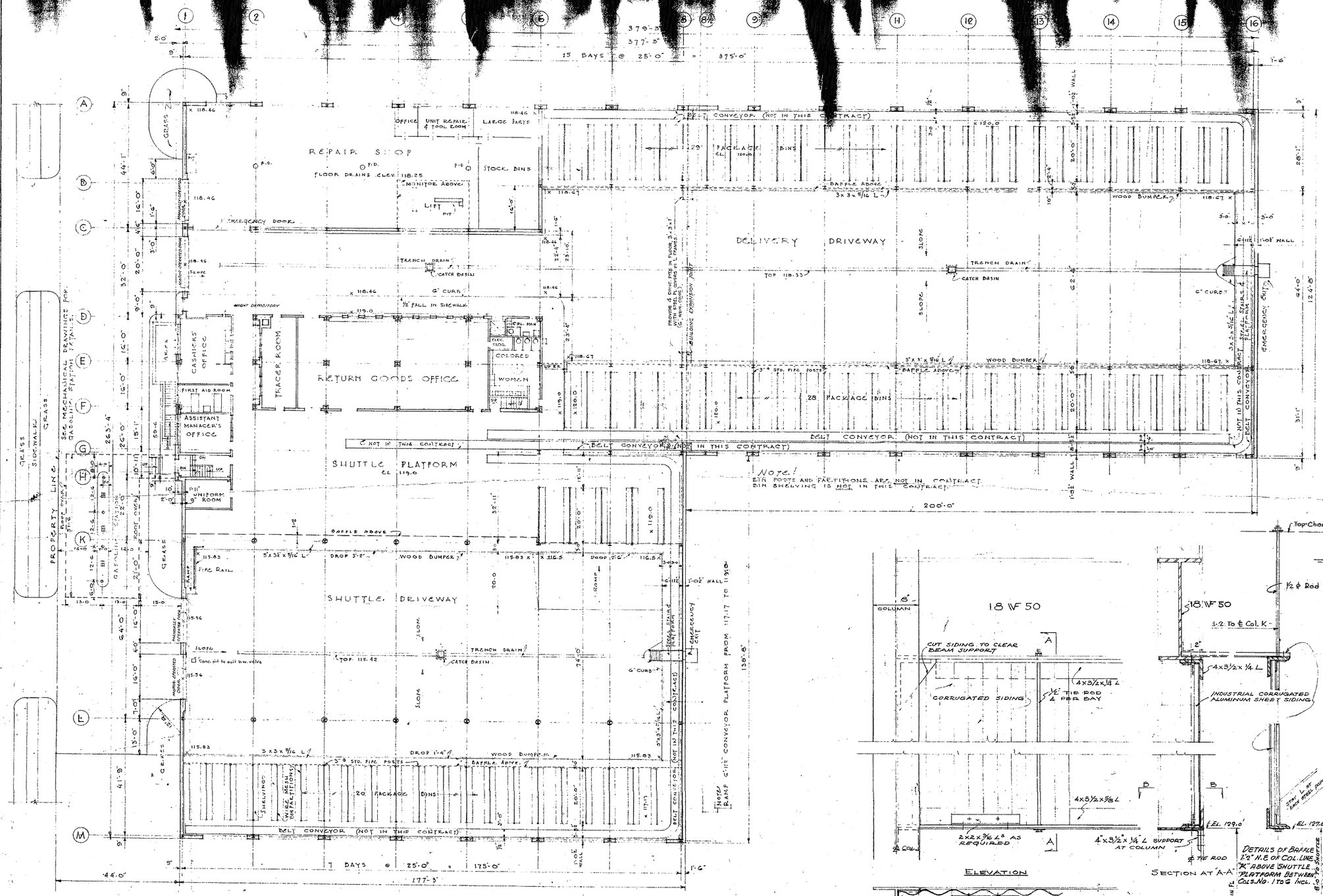
PIPE	STEAM	CONDENSATE	WATER	GAS	VALVES	TRAPS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	½"	½"
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	¾"	½"
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	¾"	½"

GENERAL NOTE

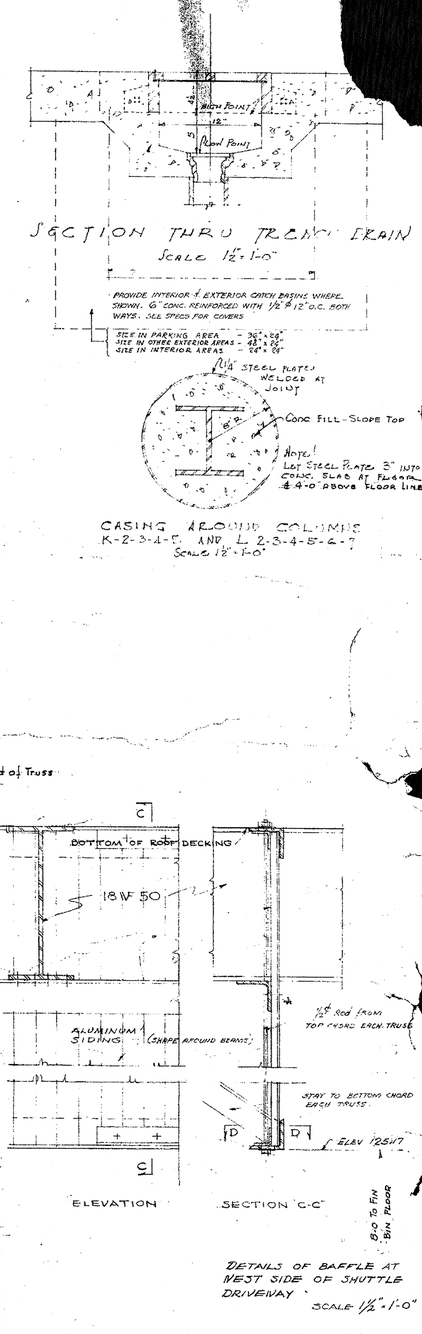
SEE ARCHITECTURAL PLAN FOR CONSTRUCTION DETAILS OF CATCH BASINS. PROVIDE WATER SERVICE CONNECTION SIMILAR TO DETAIL [illegible] ON PAGE M-E

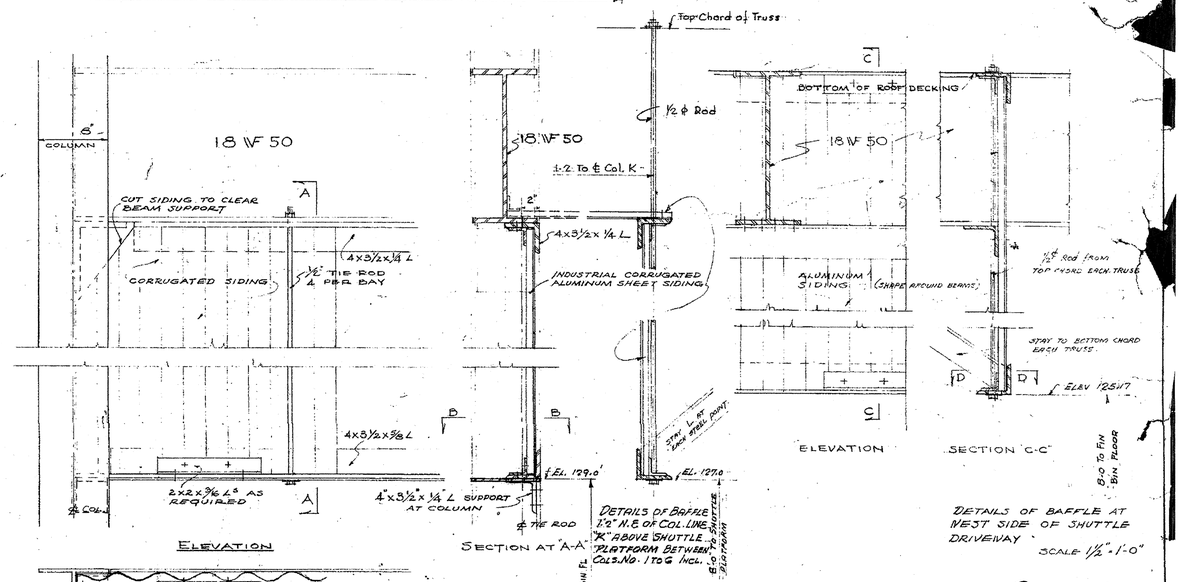
SITE PLAN

T-0705-0140



FIRST FLOOR PLAN
SCALE: 1/16" = 1'-0"



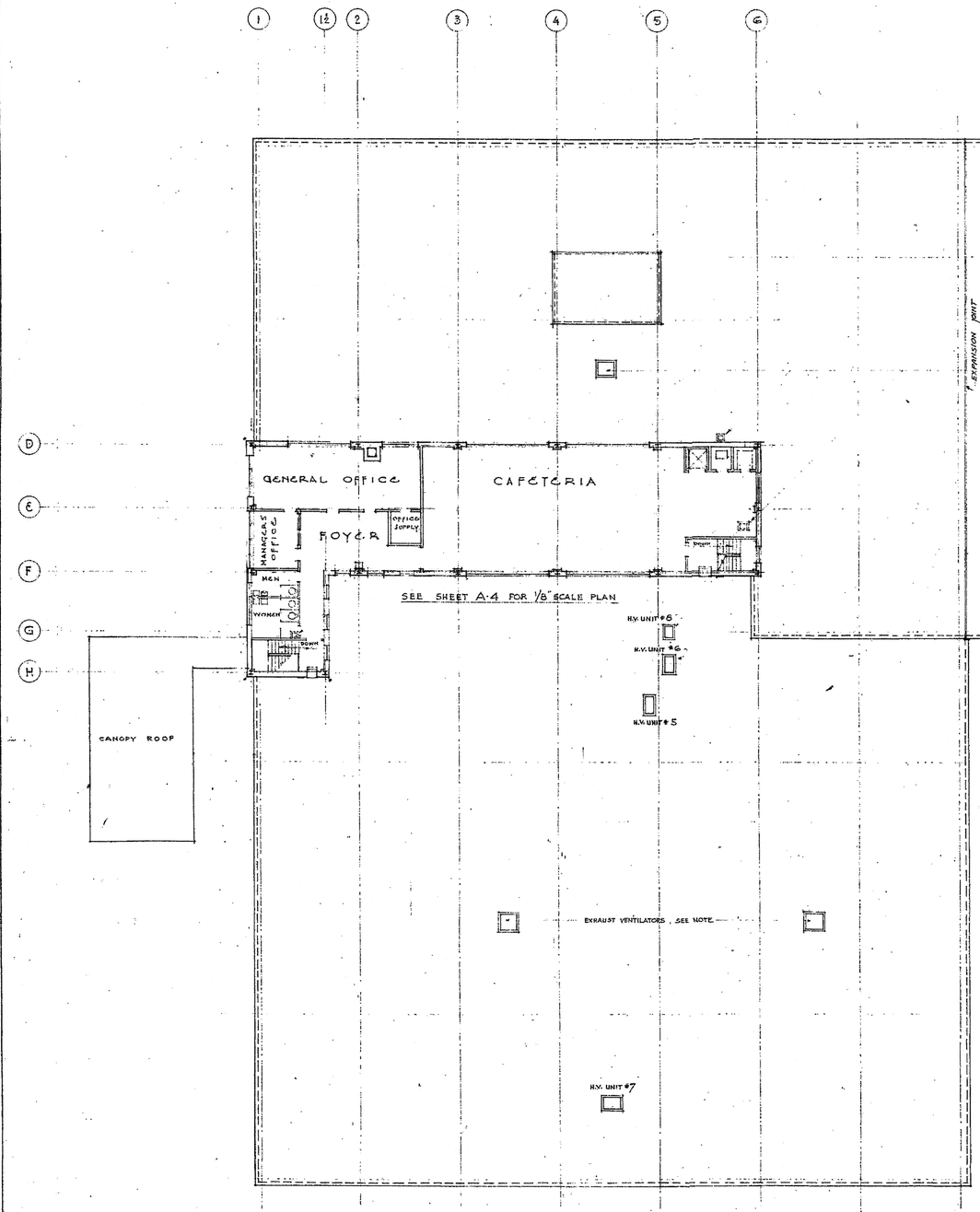


3 OF 29

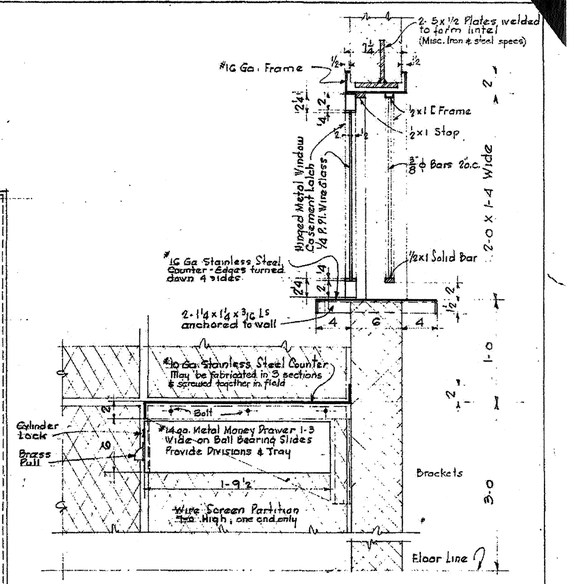
TRANSFER STATION
For The DELIVERY OF BALTIMORE, Inc.
KIRK & BONAPARTE AVES., BALTIMORE, MD.

FIRST FLOOR PLAN

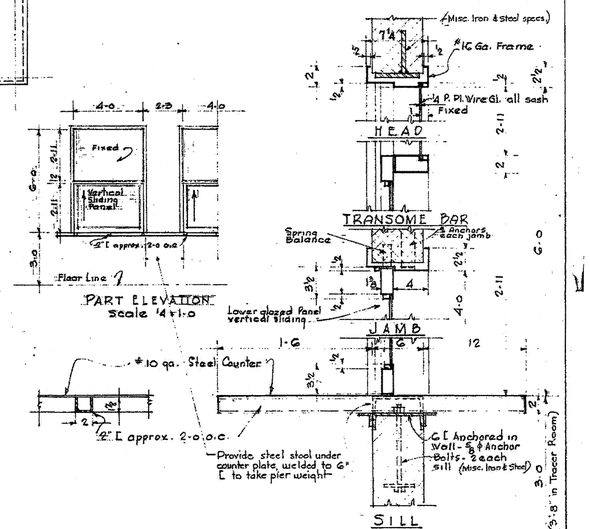
COMMISSION 4908 | JAMES R. EDMONDS ARCHITECT 130 W. HAMILTON STREET BALTIMORE 1 | DATE OCT. 17, 1949 | A-2



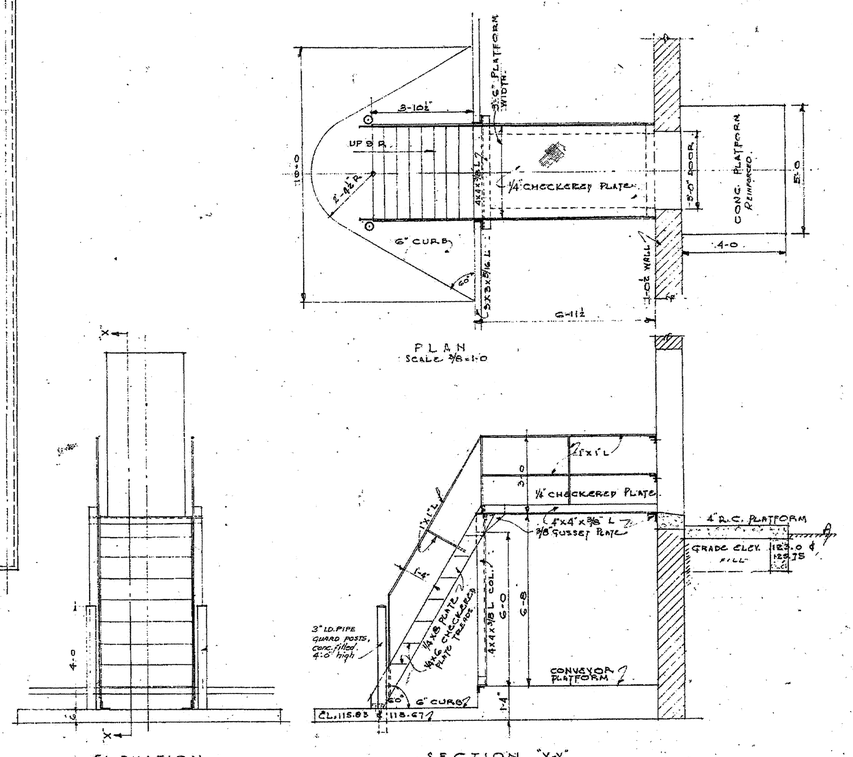
MEZZANINE & ROOF PLANS
SCALE 1/16" = 1'-0"



SEC. THRU CASHIER'S COUNTER & WINDOW
Scale 1 1/2 = 1-0



SEC. THRU COUNTER & VERTICAL SLIDING WINDOW - RETURN GOODS ROOM - Scale 1 1/2 = 1-0



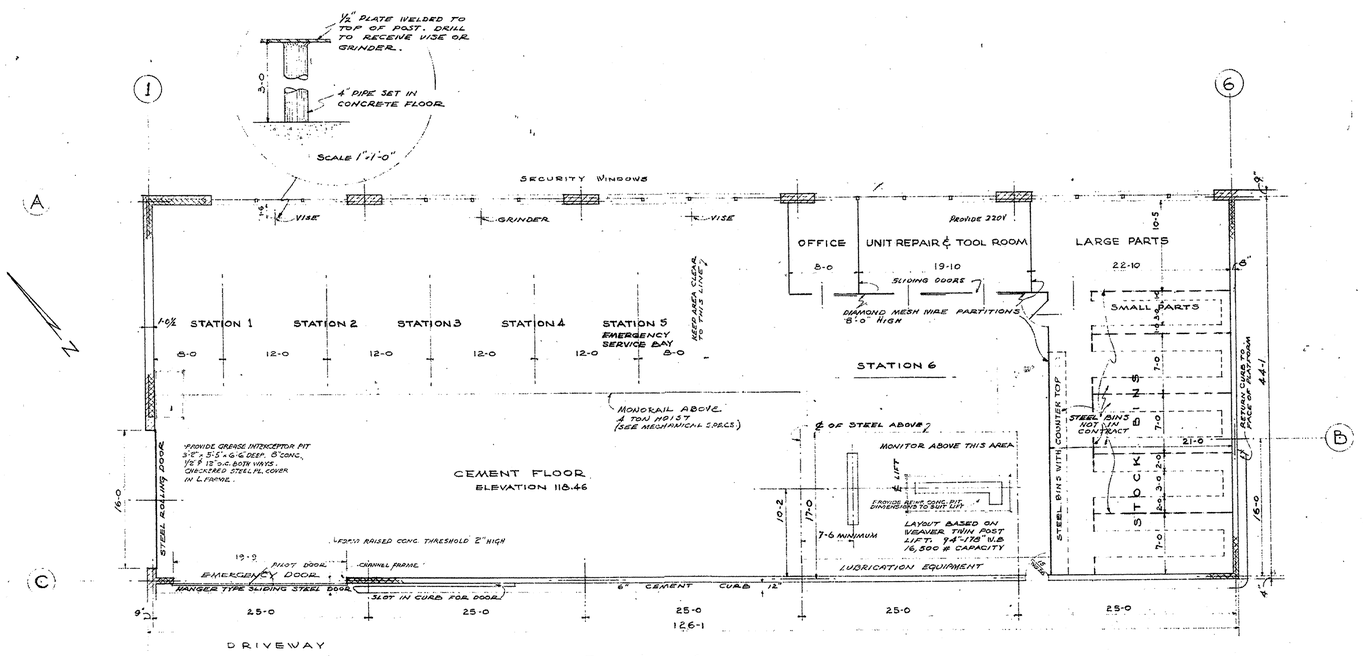
3/8" SCALE DETAILS OF EMERGENCY EXIT STAIRS
(MISCELLANEOUS IRON AND STEEL SECT.)

4 OF 29

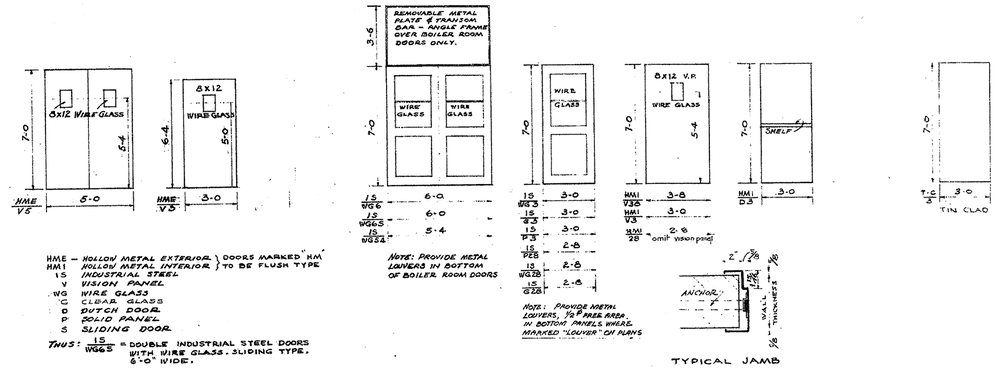
TRANSFER STATION
FOR THE DELIVERY OF BALTIMORE, INC.,
KIRK & BONAPARTE AVES., BALTIMORE, MD.

MEZZANINE & ROOF PLAN.

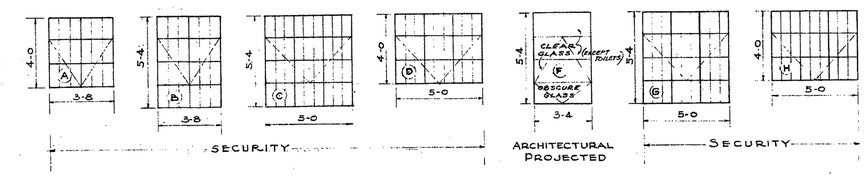
COMMISSION 4908
DATE OCT. 17, 1949
JAMES R. EDMUNDS, JR. ARCHITECT
133 W. HAMILTON STREET
BALTIMORE 1, MARYLAND
A-3



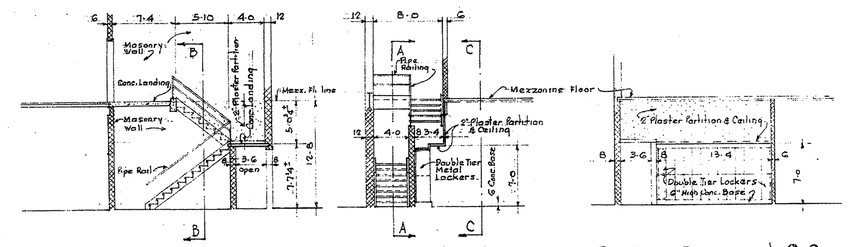
REPAIR SHOP
SCALE 1/8"=1'-0"



DOOR SCHEDULE
SCALE 1/8"=1'-0"

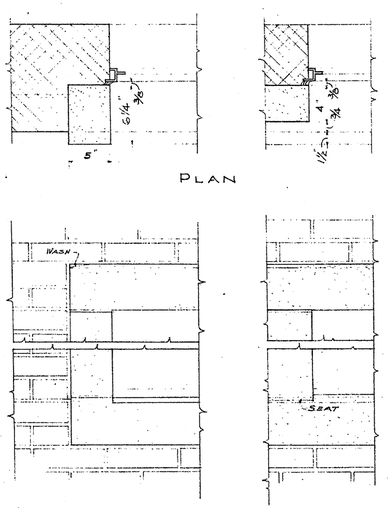


WINDOW SCHEDULE
SCALE 1/8"=1'-0"



SECTION A-A — SECTION B-B — SECTION-ELEVATION C-C

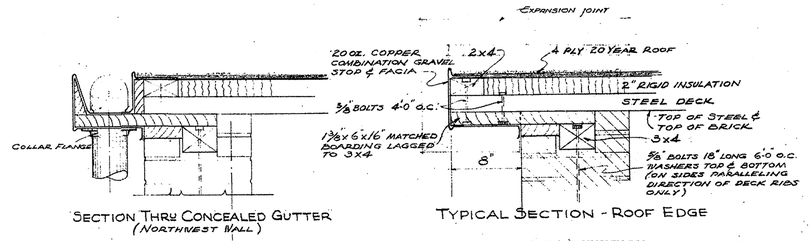
DETAILS OF NO. 2 STAIRS
Scale 1/8" = 1'-0"



PLAN

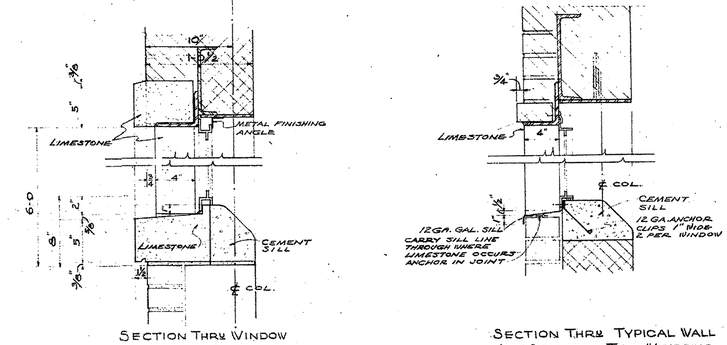
END JAMB — INTERMEDIATE JAMB

ELEVATIONS OF STONE WINDOW SURROUNDS



SECTION THRU CONCEALED GUTTER
(NORTHWEST WALL)

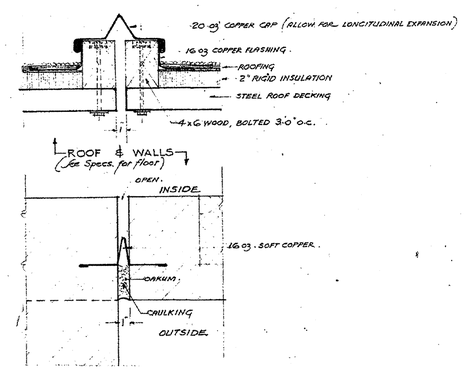
TYPICAL SECTION - ROOF EDGE



SECTION THRU WINDOW HEAD AND SILL
(NORTHWEST WALL)

SCALE 1 1/2" = 1'-0"

SECTION THRU TYPICAL WALL AT SECURITY TYPE WINDOWS



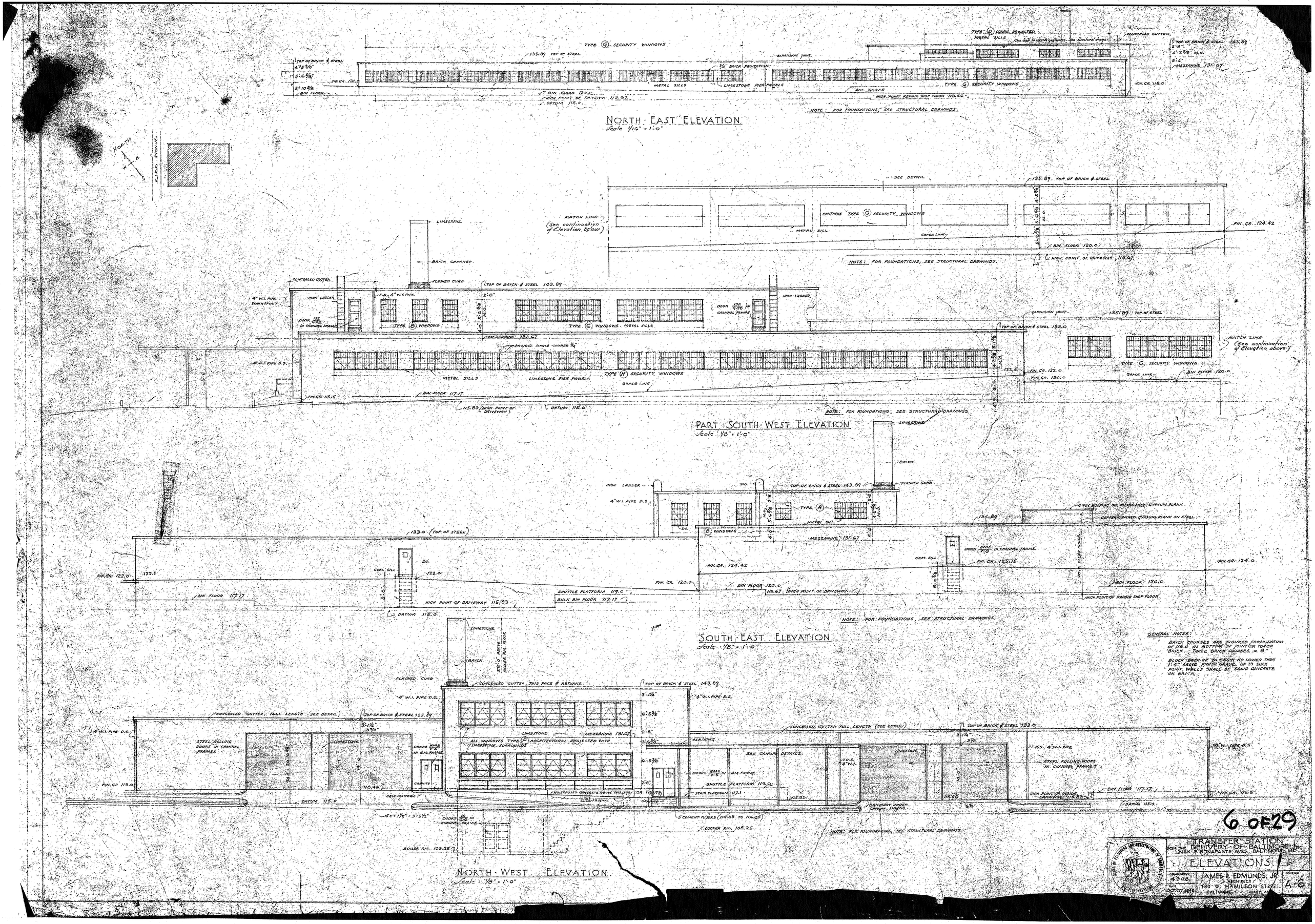
DETAILS OF EXPANSION JOINT.

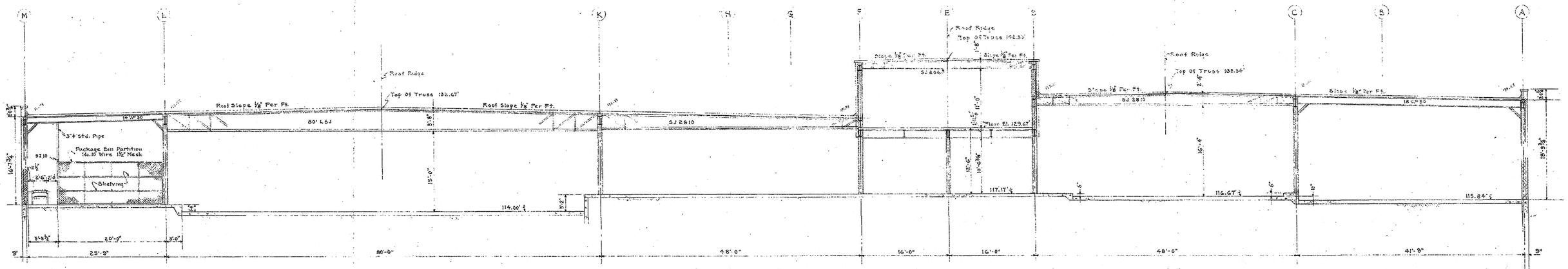
5 OF 29

TRANSFER STATION
FOR THE DELIVERY OF BALTIMORE, INC.
KIRK & BONAPARTE AVES., BALTIMORE, MD.

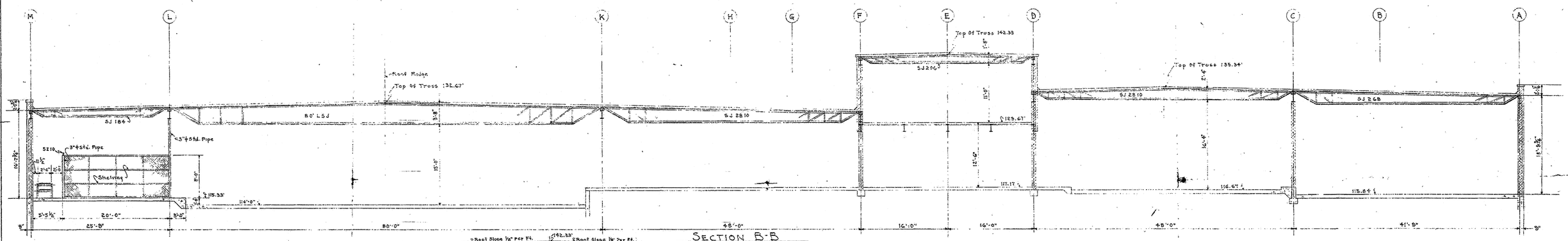
DETAILS & SHOP PLAN

JOB NO. 4908	JAMES R. EDMUNDS JR. ARCHITECT 130 W. HAMILTON STREET ALTIMORE 1, MARYLAND	A-5
DATE OCT. 17, 1949		

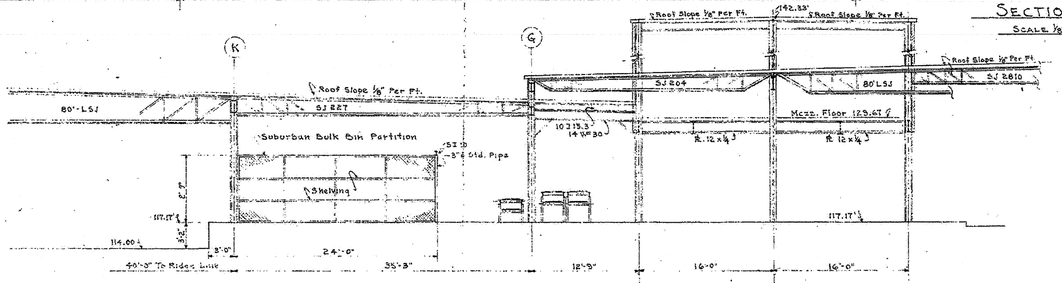

NORTH · EAST ELEVATION
Scale 1/16" = 1'-0"
TYPE (G) SECURITY WINDOWS
TYPE (D) COMM. PROJECTED METAL SILLS
CONCEALED GUTTER
TOP OF BRICK & STEEL 143.89
135.89 TOP OF STEEL
EXPANSION JOINT
TOP OF BRICK & STEEL
FIN. GR. 120.0
FIN. GR. 118.0
MEZZANINE 131.67
METAL SILLS
LIMESTONE PIER PANELS
BIN SLAB
HIGH POINT REPAIR SHOP FLOOR 118.42
BIN FLOOR 120.0
HIGH POINT OF DRIVEWAY 118.67
DATUM 115.0
NOTE: FOR FOUNDATIONS, SEE STRUCTURAL DRAWINGS.
NORTH
KIRK AVENUE
SEE DETAIL
MATCH LINE (See continuation of Elevation below)
CONTINUE TYPE (G) SECURITY WINDOWS
METAL SILL
GRADE LINE
FIN. GR. 124.42
BIN FLOOR 120.0
HIGH POINT OF DRIVEWAY 118.67
LIMESTONE
BRICK CHIMNEY
FLASHED CURB
CONCEALED GUTTER
IRON LADDER
4" W.I. PIPE DOWNSPOUT
F.S. 4" W.I. PIPE
DOOR SEE 5/26 IN CHANNEL FRAME
TYPE (B) WINDOWS
TYPE (C) WINDOWS - METAL SILLS
MEZZANINE 131.67
PROJECT SINGLE COURSE 3/4"
4" W.I. PIPE D.S.
METAL SILLS
LIMESTONE PIER PANELS
TYPE (H) SECURITY WINDOWS
GRADE LINE
BIN FLOOR 117.17
FIN. GR. 115.5
115.83 (HIGH POINT OF DRIVEWAY)
DATUM 112.0
NOTE: FOR FOUNDATIONS, SEE STRUCTURAL DRAWINGS.
PART SOUTH-WEST ELEVATION
Scale 1/8" = 1'-0"
TOP OF BRICK & STEEL 133.0
EXPANSION JOINT
MATCH LINE (See continuation of Elevation above)
TYPE (G) SECURITY WINDOWS
FIN. GR. 122.0
FIN. GR. 120.0
BIN FLOOR 120.0
LIMESTONE
BRICK
FLASHED CURB
TYPE (A)
METAL SILL
TYPE (B) WINDOWS
MEZZANINE 131.67
FIN. GR. 124.42
FIN. GR. 125.75
FIN. GR. 124.0
DOOR NONE IN CHANNEL FRAME
CEM. SILL
FIN. GR. 122.0
FIN. GR. 120.0
BIN FLOOR 120.0
BIN FLOOR 117.17
HIGH POINT OF DRIVEWAY 115.83
SHUTTLE PLATFORM 119.0
BULK BIN FLOOR 117.17
DATUM 115.0
HIGH POINT OF RAPPLE SHOP FLOOR
NOTE: FOR FOUNDATIONS, SEE STRUCTURAL DRAWINGS.
SOUTH-EAST ELEVATION
Scale 1/8" = 1'-0"
GENERAL NOTES:
BRICK COURSES ARE FIGURED FROM DATUM OF 115.0 AS BOTTOM OF JOINT FOR TOP OF BRICK. THREE BRICK COURSES = 8".
BLOCK BACK-UP TO BEGIN NO LOWER THAN 1'-4" ABOVE FINISH GRADE. UP TO SUCH POINT, WALLS SHALL BE SOLID CONCRETE OR BRICK.
CONCEALED GUTTER, THIS FACE & RETURNS
TOP OF BRICK & STEEL 143.89
4" W.I. PIPE D.S.
CONCEALED GUTTER, FULL LENGTH (SEE DETAIL)
TOP OF BRICK & STEEL 135.89
STEEL ROLLING DOORS IN CHANNEL FRAMES
LIMESTONE
ALL WINDOWS TYPE (F) ARCHITECTURAL PROJECTED WITH LIMESTONE SURROUNDS
MEZZANINE 131.67
DOORS NONE IN H.M. FRAME
GRANITE
SHUTTLE PLATFORM 119.0
STAIR PLATFORM 117.1
FIN. GR. 118.0
CEM. PLATFORM
DATUM 115.0
DOORS SEE 5/26 IN CHANNEL FRAME
BOILER RM. 103.25
5 CEMENT RISERS (114.08 TO 116.75)
LOCKER RM. 106.25
NOTE: FOR FOUNDATIONS, SEE STRUCTURAL DRAWINGS.
NORTH-WEST ELEVATION
Scale 1/8" = 1'-0"
6 OF 29
TRANSFER STATION
FOR THE DELIVERY OF BALTIMORE, INC.
KIRK & BONAPARTE AVES., BALTIMORE, MD.
ELEVATIONS
JAMES R. EDMUNDS, JR.
ARCHITECT
730 W. HAMILTON STREET
BALTIMORE, MARYLAND
A-6



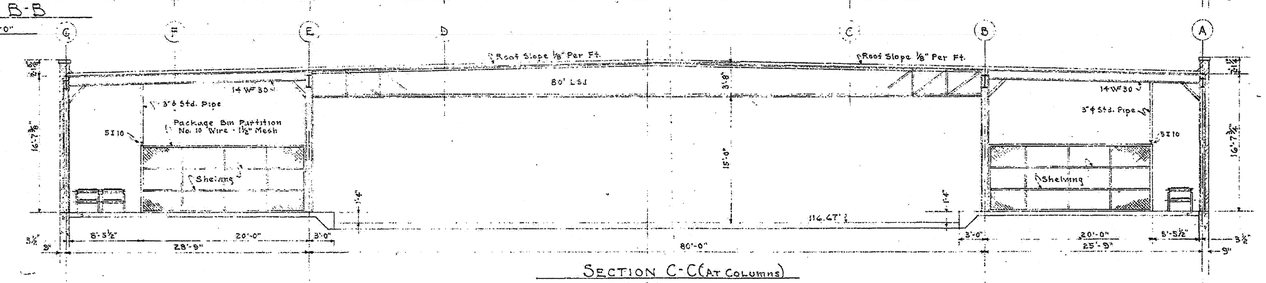
SECTION A-A (AT COLUMNS)
SCALE 1/8"=1'-0"



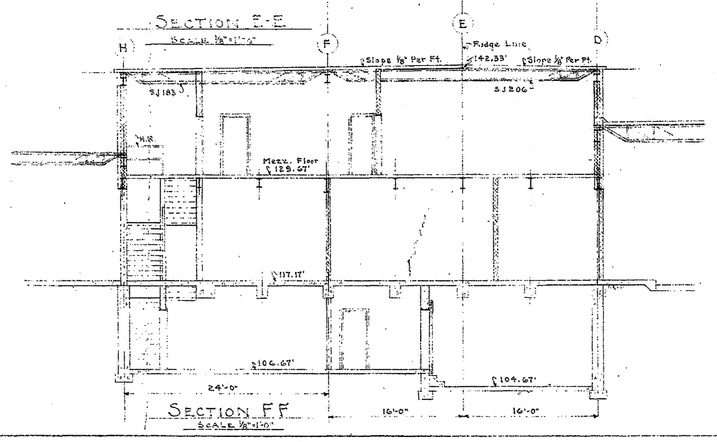
SECTION B-B
SCALE 1/8"=1'-0"



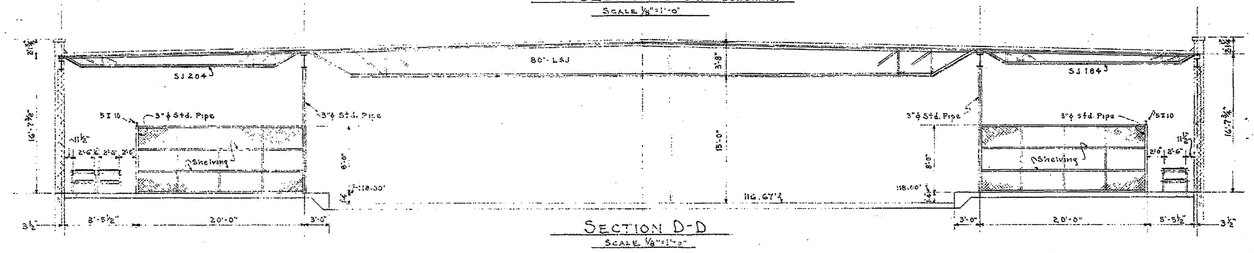
SECTION E-E
SCALE 1/8"=1'-0"



SECTION C-C (AT COLUMNS)
SCALE 1/8"=1'-0"



SECTION F-F
SCALE 1/8"=1'-0"



SECTION D-D
SCALE 1/8"=1'-0"

SLABS ON GROUND
6" thick - Reinforced with
½"ϕ - 18" o.c. each way.
Slope to Drains.

DELIVERY OF BALTIMORE
ARCH. SECTIONS THRU BUILDING

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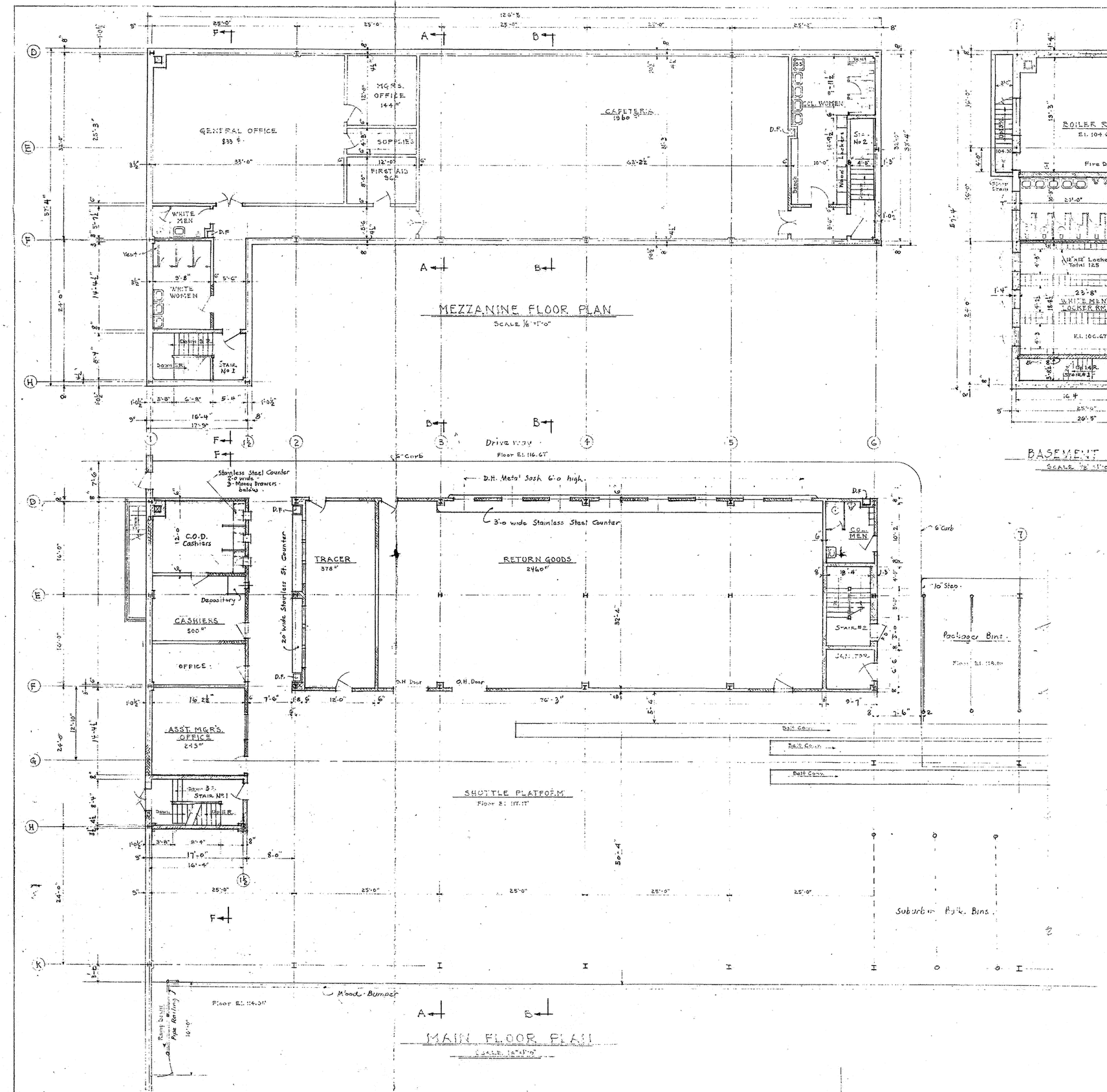

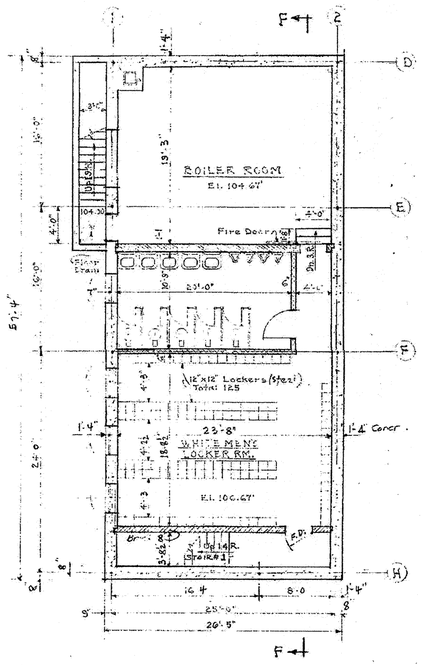

Exterior Walls. 4" Brick 8" Cinder Blk.
Interior Walls. Brick
Interior Partitions - Cinder Block
Basement Walls - Reinf Conc.

Fire Doors = F.D.
Drinking Fountains = D.F.

GENERAL NOTES.

Roofing - 4 Ply - 20 yr Roofing on 1" th Celotex Insulation
Steel Rolling Doors - Kinnear, Elec. Operated or approved substitute.
Ext. & Interior Doors } Hollow Metal & Trim } Painted
Metal Toilet Partitions
Belt Conveyor & Motors - Not in Contract
Steel Stairs - Conc. Treads, safety Nosing
1½" - Pipe Rails
Sprinklers - Entire area to be sprinkled.
Floors -
Offices - Asphalt Tile - ⅛" Grout A.
Other Floors - Steel Trowel Finish.
Partitions Allowance $ 18.00 00
Lighting, Plumbing, Electrical, Ventilating } Include in Budget

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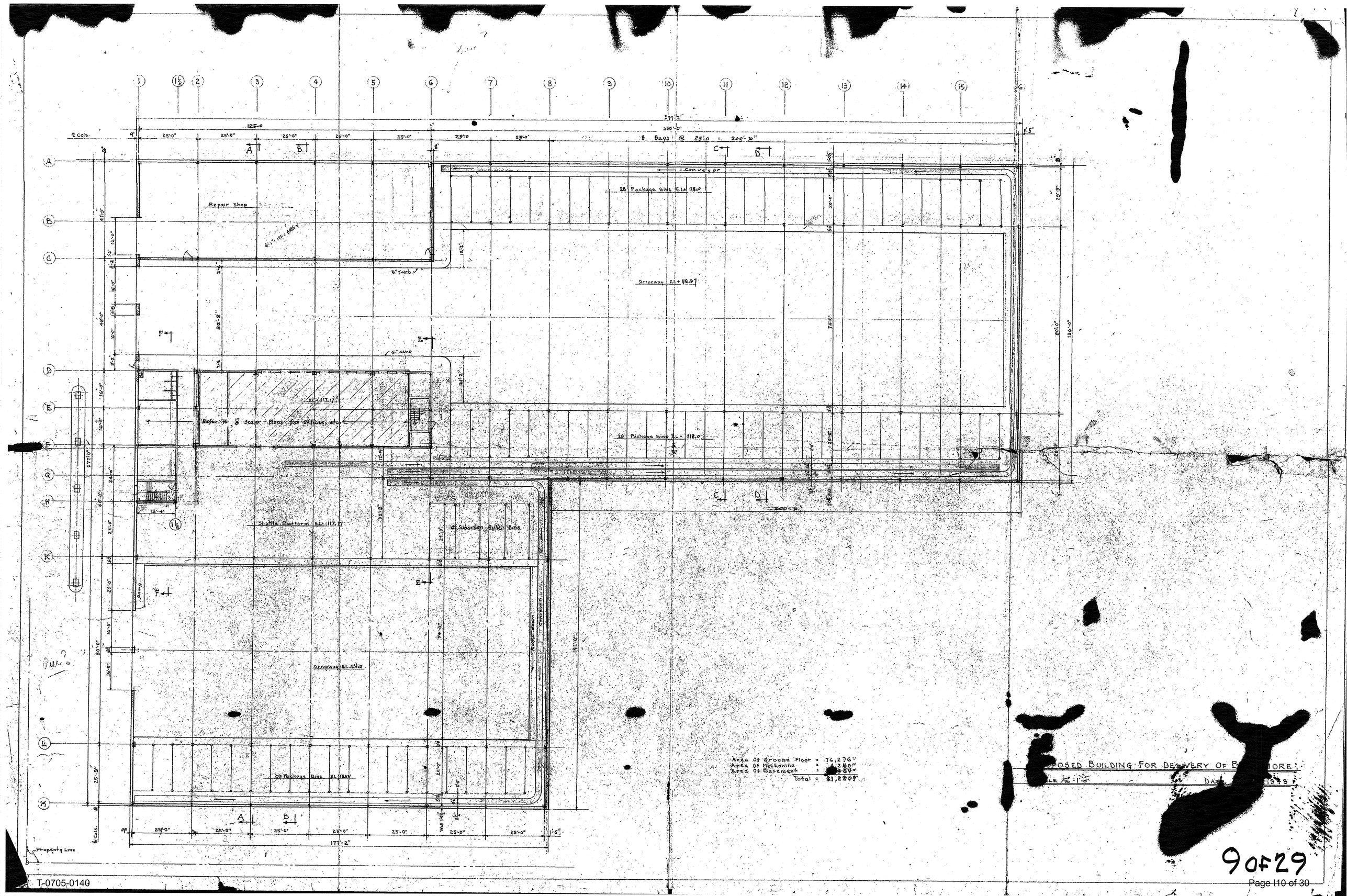
Repair Shop
Conveyor
28 Package Bins El. 118.0
Driveway El. 116.67
6" curb
Refer to 5 Scale Plans for Offices, etc.
28 Package Bins El. 118.0
Shuttle Platform El. 117.17
4 Suburban Bulk Bins
Ramp
Ramp Down
Driveway El. 114.0
20 Package Bins El. 113.5
Wall
Property Line
Area Of Ground Floor = 76,276
Area Of Mezzanine = 4,240
Area Of Basement = 1,264
Total = 81,820
PROPOSED BUILDING FOR DELIVERY OF BOOKSTORE
SCALE 1/16" = 1'-0"
DATE

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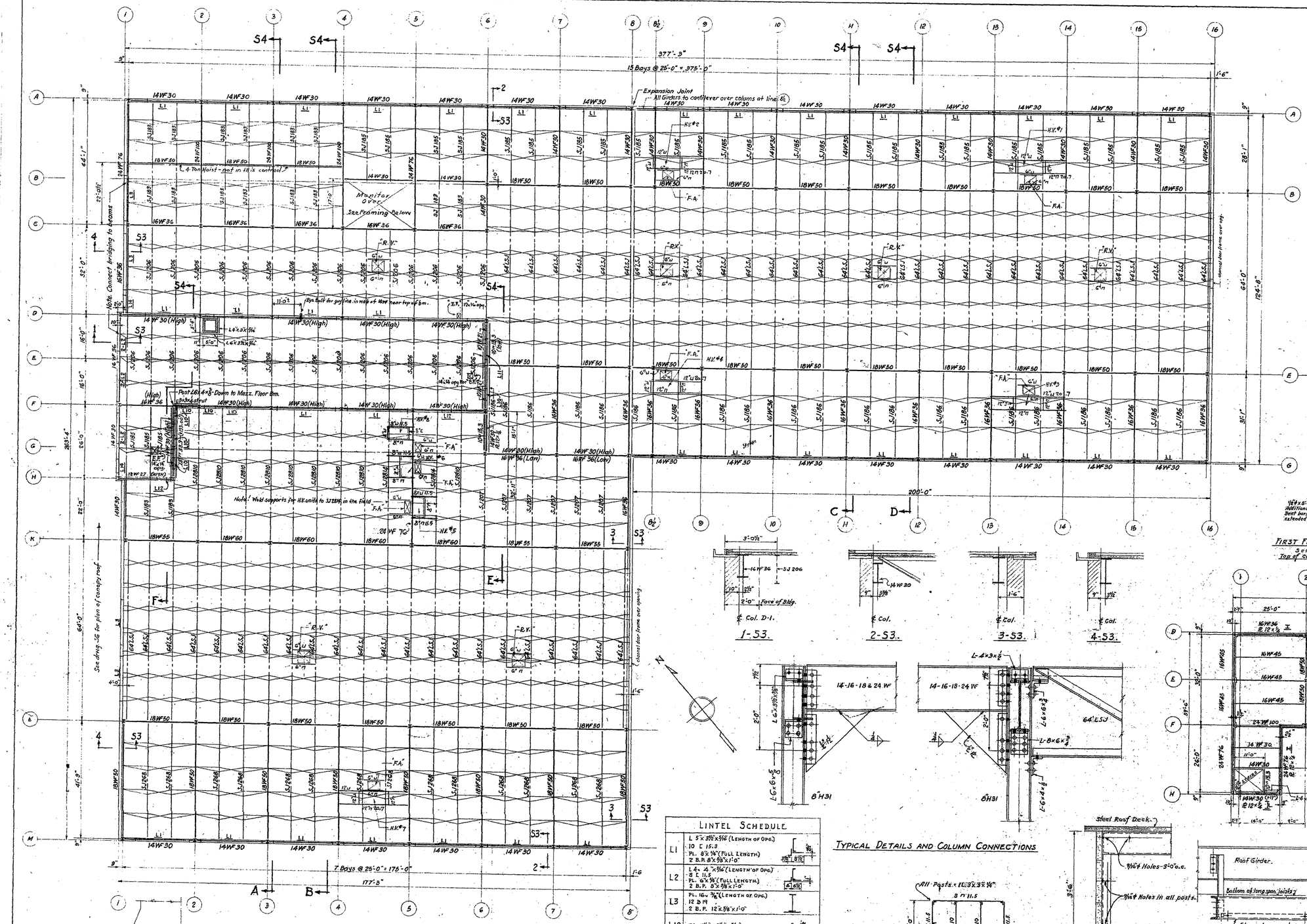
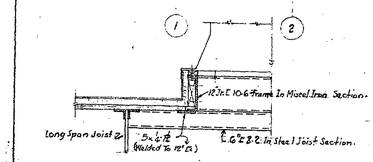
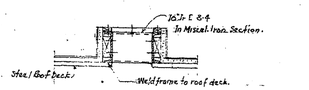


ROOF FRAMING.
Scale: 1/16" = 1'-0"

Roof deck to be Robertson #20-Q steel deck or an approved substitute



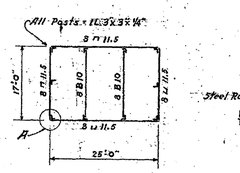
DETAIL AT ROOF VENTILATORS "R.V."
DETAIL AT FRESH AIR INTAKES "F.A."



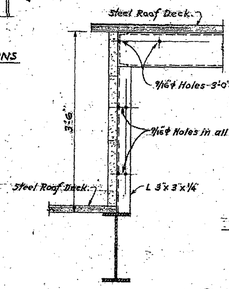
DETAIL AT EXHAUST FAN OPENINGS "E.F."

TYPICAL DETAILS AND COLUMN CONNECTIONS

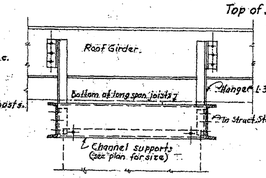
LINTEL SCHEDULE	
L1	L 5"x 3½"x 5/16" (LENGTH OF OPG.) 10 C 15.3 PL. 8"x 1/4" (FULL LENGTH) 2 B.P. 8"x 5/8"x 1'-0"
L2	L 4"x 4"x 5/16" (LENGTH OF OPG.) 8 C 11.5 PL. 6"x 1/4" (FULL LENGTH) 2 B.P. 8"x 5/8"x 1'-0"
L3	PL. 16"x 3/8" (LENGTH OF OPG.) 12 B.P. 2 B.P. 12"x 5/8"x 1'-0"
L10	3 L 3½"x 3½"x 5/16"
L11	3 L 5"x 3½"x 5/16"
L12	3 L 3½"x 3½"x 5/16"
L13	2 L 3½"x 3½"x 5/16"
L14	3 L 5"x 3½"x 5/16"



MONITOR FRAMING.
(Steel Roof Deck)



ELEVATION AT (A)



SECTION THROUGH "H.V." UNIT SUPPORTS

S1 { 5" Conc. Slab; 1/2" ϕ x 8" o.c. Alt. bars bent; 1/2" ϕ Temp. 18" o.c.

B1 { 24"x 15"; 5-1" ϕ 3-str. 2-bent; 3/8" ϕ Stirrups spaced 2", 12", 5@ 24" each end.

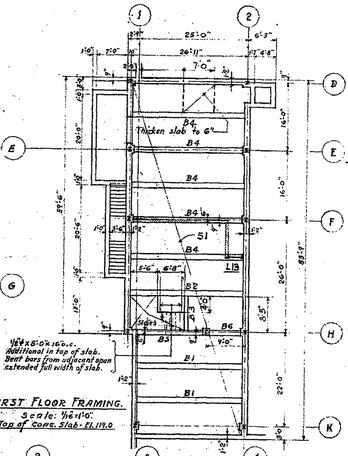
B2 { 24"x 15"; 3-1" ϕ Str. - 2-1 1/16" □ bent; 3/8" ϕ Stirrups spaced 2", 10", 5@ 36" each end

B3 { 10"x 8"; 3-3/4" ϕ 2-str. 1-bent; 1/4" ϕ Stirrups spaced 2", 2'-0" each end.

B4 { 24"x 15"; 5-1" ϕ 3 Str. - 2 bent; 9/16" ϕ Stirrups spaced 2", 10", 5@ 30" each end

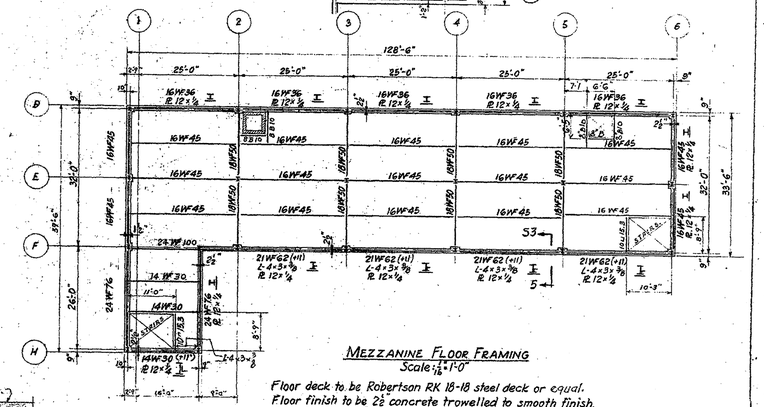
B5 { 18"x 14"; 3-1" ϕ 2 Str. 1 bent; 9/16" ϕ Stirrups spaced 2", 3@ 24" each end.

B6 { 18"x 14"; 3-7/8" ϕ 2 Str. 1 bent; 9/16" ϕ Stirrups spaced 2", 24" each end.



FIRST FLOOR FRAMING.
Scale: 1/16" = 1'-0"
Top of Conc. 216'-11.0

SECT. 5-S3.
Scale: 3/8" = 1'-0"



MEZZANINE FLOOR FRAMING
Scale: 1/16" = 1'-0"

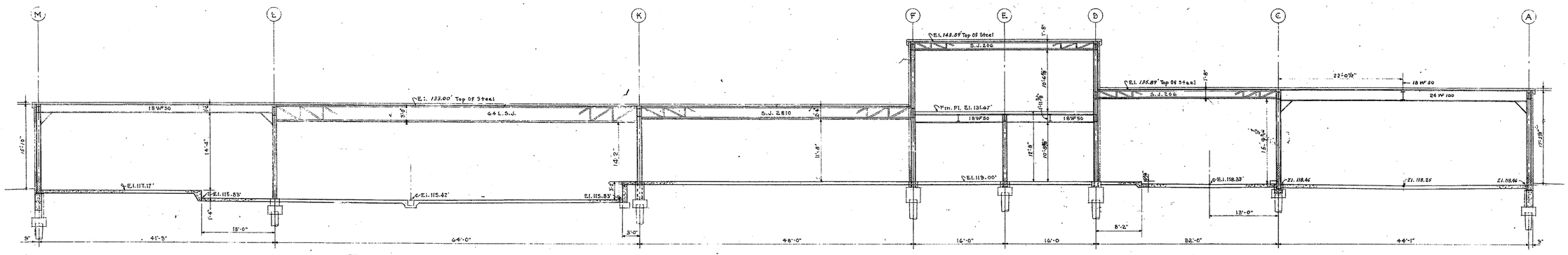
Floor deck to be Robertson RK 18-18 steel deck or equal.
Floor finish to be 2½" concrete trowelled to smooth finish.
Top of steel (-5⅛") unless noted.

10 OF 29

CROUT, SNYDER & CRANDALL
STRUCTURAL ENGINEERS
20 E. LEXINGTON ST.
BALTIMORE, MD.
Designed by Fouse

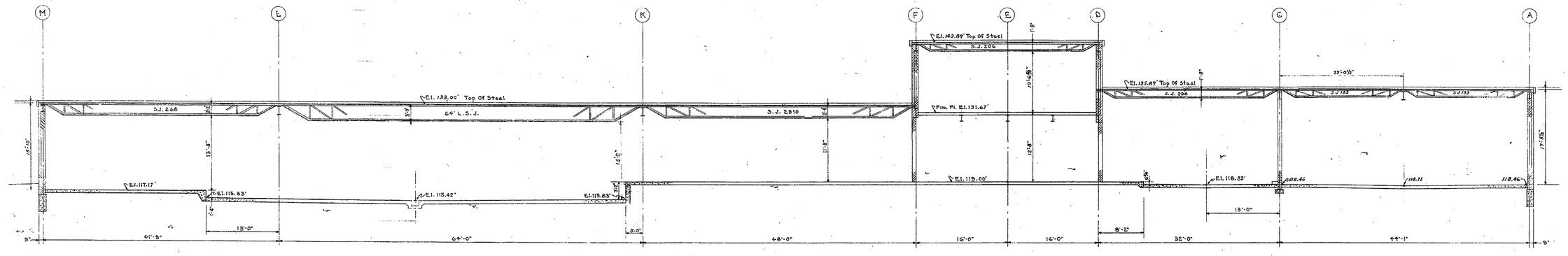
TRANSFER STATION FOR DELIVERY OF BALTIMORE INC.
KIRK AND BONAPARTE AVES., BALTIMORE, MD.
ROOF FRAMING AND FLOOR PLANS

COMMISSION	THE OFFICE OF JAMES R. EDMUNDS ARCHITECT 130 W. HAMILTON STREET BALTIMORE 1, MARYLAND	S3
4908		
DATE OCT. 17, 1949		



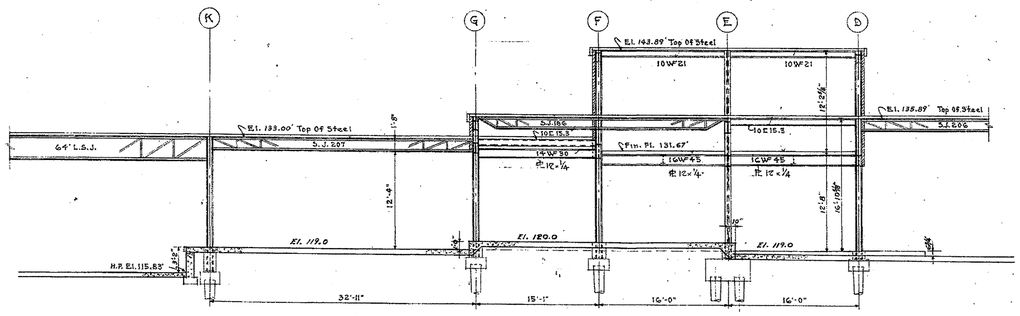
SECTION A-S4.

SCALE: 1/8" = 1'-0"



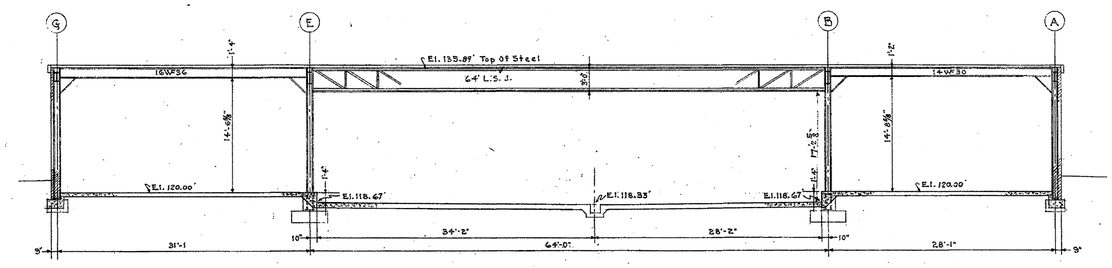
SECTION B-S4.

SCALE: 1/8" = 1'-0"



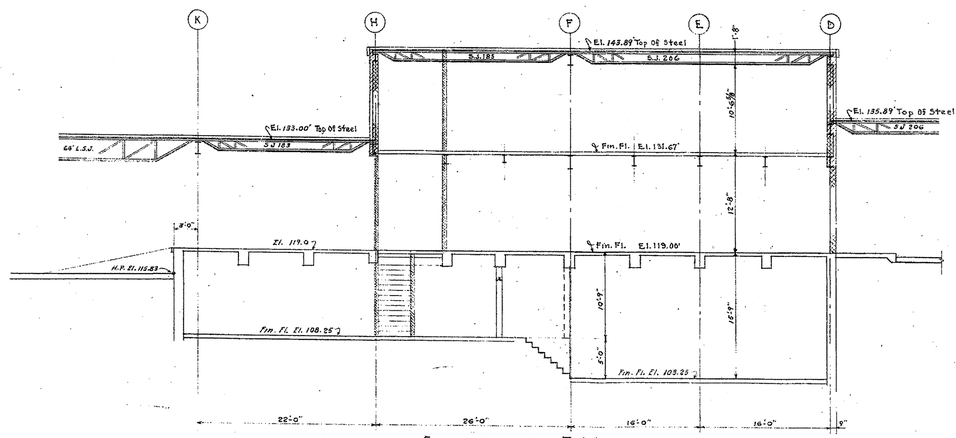
SECTION E-S4.

SCALE: 1/8" = 1'-0"



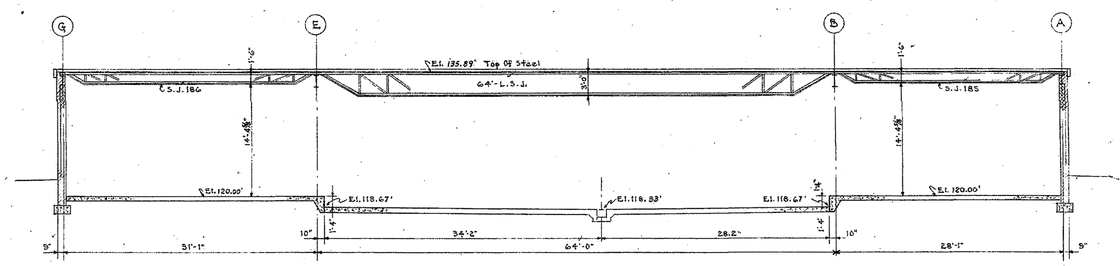
SECTION C-S4.

SCALE: 1/8" = 1'-0"



SECTION F-S4.

SCALE: 1/8" = 1'-0"



SECTION D-S4.

SCALE: 1/8" = 1'-0"

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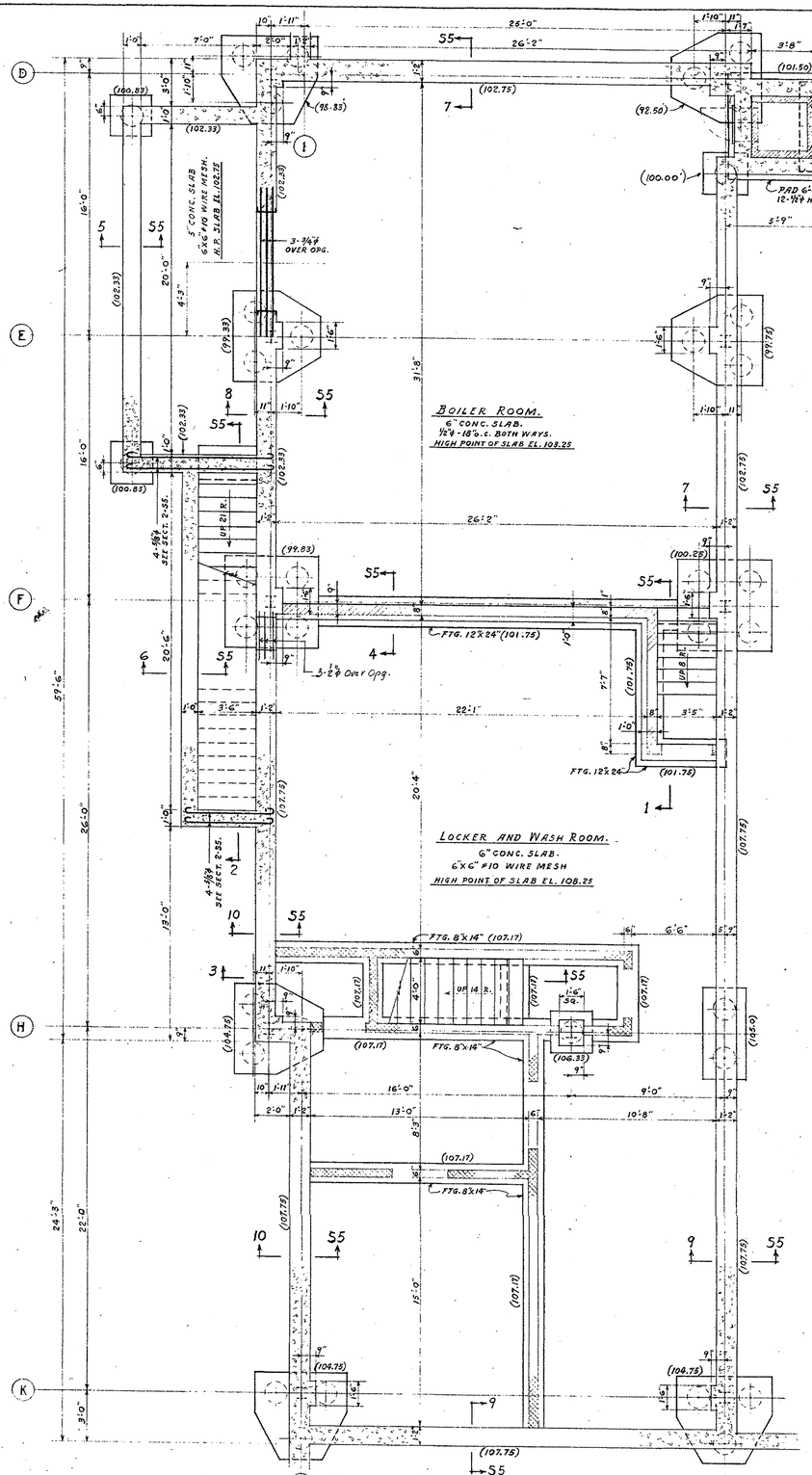
CROUSE, SNYDER & CHATHALL
STRUCTURAL ENGINEERS
20 E. LEXINGTON ST
BALTIMORE, MD.
Designed by Tousek

TRANSFER STATION FOR DELIVERY OF BALTIMORE INC.
KIRK AND BONAPARTE AVES., BALTIMORE, MD.

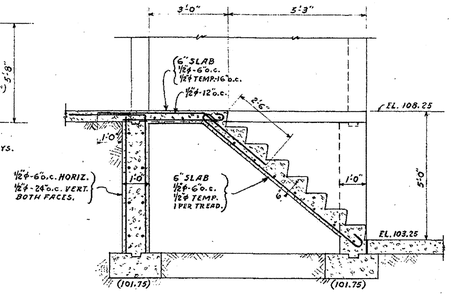
CROSS SECTIONS

4902 | OCT. 17, 1949 | ARCHITECTS | S4



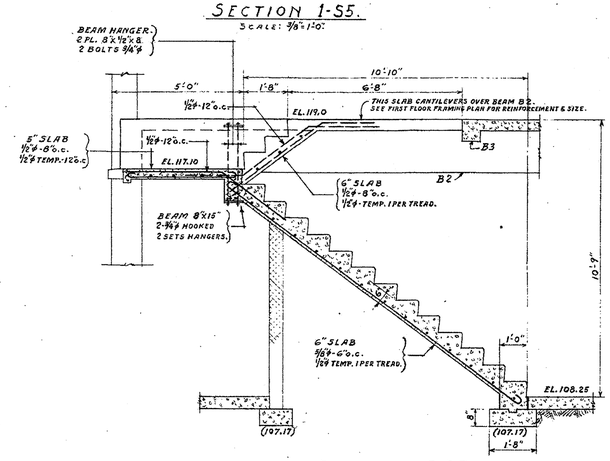
FOUNDATION PLAN OF BOILER RM., LOCKER & WASH ROOM.

SCALE: 1/4" = 1'-0"



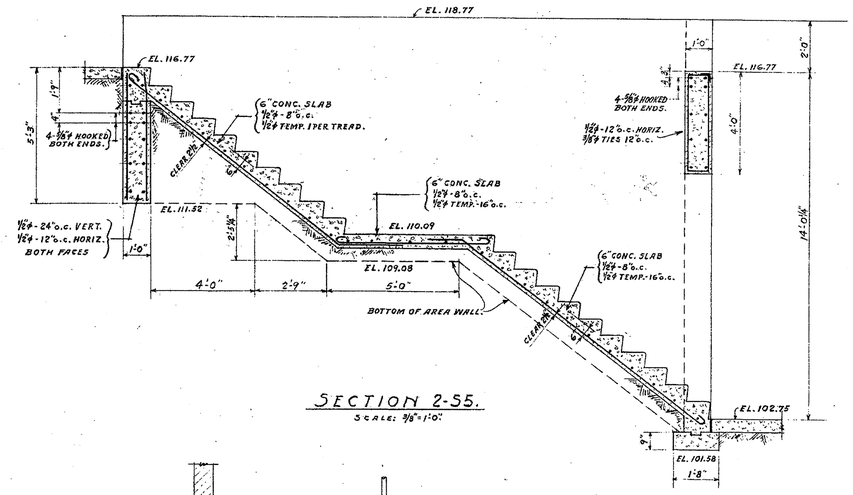
SECTION 1-55.

SCALE: 3/8"=1'-0"



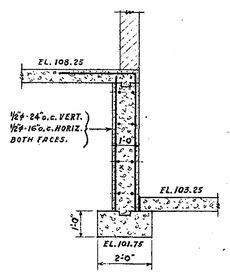
SECTION 3-55.

SCALE: 3/8"=1'-0"



SECTION 2-55.

SCALE: 3/8"=1'-0"



SECTION 4-55.

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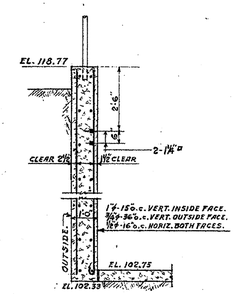
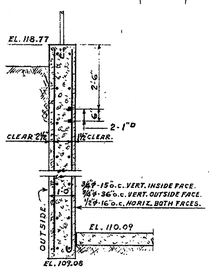


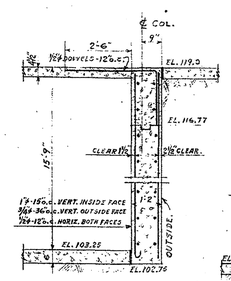
SECTION 5-55.

SCALE: 3/8"=1'-0"



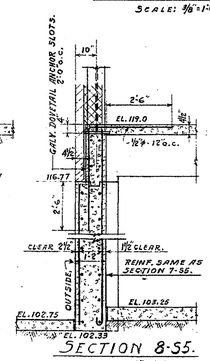
SECTION 6-55.

SCALE: 3/8"=1'-0"



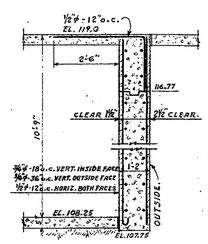
SECTION 7-55.

SCALE: 3/8"=1'-0"



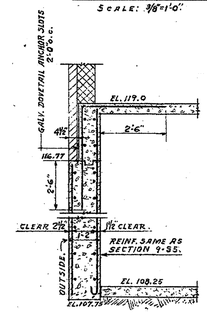
SECTION 8-55.

SCALE: 3/8"=1'-0"



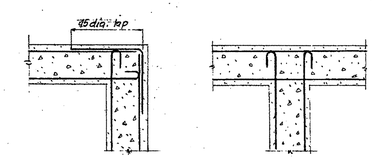
SECTION 9-55.

SCALE: 3/8"=1'-0"

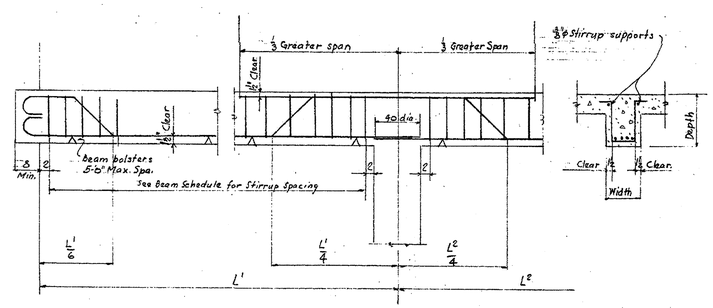


SECTION 10-55.

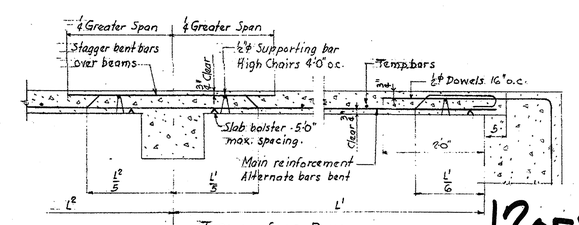
SCALE: 3/8"=1'-0"



REINFORCEMENT DETAILS AT WALL JUNCTURES



BEAM BAR BENDING DIAGRAM.



TYPICAL SLAB DETAIL

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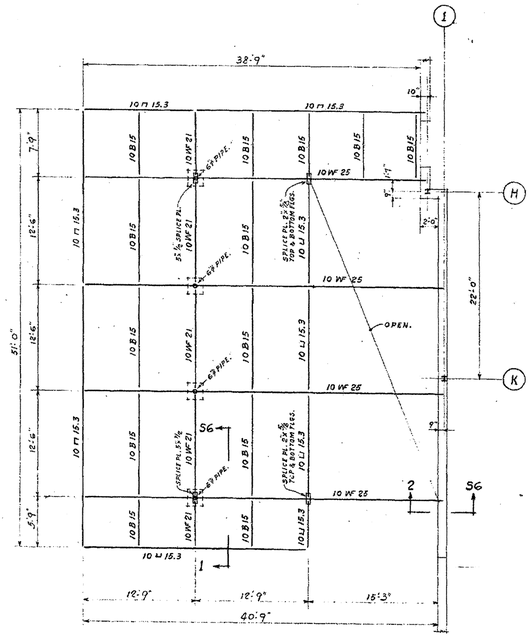
GROUT, SNYDER & CRANDALL
STRUCTURAL ENGINEERS
20 E. LEXINGTON ST.
BALTIMORE, MD.
Designed by Fousek

TRANSFER STATION FOR DELIVERY OF BALTIMORE INC.
KIRK AND BONAPARTE AVES., BALTIMORE, MD.

BASEMENT PLAN AND SECTIONS

4908 | OCT. 17, 1949 | S5

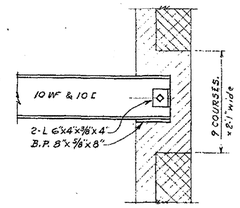


ROOF FRAMING PLAN.

CANOPY OVER GASOLINE STATION.

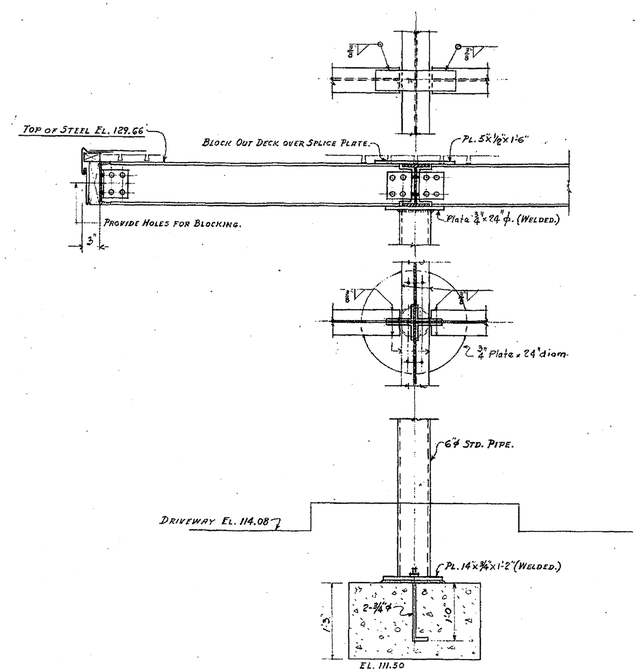
STEEL ROOF DECK TO BE ROBERTSON 20-Q OR AN APPROVED SUBSTITUTE.

Scale $\frac{1}{8}$" = 1 ft.



SECTION 2-S6.

SCALE: ¾" = 1'-0".



SECTION 1-S6.

SCALE: ¾" = 1'-0".

GENERAL NOTES.

Structural Steel:

The Structural Steel shall conform to the "Standard Specifications for Structural Steel for Bridges and Buildings, Serial Designation A7" of the American Society for Testing Materials, as amended to date.

The design, fabrication and erection of the Structural Steel shall be in accordance with the latest Specifications for Structural Steel for Buildings of the American Institute of Steel Construction. Shop connections shall be riveted or welded and the field connections shall be bolted with Dardelet bolts.

All welding shall be done in accordance with the latest code of the American Welding Society, and by welders carrying certificates of qualification.

Lintels shall have a minimum bearing at each end of 9 inches for spans up to 6 feet, and at least 12 inches for longer spans.

The columns shall be milled at the bearing ends and base plates shall be straightened.

The steel shall receive one shop coat of red lead and oil paint, mixed in the proportion of 25 pounds of red lead to one gallon of pure linseed oil. For field paint see Architectural specifications.

The steel contractor shall be responsible for all his detailing dimensions and for the proper fit of his work. He shall submit four sets of framing plans and shop details for approval before starting fabrication.

Steel Joists:

The Steel Joists shall be of the long span, open web type, and shall conform to the latest Specifications of The Steel Joist Institute

The joists marked 64" L.S.J. shall be designed for a uniform load of 375 pounds per lineal foot, which includes the weight of the joist.

The joists shall be connected to the flanges of the steel beams on which they rest, by 2-¾" diameter machine bolts or 2 welds of equal strength.

All joists shall be laterally braced by rigid strut bridging, spaced not over 10 feet apart, and consisting of not less than 1½"x 1½"x ⅛" angles, bolted together at their crossing.

No part of any joist shall be burned or cut away for any purpose whatever.

The joists shall receive one shop coat of red lead and linseed oil paint. For field paint see Architectural specifications.

The contractor shall submit four sets of details and setting plans for approval.

Steel Roof & Floor Deck:

The steel decking shall be of the gauge and type specified on the plans, and shall be erected and fastened in strict accordance with the manufacturers recommendations. The contractor shall submit 4 sets of details and setting plans for approval.

Plain & Reinforced Concrete:

All concrete used in this structure shall test 2500 p.s.i. after 28 days.

All reinforcing steel shall be of the deformed type, intermediate grade, new billet steel, and shall conform to the "Standard Specifications for Billet Steel Bars for Concrete Reinforcement" (A.S.T.M. Serial Designation: A15-39.) Bars shall be bent in the shop only, from bar bending diagrams. Bars shall lap 45 diameters at the splices.

The contractor shall submit four sets of bar setting plans and bar bending diagrams for approval before starting fabrication.

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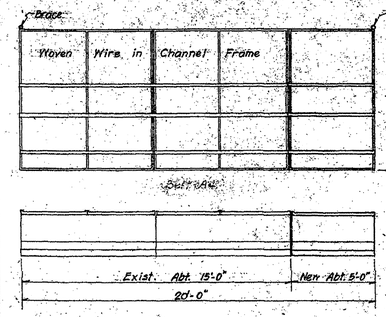
GROUT, SNYDER & CRANDALL
STRUCTURAL ENGINEERS
20 E. LEXINGTON ST.
BALTIMORE, MD.
Designed by Rouek

STATE OF MARYLAND
COMMISSION 4908
DATE OCT. 17, 1949

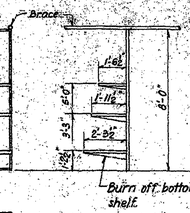
TRANSFER STATION FOR DELIVERY O
KIRK AND BONAPARTE AVES., BALT
CANOPY FRAMING PLAN

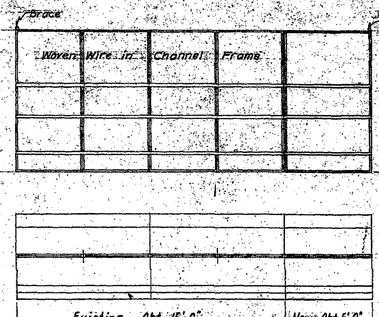
JAMES R. [illegible]
ARCHITECTS
130 W. HAMILTON STREET
BALTIMORE 1, MARYLAND

Existing partitions in basement of Centre St. Building

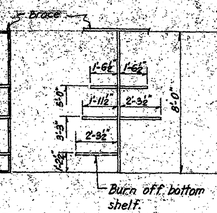


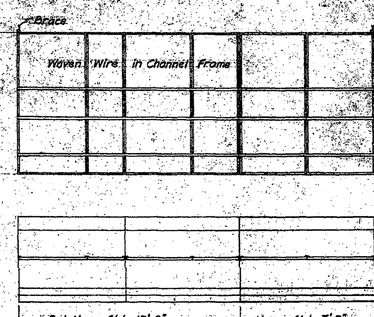
Mark MARK A



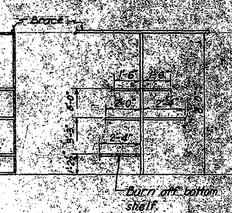


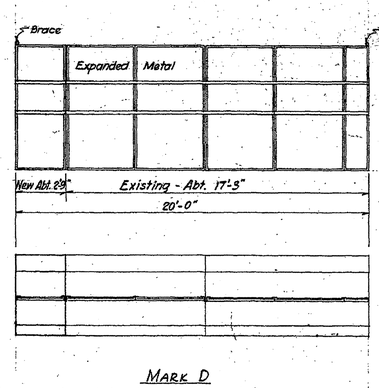
MARK B



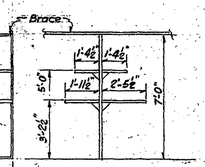


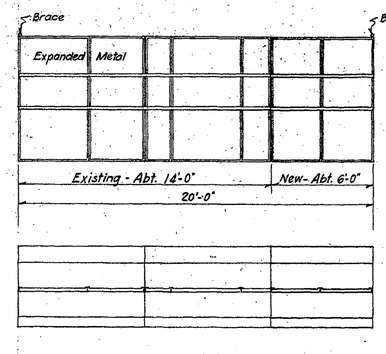
MARK C





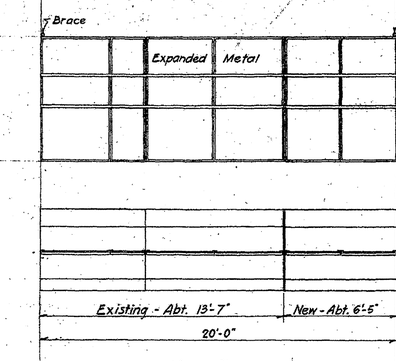
MARK D
One similar, but shelves on one side only



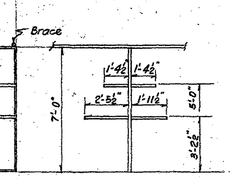


MARK E

Section same as for Mark D

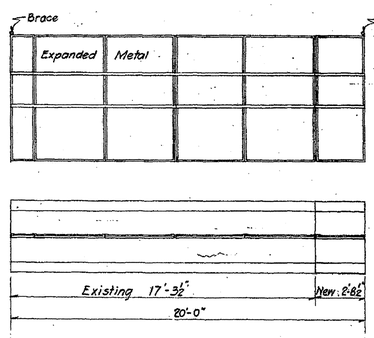


MARK F

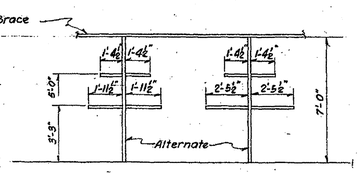


Notes.
All partitions to be 20'-0" long overall.
All other dimensions are approximate.
Braces between partitions are 1" diam. pipe welded to partitions.

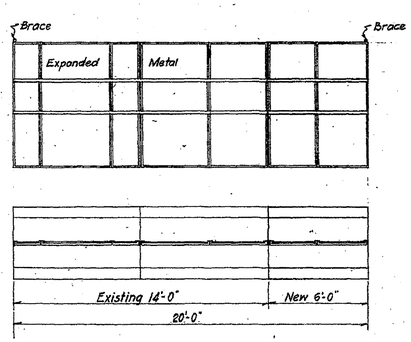
Existing partitions on second floor of Centre St Building



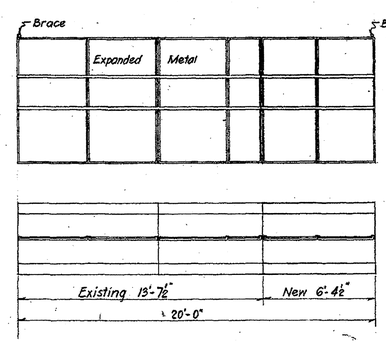
MARK G



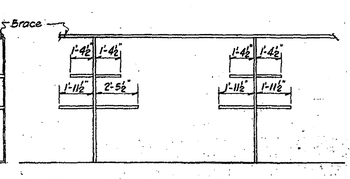
SECTION FOR G & H



MARK H

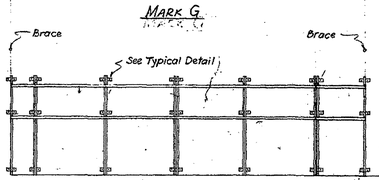


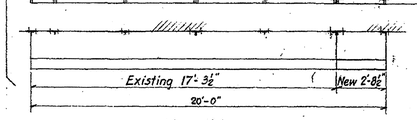
MARK K
MARK L



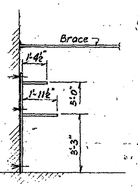
SECTION FOR K

SECTION FOR L

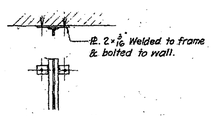




MARK M



SECTION FOR M



TYPICAL DETAIL OF CONNECTION TO WALL

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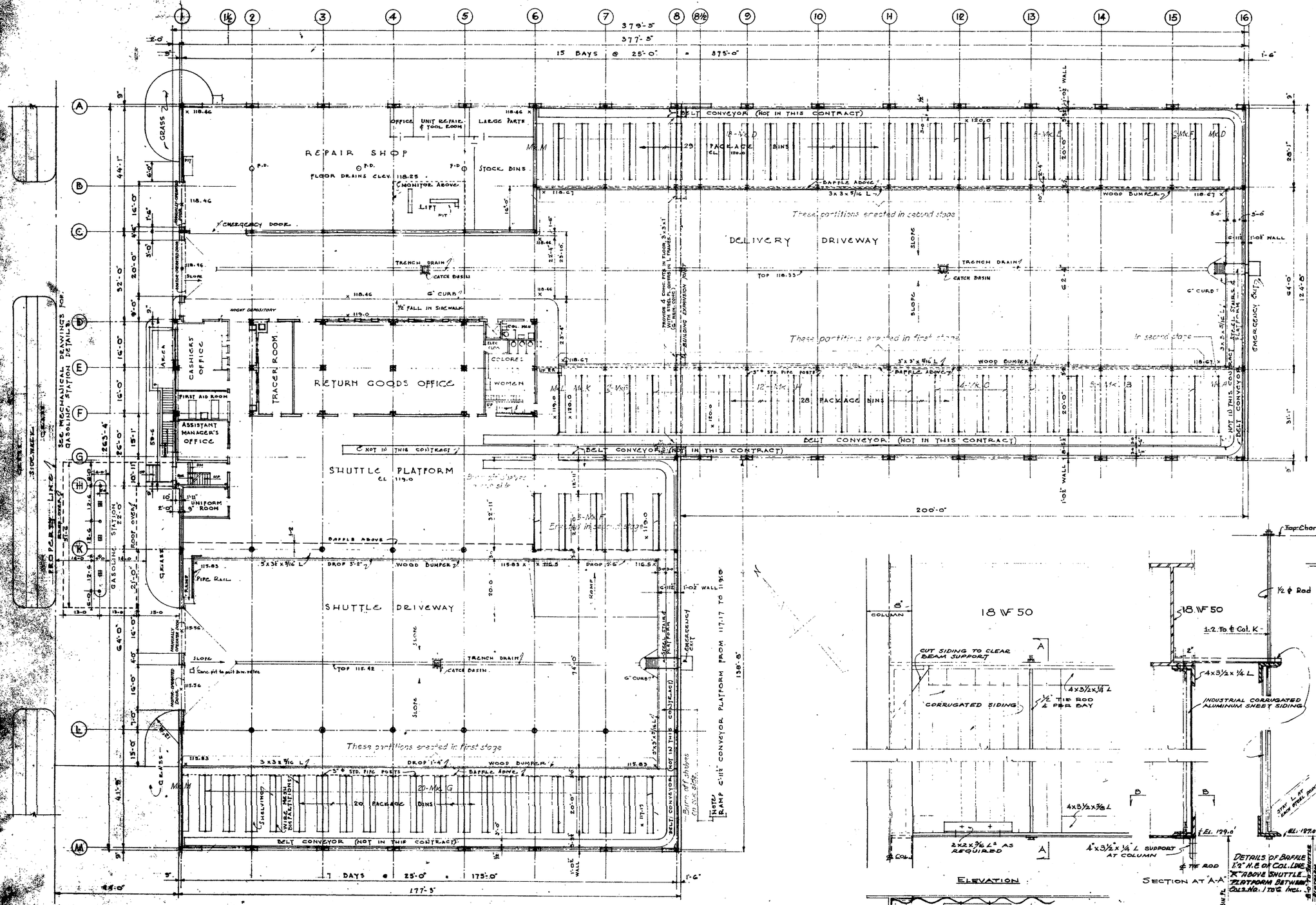
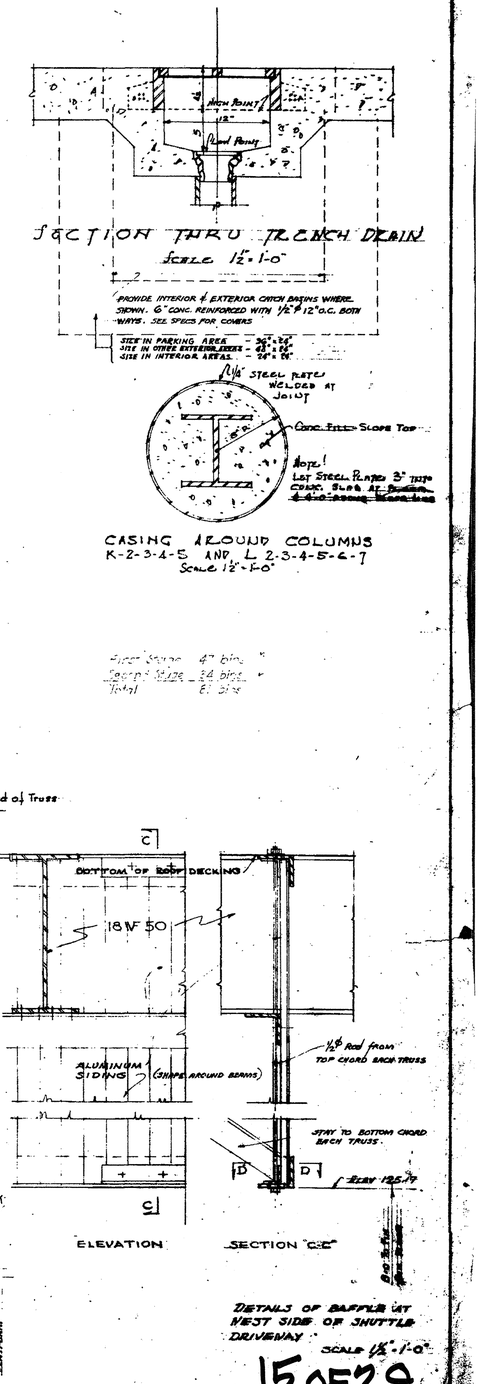
	PARTITION DETAILS	
SCALE ¼" = 1'-0"	DELIVERY OF BALTIMORE, INC. TRANSFER STATION	SHEET No. B1
REVISIONS	KIRK & BONAPARTE AVES. BALTIMORE, MD.	
DATE June 1950	CROUT, SNYDER & CRANDALL REGISTERED ENGINEERS 20 E. LEXINGTON ST. BALTIMORE 2, MD.	COMM. No. 1127-B



FIRST FLOOR PLAN
SCALE 1/16"=1'-0"



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PACKAGE BIN ARRANGEMENT

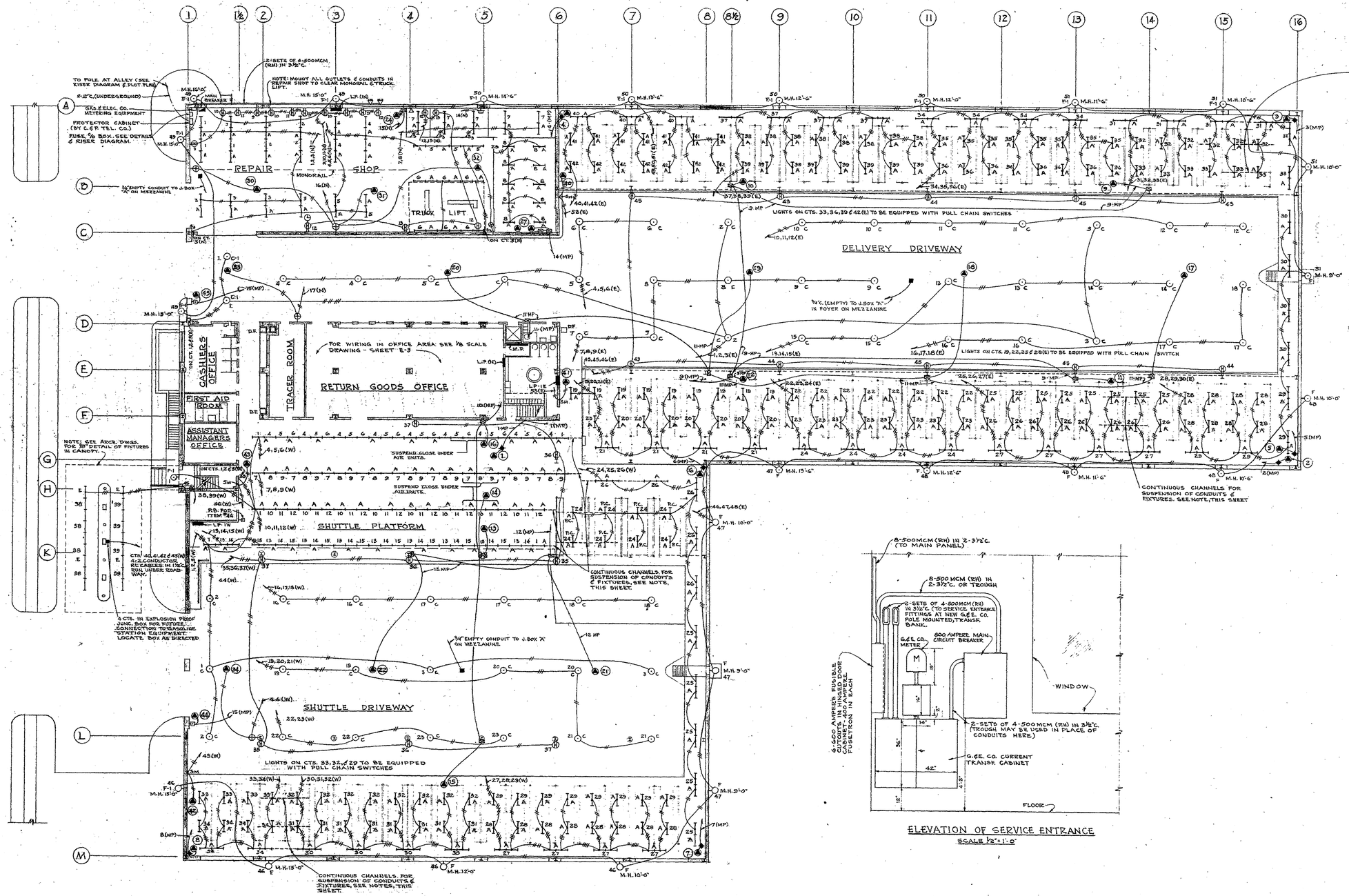
BOARD OF EXAMINERS FOR ARCHITECTS — STATE OF MARYLAND

TRANSFER STATION
For The DELIVERY BY RAILROAD
KIRK & BONDURANT AVES., BALTIMORE, MD.

FIRST FLOOR PLAN

COMMISSION 4908
DATE June
REGISTERED ARCHITECTS
BALTIMORE, MARYLAND

B-2



SYMBOLS

- SURFACE MOUNTED FLUORESCENT FIXTURE } NOTE SCALE ON SHEETS
- " " " " }
- DUPLEX RECEPTACLE - 15A-3P-125V
- " " " - 20A-3P-250V - TWISTLOCK
- S SINGLE POLE ROOM SWITCH
- S_3 THREE WAY " "
- S_4 FOUR WAY " "
- S_M MOTOR STARTING SWITCH
- MOTOR OUTLET
- (1) SPECIAL ITEM NUMBER
- CEILING OUTLET
- TELEPHONE OUTLET
- PUSH BUTTON
- PANEL
- CIRCUIT BREAKER
- BRACKET OUTLET
- CLOCK OUTLET
- 4" OUTLET BOX MOUNTED ON TRUSSES, FOR FUTURE PAGING SYSTEM OUTLETS
- CIRCUIT OR FEEDER CONDUIT TERMINATED IN BUSHING FOR CONNECTION TO EQUIPMENT UNDER ANOTHER CONTRACT. LEAVE 3'-0" OF CONDUCTOR SLACK AT END OF CONDUIT.
- STARTING EQUIPMENT (AS SPECIFIED)
- UNIT HEATER CONTROL
- SERVICE ENTRANCE FITTING
- WIRING IN CONDUIT RUN IN SLAB OR ON CEILING BELOW.
- WIRING IN CONDUIT RUN EXPOSED
- LAMP RECEPTACLE
- P.C. PULL CHAIN SWITCH

FIRST FLOOR PLAN & DETAIL

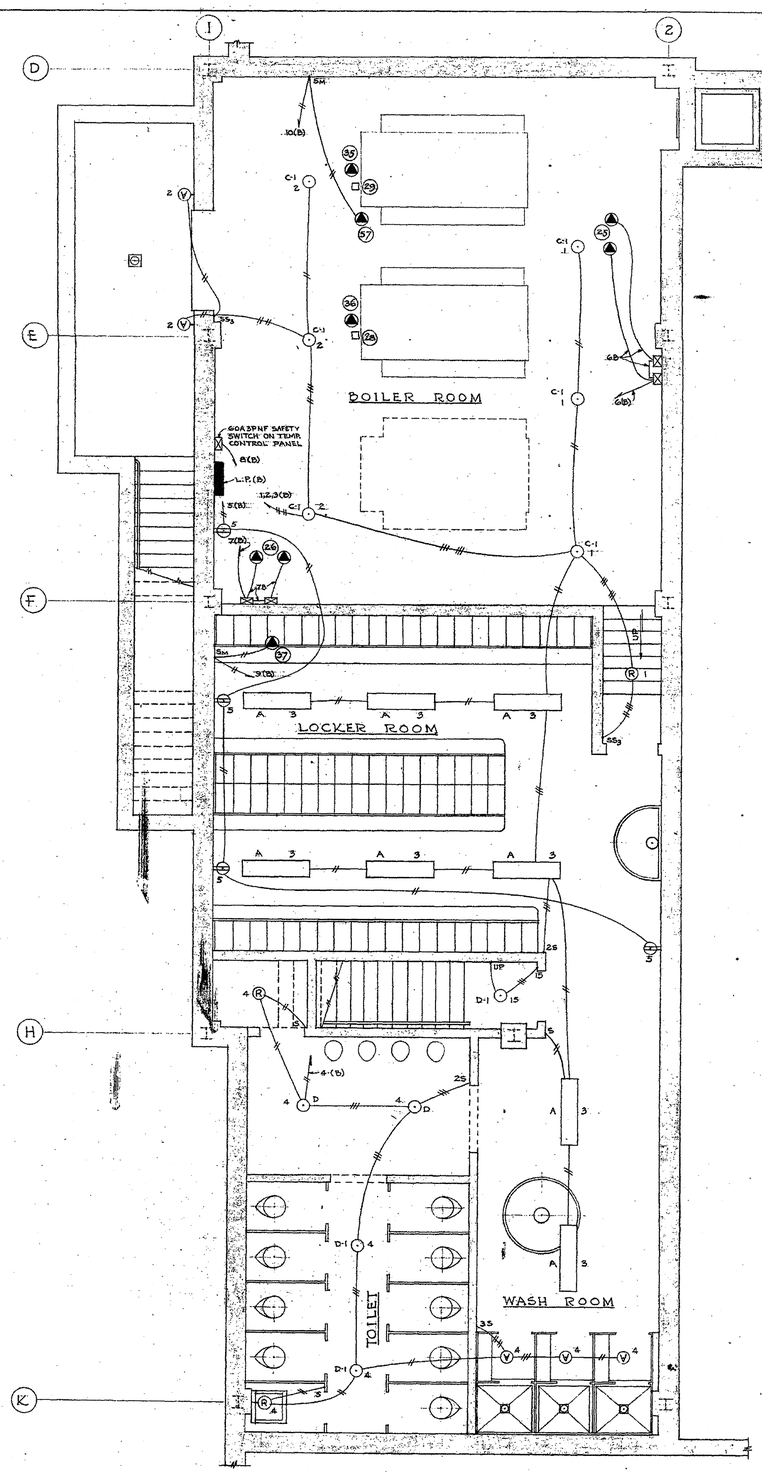
16 OF 29

TRANSFER STATION
FOR THE
DELIVERY of BALTIMORE INC.
KIRK & BONAPARTE AVES. BALTIMORE, MD.

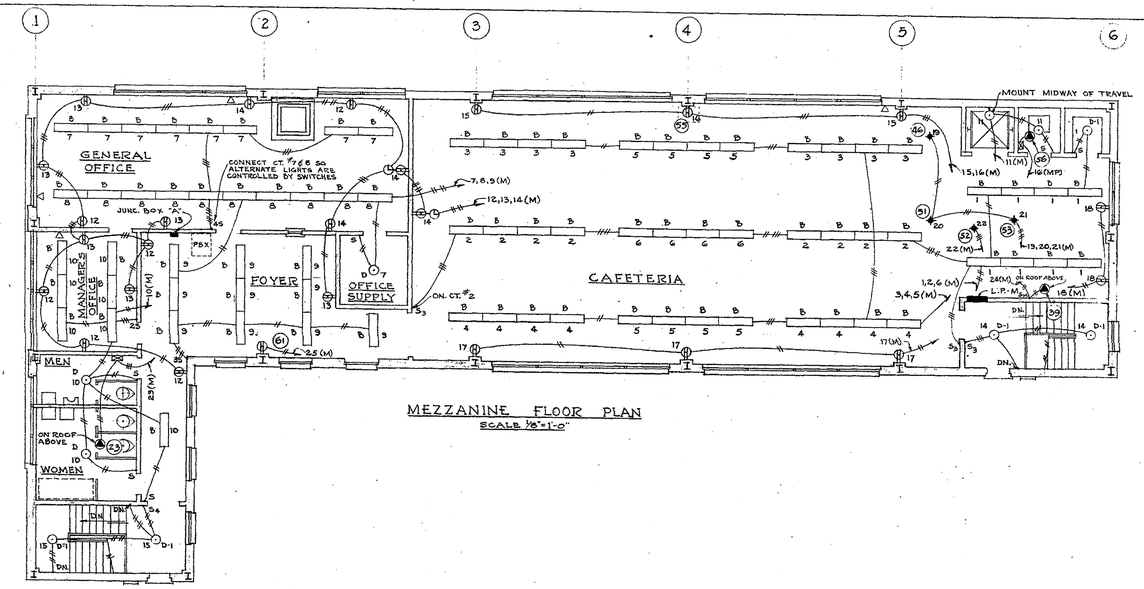
BOARD OF EXAMINERS AND REGISTRATION OF ARCHITECTS — STATE OF MARYLAND — 3

COMMISSION	JAMES R. EDMUNDS, JR. ARCHITECT	DRAWING
4908	HENRY ADAMS, INC. CONSULTING ENGINEERS BALTIMORE	F-2
DATE 10-17-49		

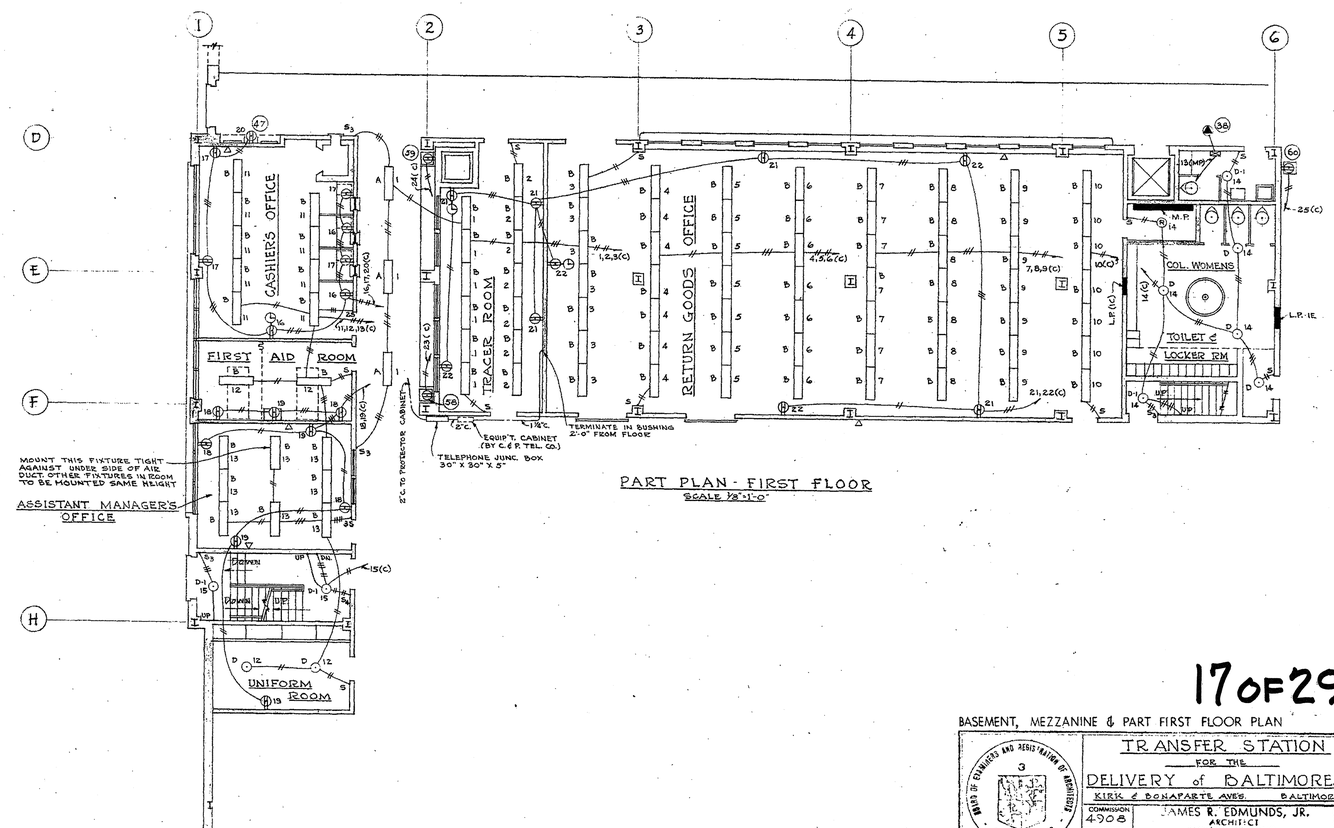
T-0705-0140



BASEMENT PLAN
SCALE 1/8"=1'-0"



MEZZANINE FLOOR PLAN
SCALE 1/8"=1'-0"



PART PLAN - FIRST FLOOR
SCALE 1/8"=1'-0"

17 OF 29

BASEMENT, MEZZANINE & PART FIRST FLOOR PLAN

TRANSFER STATION
FOR THE
DELIVERY of BALTIMORE, INC.
KIRK & BONAPARTE AVES. BALTIMORE, MD.

BOARD OF EXAMINERS AND REGISTRATION OF ARCHITECTS · STATE OF MARYLAND

COMMISSION 4908
DATE 10-17-49

JAMES R. EDMUNDS, JR.
ARCHITECT
HENRY ADAMS, INC.
CONSULTING ENGINEERS
BALTIMORE, MD.

DRAWING 5-3

EQUIPMENT & MOTOR SCHEDULE

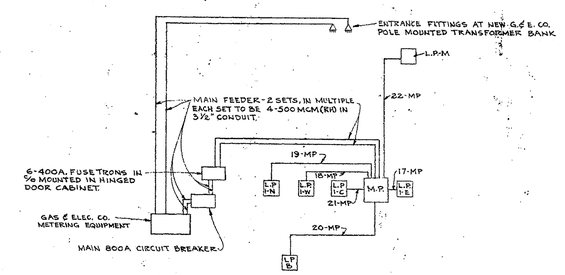
ITEM No	EQUIPMENT	H.P.	VOLTS	PHASE	STARTER TYPE	FEEDER OR CIRCUIT	SWITCH SIZE WHERE REQ'D.	WIRE SIZE TO MOTOR	LOCATION
1	CONVEYOR #1	1/2	208	3Φ-3W	BY OTHERS	1-MP	—	—	MAIN FLOOR
2	" #2	2	"	"	" "	2-MP	—	—	" "
3	" #3	1	"	"	" "	3-MP	—	—	" "
4	" #4	3	"	"	" "	4-MP	—	—	" "
5	" #5	3	"	"	" "	5-MP	—	—	" "
6	" #6	1	"	"	" "	6-MP	—	—	" "
7	" #7	1	"	"	" "	7-MP	—	—	" "
8	" #8	2	"	"	" "	8-MP	—	—	" "
9	HTG. & VENT. UNIT #1	5	"	"	A	9-MP	30ANF	6-#10(RH) IN 1"C.	DELIV. DRIVEWAY
10	" " " #2	5	"	"	"	"	"	" " " "	" "
11	" " " #3	5	"	"	"	"	"	" " " "	" "
12	" " " #4	5	"	"	"	"	"	" " " "	" "
13	" " " #5	3	"	"	"	10-MP	"	" " " "	SHUTTLE PLATFORM
14	" " " #6	3	"	"	"	"	"	" " " "	" "
15	" " " #7	5	"	"	"	"	"	" " " "	" DRIVEWAY
16	" " " #8	3	"	"	"	"	"	" " " "	" PLATFORM
17	EXH. VENT. UNIT #1	1 1/2	"	"	B	11-MP	NONE	3-#12(RH) IN 3/4"C.	DELIV. DRIVEWAY
18	" " " #2	"	"	"	"	"	"	" " " "	"
19	" " " #3	"	"	"	"	"	"	" " " "	" "
20	" " " #4	"	"	"	"	"	"	" " " "	" "
21	" " " #5	"	"	"	"	12-MP	"	" " " "	SHUTTLE DRIVEWAY
22	" " " #6	"	"	"	"	"	"	" " " "	" "
23	WHITE TOILET VENT FAN	3/4	"	"	C	23-M	WEATHERPROOF 30A-NF	3-#12(RH) IN 3/4"C.	ROOF
24	REPAIR SHOP EXH. FAN	1/2	"	"	B	13-1N	NONE	" " " "	REPAIR SHOP
25	CONDENSATE PUMP	2 @ 2 EA.	"	"	D	6-B	"	" " " "	BASEMENT
26	SUMP PUMP	2 @ 1 EA.	"	"	BY OTHERS	7-B	"	" " " "	"
27	AIR COMPRESSOR	2 @ 5 EA.	"	"	"	14-MP	1-60A NF	3-#10(RH) IN 3/4"C.	REPAIR SHOP
28	OIL IMMERSION HEATER	5 KW.	"	"	"	8-B	1-60A NF	—	BASEMENT
29	OIL IMMERSION HEATER	"	"	"	"	8-B	—	—	"
30	REPAIR SHOP UNIT HTR.	1/8	120	1Φ-2W	AS SPECIFIED	16-1N	—	2-#12(RH) IN 3/4"C.	REPAIR SHOP
31	" " " "	"	"	"	"	16-1N	—	" " " "	" "
32	" " " "	"	"	"	"	16-1N	—	" " " "	" "
33	ENTRANCE UNIT HTR.	"	"	"	"	17-1N	—	" " " "	ENTRANCE TO DELIV. DRIVEWAY
34	" " " "	"	"	"	"	44-1W	—	" " " "	ENTRANCE TO SHUTTLE DRIVEWAY
35	OIL BURNER	3/4	208	3Φ-3W	BY OTHERS	8-B	SEE ITEM #28	—	BASEMENT
36	" " " "	"	"	"	"	8-B		—	"
37	BASEMENT UNIT HTR.	1/8	120	1Φ-2W	SW	9-B	NONE	2-#12(RH) IN 3/4"C.	"
38	COLORED TOILET VENT FAN	1/2	208	3Φ-3W	C	13-MP	30A NF	3-#12(RH) IN 3/4"C	MAIN FLOOR
39	KITCHEN VENT FAN	1/2	"	"	SM	24-M	NONE	" " " "	ROOF
40	WATER CIRCULATOR	1/3	120	1Φ-2W	SM	52-1E	NONE	2-#12(RH) IN 3/4"C.	MAIN FLOOR
41	" "	1/3	"	1Φ-2W	"	53-1E	"	" " " "	" "
42	" "	"	"	"	"	45-1W	"	" " " "	" "
43	" "	"	"	"	"	46-1W	"	" " " "	" "
44	DOOR MOTOR	1	208	3Φ-3W	BY OTHERS	15-MP	30A 3PNF	3-#12(RH) IN 3/4"C	DOOR TO SHUTTLE DRIVEWAY
45	" " " "	"	"	"	"	"	"	" " " "	DOOR TO DELIVERY DRIVEWAY
46	CASH REGISTER	—	120	1Φ-2W	NONE	19-M	NONE	—	
47	TIME CLOCK	"	"	"	"	20-1C	RECEPT.	2-#12(RH) IN 3/4"C.	DELIV. DRIVEWAY
48	GASOLINE PUMP	1/3	"	"	BY OTHERS	40-1W	NONE	—	OUTSIDE
49	" "	"	"	"	"	41-1W	"	—	"
50	" "	"	"	"	"	42-1W	"	—	"
51	ICE CREAM CABINET	"	"	"	"	20-M	"	—	CAFETERIA - MEZZ.
52	BACK BAR	5 KW	208	1Φ-3W	"	22-M	"	—	" "
53	COOKS TABLE	1/6	120	1Φ-2W	"	21-M	"	—	" "
54	REFRIGERATOR	1/3	"	"	"	18-M	RECEPT.	—	" "
55	WATER COOLER	1/8	"	"	NONE	16-M	"	—	" "
56	ELEVATOR PUMP	7 1/2	208	3Φ-3W	BY OTHERS	16-MP	100A-3P-NF.	—	MEZZ.
57	DOMESTIC HOT WATER CIRCULATOR	1/6	120	1Φ-2W	SW & AQUASTAT AS SPECIFIED	10-B	NONE	—	BASEMENT
58	WATER COOLER	1/8	"	"	NONE	23-1C	RECEPT.	—	MAIN FLOOR
59	" "	"	"	"	"	24-1C	"	—	" "
60	" "	"	"	"	"	25-1C	"	—	"
61	" "	"	"	"	"	25-M	"	—	MEZZ. FOYER

SPECIAL BRANCH CIRCUIT & SUB-FEEDER SCHEDULE

CT. No	FROM	FEEDING	CONDUCTORS NO	TYPE	SIZE	CONDUIT	CT. BKR. CONTROL FRAME	CAL.	PHASE FEED	VOLTS
1	M.P.	ITEM #1	3	RW	#12	3/4"	50A-3P	15A	3Φ-3W	208
2	"	" 2	"	"	"	"	"	"	"	"
3	"	" 3	"	"	"	"	"	"	"	"
4	"	" 4	"	"	"	"	"	20A	"	"
5	"	" 5	"	"	"	"	"	"	"	"
6	"	" 6	"	"	"	"	"	15A	"	"
7	"	" 7	"	"	"	"	"	"	"	"
8	"	" 8	"	"	"	"	"	"	"	"
9	"	" 9,10,11 & 12	"	RH	#4	1 1/2"	100A-3P	90A	"	"
10	"	" 13,14,15 & 16	"	"	#6	1"	"	70A	"	"
11	"	" 17,18,19 & 20	"	"	#10	3/4"	50A-3P	30A	"	"
12	"	" 21 & 22	"	"	#12	"	"	20A	"	"
13	"	" 38	"	"	"	"	"	15A	"	"
14	"	" 27	"	"	#8	"	100A-3P	70A	"	"
15	"	" 44 & 45	"	"	#12	"	50A-3P	15A	"	"
16	"	" 56	"	"	#8	"	100A-3P	50A	"	"
17	"	LP-1E	4	"	#1/0	2"	225A-3P	150A	3Φ-4W	120/208
18	"	LP-1W	"	"	"	"	"	"	"	"
19	"	LP-1N	"	"	#4	1 1/2"	100A-3P	70A	"	"
20	"	LP-B	"	"	#2	2"	"	90A	"	"
21	"	LP-1C	"	"	#6	1 1/2"	"	50A	"	"
22	"	LP-M	"	"	#4	1 1/2"	"	70A	"	"
16	LP-M	ITEM 55	2	RH	#12	3/4"	50A-1P	15.0A	1Φ-2W	120
18	"	" 54	"	"	"	"	"	"	"	"
19	"	" 46	"	"	"	"	"	"	"	"
20	"	" 51	"	"	"	"	"	"	"	"
21	"	" 53	"	"	"	"	"	"	"	"
22	"	" 52	3	RH	#10	"	50A-2P	30.0A	1Φ-3W	120/208
23	"	" 23	"	"	#12	"	50A-3P	15.0A	3Φ-3W	208
24	"	" 39	"	"	"	"	"	"	"	"
25	"	" 61	2	"	"	"	50A-1P	"	1Φ-2W	120
52	LP-1E	" 40	"	"	"	"	"	"	"	"
53	"	" 41	"	"	"	"	"	"	"	"
40	LP-1W	" 48	"	RL	"	SEE NOTES ON DWG.	50A-2P	"	"	"
41	"	" 49	"	"	"	"	"	"	"	"
42	"	" 50	"	"	"	"	"	"	"	"
43	"	L.T.S. ON GAS PUMPS	"	"	"	"	"	"	"	"
44	"	ITEM 34	"	RH	"	3/4"	50A-1P	"	"	"
45	"	" 42	"	"	"	"	"	"	"	"
46	"	" 43	"	"	"	"	"	"	"	"
20	LP-1C	" 47	"	"	"	"	"	"	"	"
23	"	" 58	"	"	"	"	"	"	"	"
24	"	" 59	"	"	"	"	"	"	"	"
25	"	" 60	"	"	"	"	"	"	"	"
14	LP-1N	120/208 RECEPT.	3	"	"	3/4"	50A-2P	"	1Φ-3W	120/208
15	"	ITEM 24	3	"	"	"	50A-3P	"	3Φ-3W	208
16	"	" 30,31 & 32	2	"	"	"	50A-1P	20A	1Φ-2W	120
17	"	" 33	2	"	"	"	"	15A	"	"
6	LP-B	" 25	3	"	"	"	50A-3P	25.0A	3Φ-3W	208
7	"	" 26	"	"	"	"	"	15.0A	"	"
8	"	" 28,29,35,36	4	"	#8	1"	100A-3P	50.0A	"	"
9	"	" 37	2	"	#12	"	50A-1P	15.0A	1Φ-2W	120
10	"	" 57	"	"	"	"	"	"	"	"

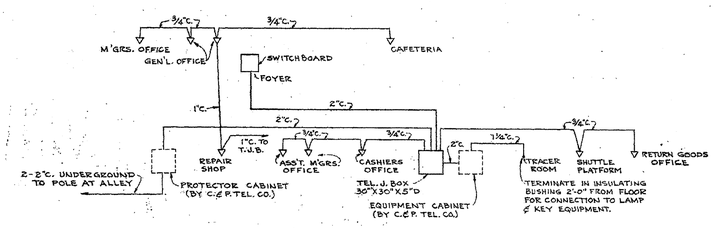
PANEL SCHEDULE

PANEL	BRANCH CT. EQUIP'T.	BRANCH CIRCUITS NO.	POLES	FRAME	CAL.	VOLTS	MAINS TYPE	MAINS CAP.	PHASE FEED	VOLTS	TYPE	REMARKS
L.P. 1W	CT. BREAKER	24	1	50A	15A	120	LUGS	100A	3Φ-4W	120/208	SURFACE	2-SECTION PANEL SINGLE TRIM
		24	1	"	"	"	"	200A				
		4	2	"	"	"						
L.P. 1E	CT. BREAKER	32	1	50A	15A	120	LUGS	200A	3Φ-4W	120/208	FLUSH	2-SECTION PANEL SINGLE TRIM
		28	1	"	"	"	"	100A				
L.P. M	CT. BREAKER	28	1	50A	15A	120	LUGS	200A	3Φ-4W	120/208	FLUSH	
		2	2	50A	30A	208						
		4	3	"	15A	"						
L.P. B	CT. BREAKER	12	1	50A	15A	120	LUGS	100A	3Φ-4W	120/208	SURFACE	
		4	3	"	"	208						
		1	"	"	25A	"						
		1	"	100A	50A	"						
L.P. 1C	CT. BREAKER	32	1	50A	15A	120	LUGS	200A	3Φ-4W	120/208	FLUSH	
L.P. 1N	CT. BREAKER	20	1	50A	15A	120	LUGS	100A	3Φ-4W	120/208	SURFACE	
		2	1	"	20A	"						
		2	2	"	15A	208						
		"	3	"	"	"						
M. P.	CT. BREAKER	12	3	50A	15A	208	2 SETS OF 400A LUGS ON 1200A MAIN COPPER		3Φ-4W	120/208	SURFACE	
		4	"	"	20A	"						
		2	"	"	30A	"						
		4	"	100 A	50 A	"						
		6	"	"	70 A	"						
		4	"	"	90 A	"						
		3	"	225 A	150 A	"						



SCHEMATIC RISER DIAGRAM

NO SCALE



TELEPHONE RISER DIAGRAM

NO SCALE

SCHEDULES & DETAILS

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TRANSFER STATION

FOR THE

DELIVERY of BALTIMORE, INC.

KIRK & BONAPARTE AVES BALTIMORE, MD.

COMMISSION 4908 | DATE 10-17-49

JAMES R. EDMUNDS, JR. ARCHITECT
HENRY ADAMS, INC. CONSULTING ENGINEERS BALTIMORE, MD.

BOARD OF EXAMINERS AND REGISTRATION OF ARCHITECTS — STATE OF MARYLAND

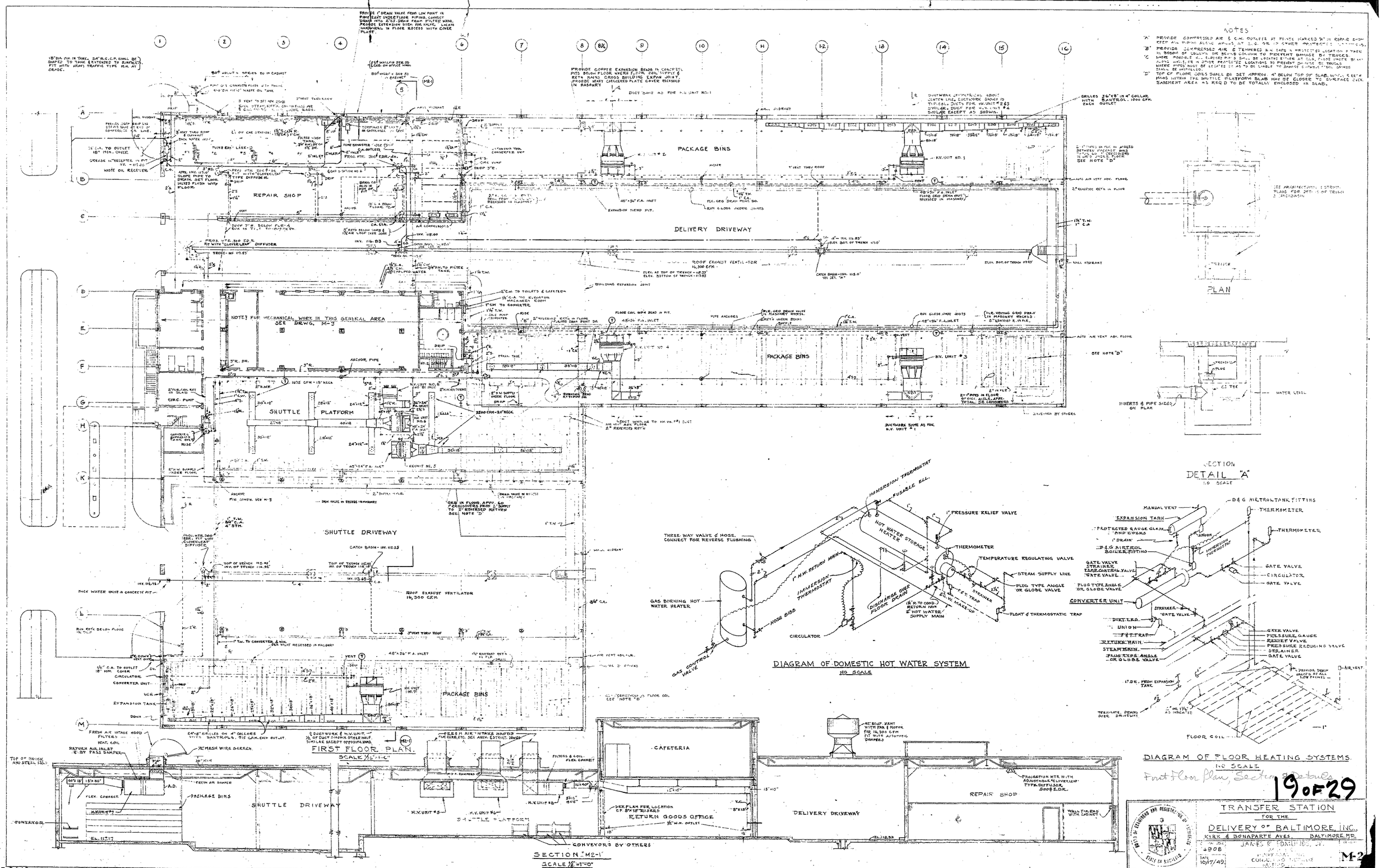
NOTES

"A" PROVIDE COMPRESSED AIR & C.W. OUTLETS AT POINTS MARKED "A" IN REPAIR SHOP KEEP ALL PIPING ALONG WALLS AT 2'-0" OR IN OTHER INCONSPICUOUS LOCATIONS.

"B" PROVIDE COMPRESSED AIR & TEMPERED H.W. TAPS IN VANITIES LOCATION IN THEIR BOSOM OF COLUMN OR BEHIND COLUMN TO PREVENT DAMAGE BY TRUCKS.

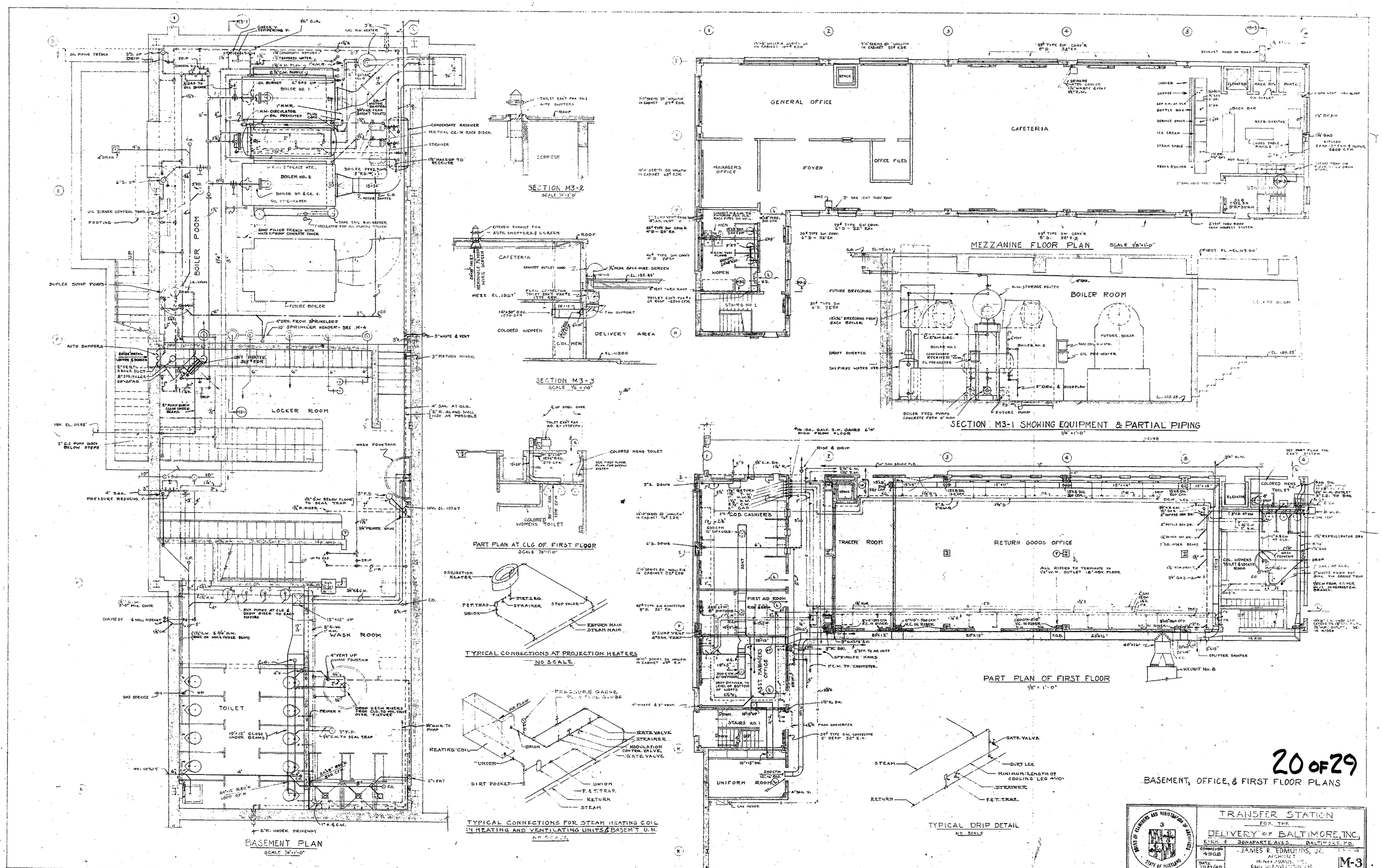
"C" SHOP MODELS & ELEVATOR PIT & SHALL BE LOCATED EITHER AT COL. FLOOR UNDER BUILDING WHERE PIPES MUST BE LOCATED IN AS TO BE LIABLE TO DAMAGE COMPACTED GRAVEL SHALL BE INSTALLED.

"D" TOP OF FLOOR COILS SHALL BE SET APPROX. 4" BELOW TOP OF SLAB, WHICH IS EQUAL WITH THE SHUTTLE PLATFORM SLAB MAY BE CLOSER TO SURFACE OVER BASEMENT AREA AS REQ'D TO BE TOTALLY ENCLOSED IN SLAB.



Fact Floor Plan, Section & Details

19 of 29



20 OF 29

BASEMENT, OFFICE, & FIRST FLOOR PLANS

TRANSFER STATION
FOR THE
DELIVERY OF BALTIMORE, INC.
KIRK & BONAPARTE AVES. BALTIMORE, MD.

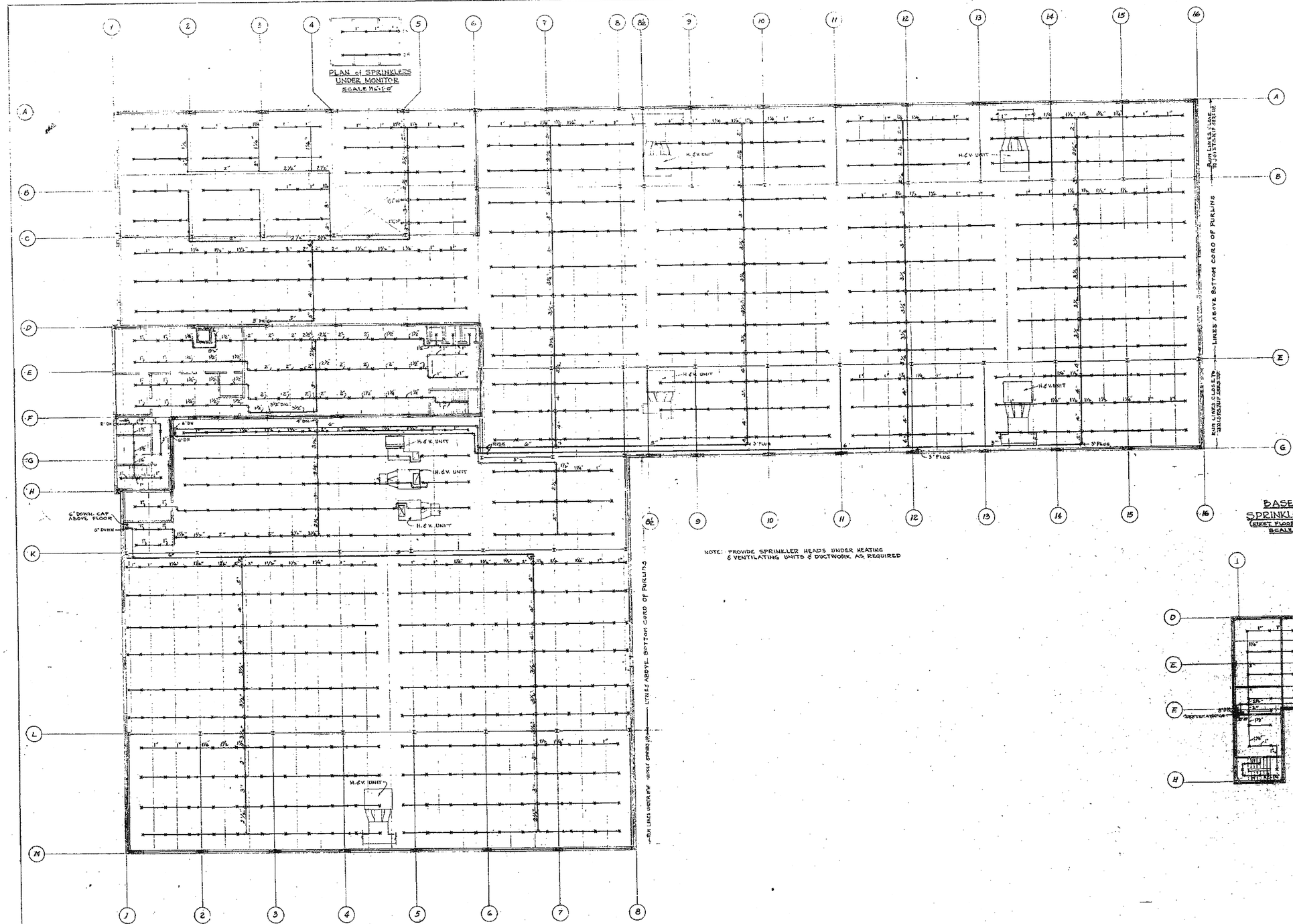
JAMES R. EDMUNDS, JR.
ARCHITECT
HENRY ADAMS, INC.
CIVIL & MECHANICAL ENGINEERS

COMMISSION 4908
DATE 10/1/49

M-3

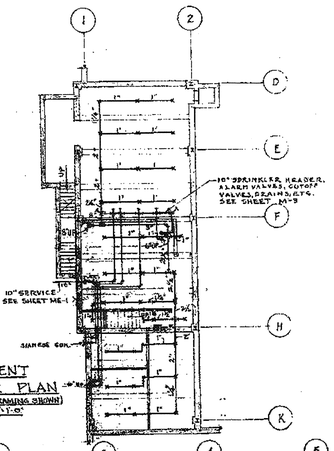
H.A.-8585

T-0705-0140

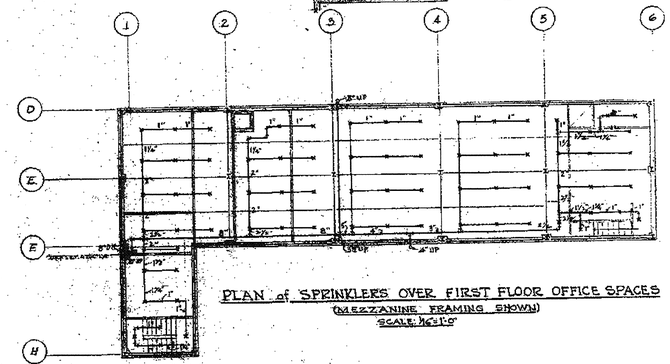


PLAN of SPRINKLERS OVER DELIVERY, GARAGE, SHUTTLE & MEZZ. SPACES
(ROOF FRAMING SHOWN)
SCALE 1/16"=1'-0"

NOTE: PROVIDE SPRINKLER HEADS UNDER HEATING & VENTILATING UNITS & DUCTWORK AS REQUIRED



BASEMENT
SPRINKLER PLAN
(FIRST FLOOR FRAMING SHOWN)
SCALE 1/16"=1'-0"



PLAN of SPRINKLERS OVER FIRST FLOOR OFFICE SPACES
(MEZZANINE FRAMING SHOWN)
SCALE 1/16"=1'-0"

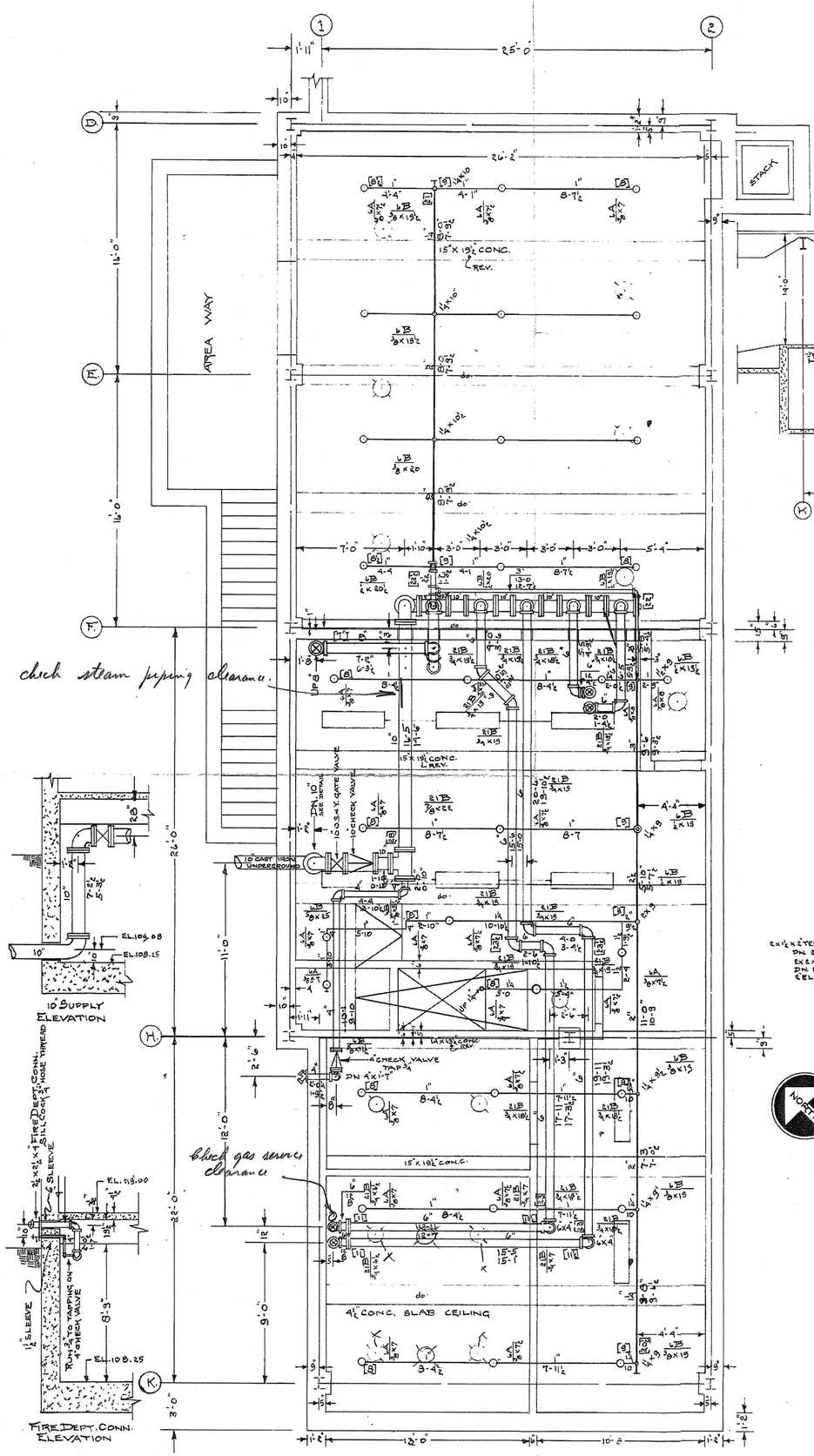
21 OF 29
PLAN OF SPRINKLERS

TRANSFER STATION
FOR THE
DELIVERY OF BALTIMORE, INC.,
KIRK & BONAPARTE AVES. BALTIMORE, MD.

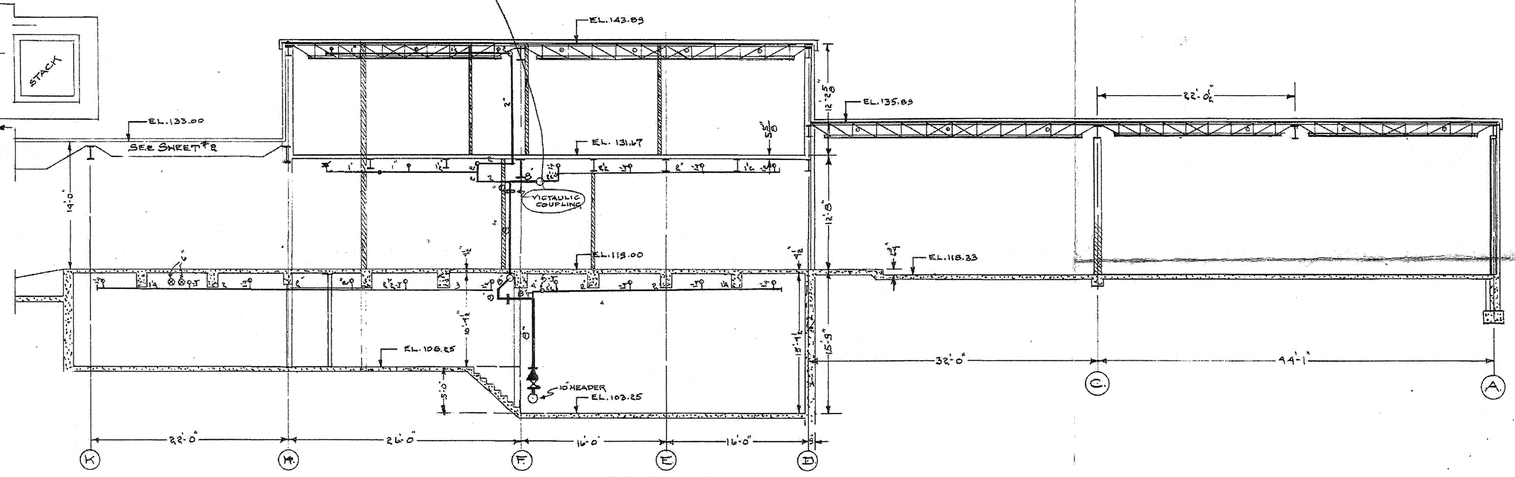
COMMISSION 4908
DATE 10/27/49
JAMES R. EDMUNDS, JR.
ARCHIT-CT
HENRY ADAMS, INC.
CONSULTING ENGINEERS
BALTIMORE, MD.
DRAWING M-4

H.A.-8526.

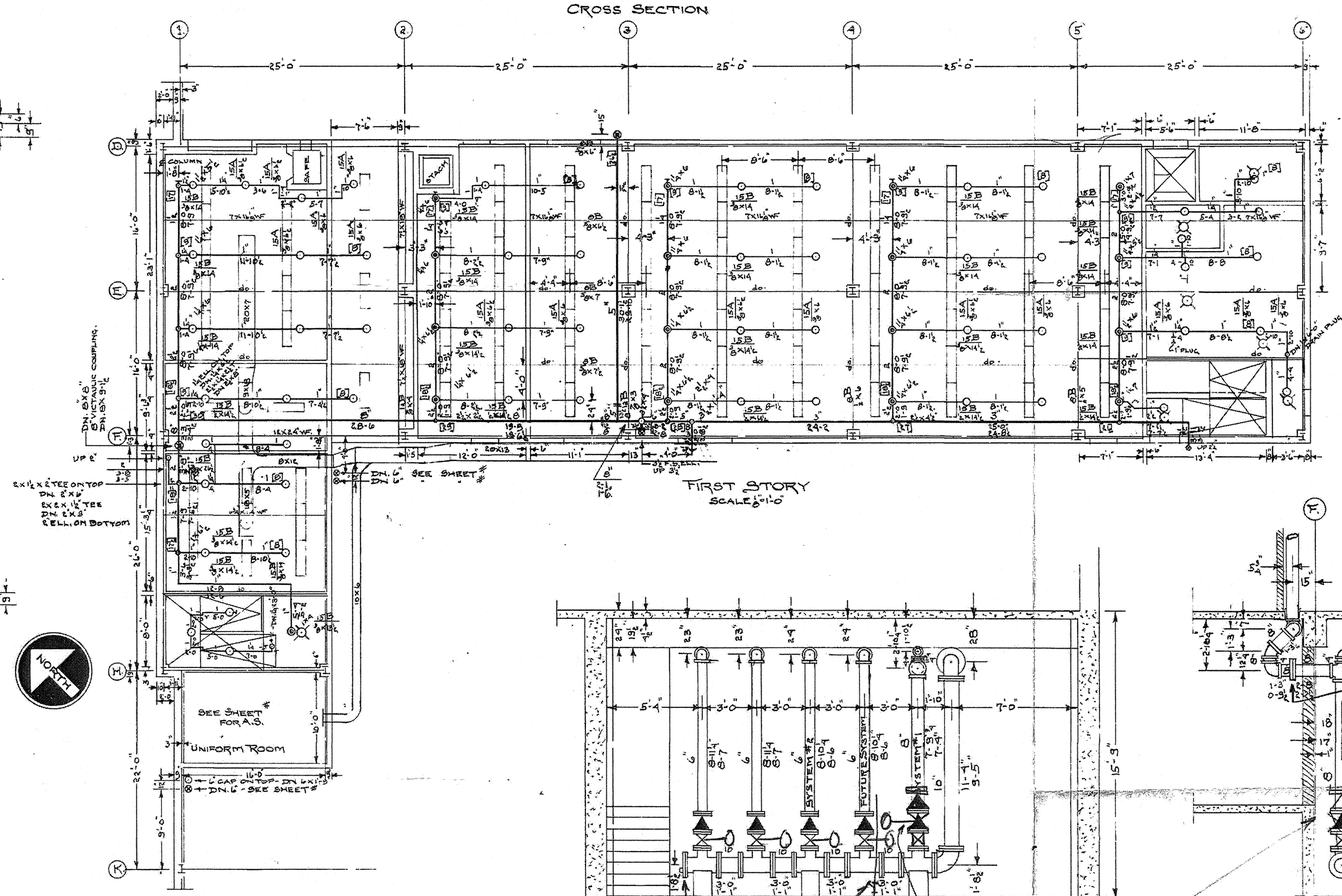
Is this coupling approved by Factory Mutual? What material is used for gasket? Unless req'd for some special reason this office will insist on flanged or screwed connection.
H.A. Inc.
Ind.



BASEMENT
SCALE ¼"=1'-0"



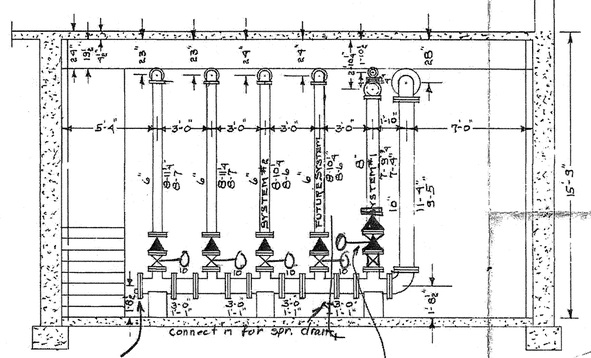
CROSS SECTION



FIRST STORY
SCALE ¼"=1'-0"

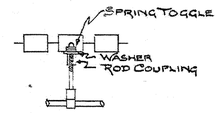
NOTES:- PIPES THRU STRUCTURAL WALLS TO HAVE STEEL PIPE SLEEVES, THE END OF SLEEVES TO BE FLUSH WITH WALL SURFACES. PIPE THRU PARTITIONS TO HAVE #20GA. GALV. IRON THIMBLES. PIPES PASSING THRU FLOORS SHALL HAVE STEEL PIPE SLEEVES EXTENDING 3" ABOVE FINISHED FLOOR.

NOTE: FIGURES IN [X] INDICATE DISTANCE DOWN IN INCHES FROM FINISHED CEILING TO ℄ OF PIPE FOR DETAIL #4B HANGER SEE SHEET #3

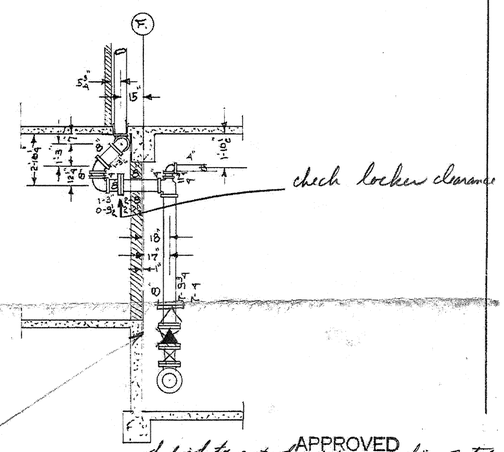


HEADER DETAIL

Raise valves to allow handwheels on gate valves to be located close to wall thus allowing maximum passage space between sprinkler heater assembly and future boiler.



#15A OR B HANGER FOR ROBERTSON DECKING

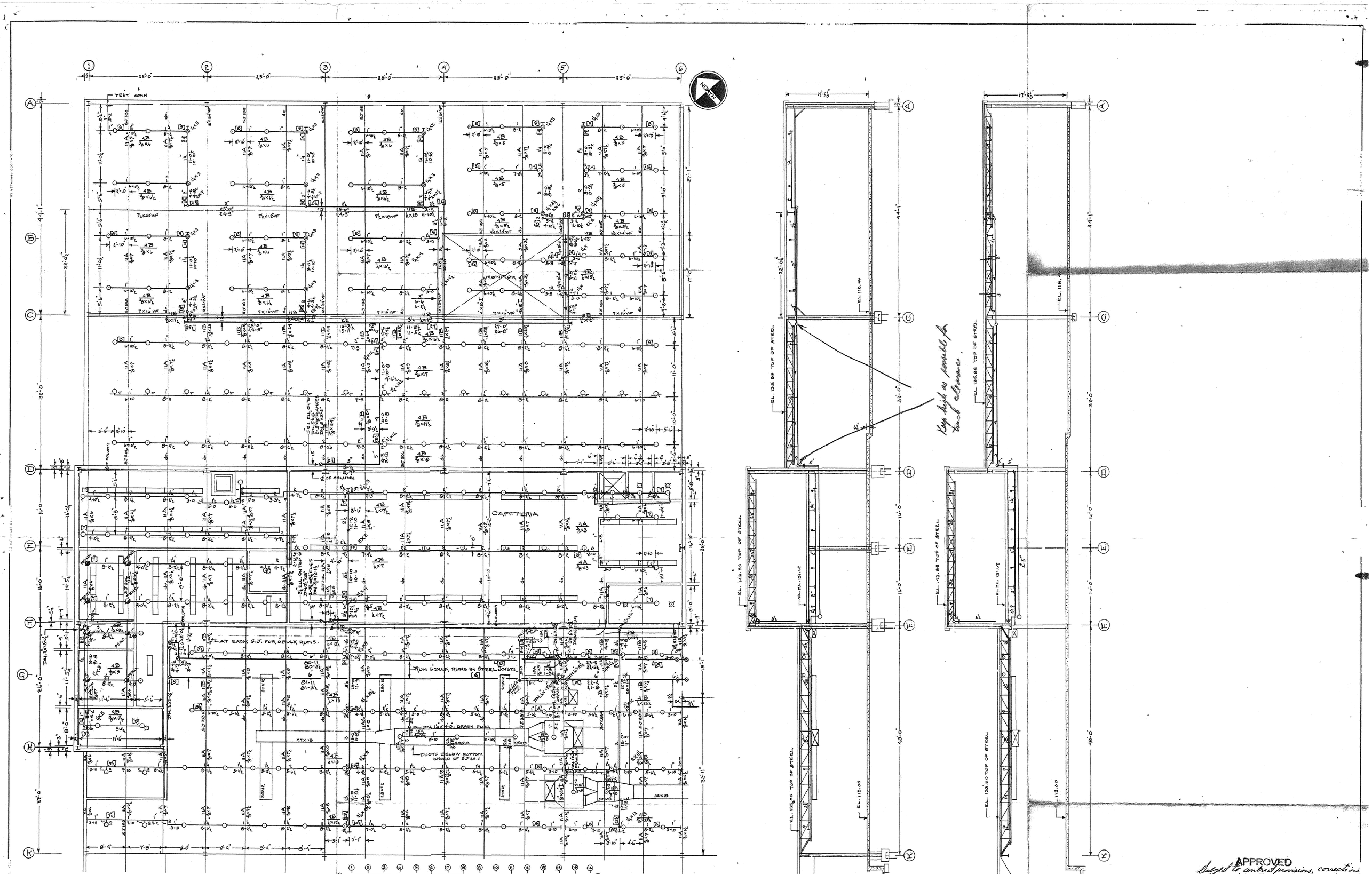


APPROVED
Subject to contract provisions, conditions noted and Underwriter Approval
MAY 1 1950
HENRY ADAMS, INC.
By

22 OF 29

BASEMENT + FIRST STORY - SYSTEM #1

REGULAR 160	107	MORROW BRO'S INC. 2315 N. CHARLES ST., BALTIMORE, MD.
		DELIVERY OF BALTIMORE, INC. KIRK AND BONAPARTE AVES., BALTIMORE, MD.
		TRANSFER WAREHOUSE JAN. 1950
		AS NOTED PLANS. A.W.S.
		AS NOTED 1/5 AS
		CONTRACT NO 8126
		CUSTOMER'S NO 273
NATURE OF REVISION		ROCKWOOD SPRINKLER CO. AUTOMATIC SPRINKLER & WATER H&L SYSTEMS 112 SOUTH 12TH STREET PHILADELPHIA, PA.
REVISIONS	107	



NOTE: FIGURES IN [ ] INDICATE DISTANCE DOWN IN INCHES FROM FINISHED CEILING TO ℄ OF PIPE. FOR DETAIL #1B HANGER SEE SHEET #8

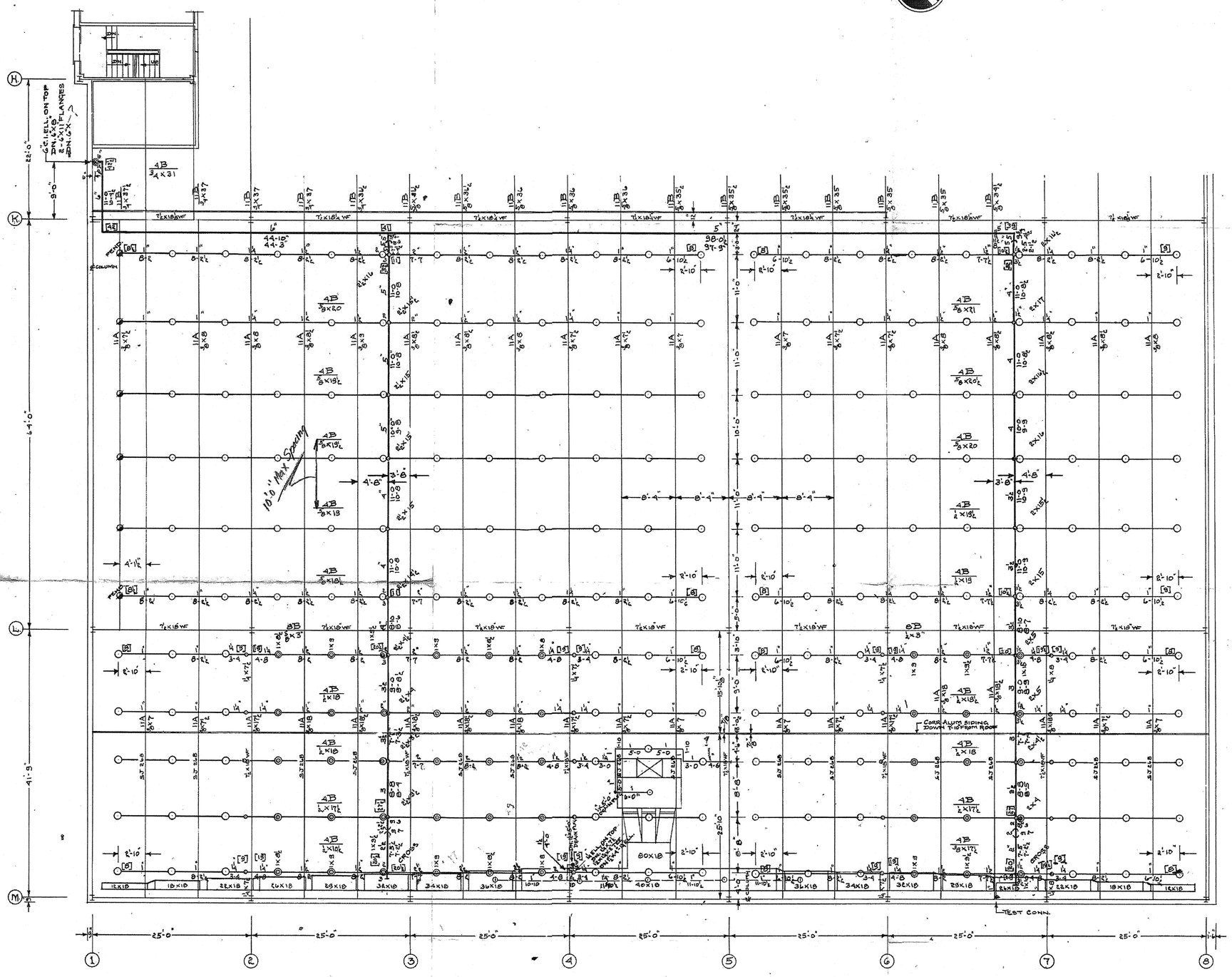
APPROVED
Subject to contract provisions, corrections noted and Underwriters Approval
MAY 1 1950
HENRY ADAMS, INC.
By E.D.H.

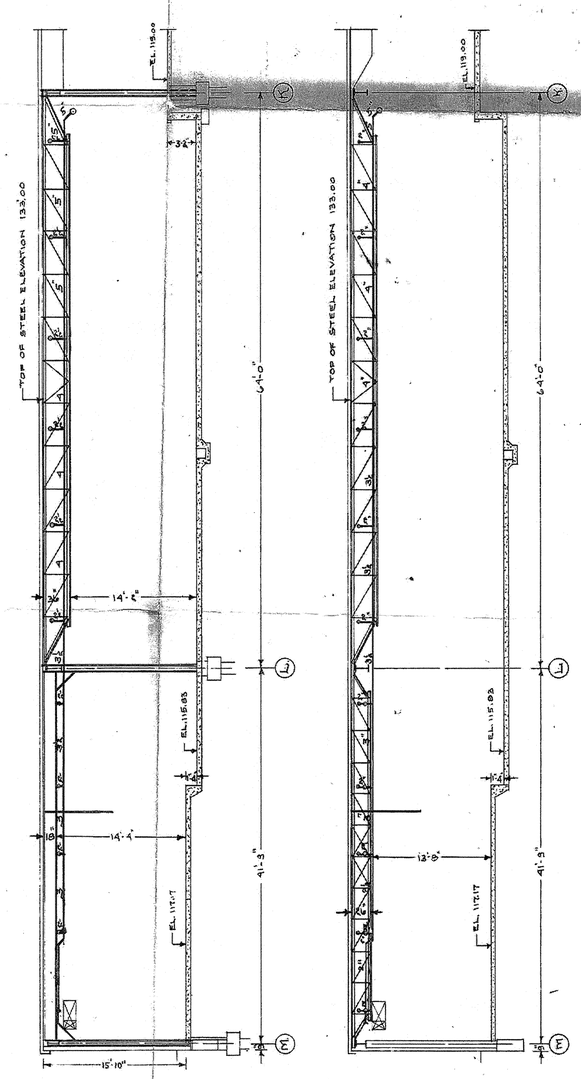
23 OF 29

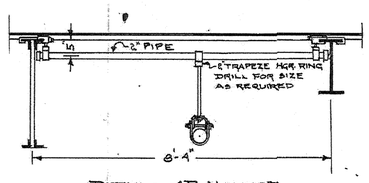
ROOF
SYSTEM #1

MORROW BROS. INC. 2315 N CHARLES ST. BALTIMORE, MD.		
DELIVERY OF BALTIMORE, INC. KIRK AND BONAPARTE AVES., BALTIMORE, MD.		
TRANSFER WAREHOUSE,	JAN. 1950	
AS NOTED	1/8"=1'-0"	2 5 AS
PLANS		
A.W.S.		
F.I.A.+ MD. DF.		
CONTRACT NO 8126	ROCKWOOD SPRINKLER CO. AUTOMATIC SPRINKLER & WATER FOG SYSTEMS 112 SOUTH 16TH STREET PHILADELPHIA, PA.	
CUSTOMERS NO 8773		

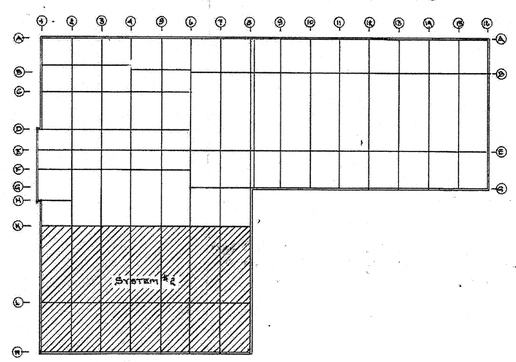
NATURE OF REVISION		
REVISIONS	TOTAL	849







DETAIL- 4B HANGER



APPROVED
Subject to conditions noted, contract provisions and Factory Mutual Approval
APR 28 1950
HENRY ADAMS, INC.
By

APPROVED
Subject to contract provisions, conditions noted and Underwriters Approval
MAY 1 1950
HENRY ADAMS, INC.
By

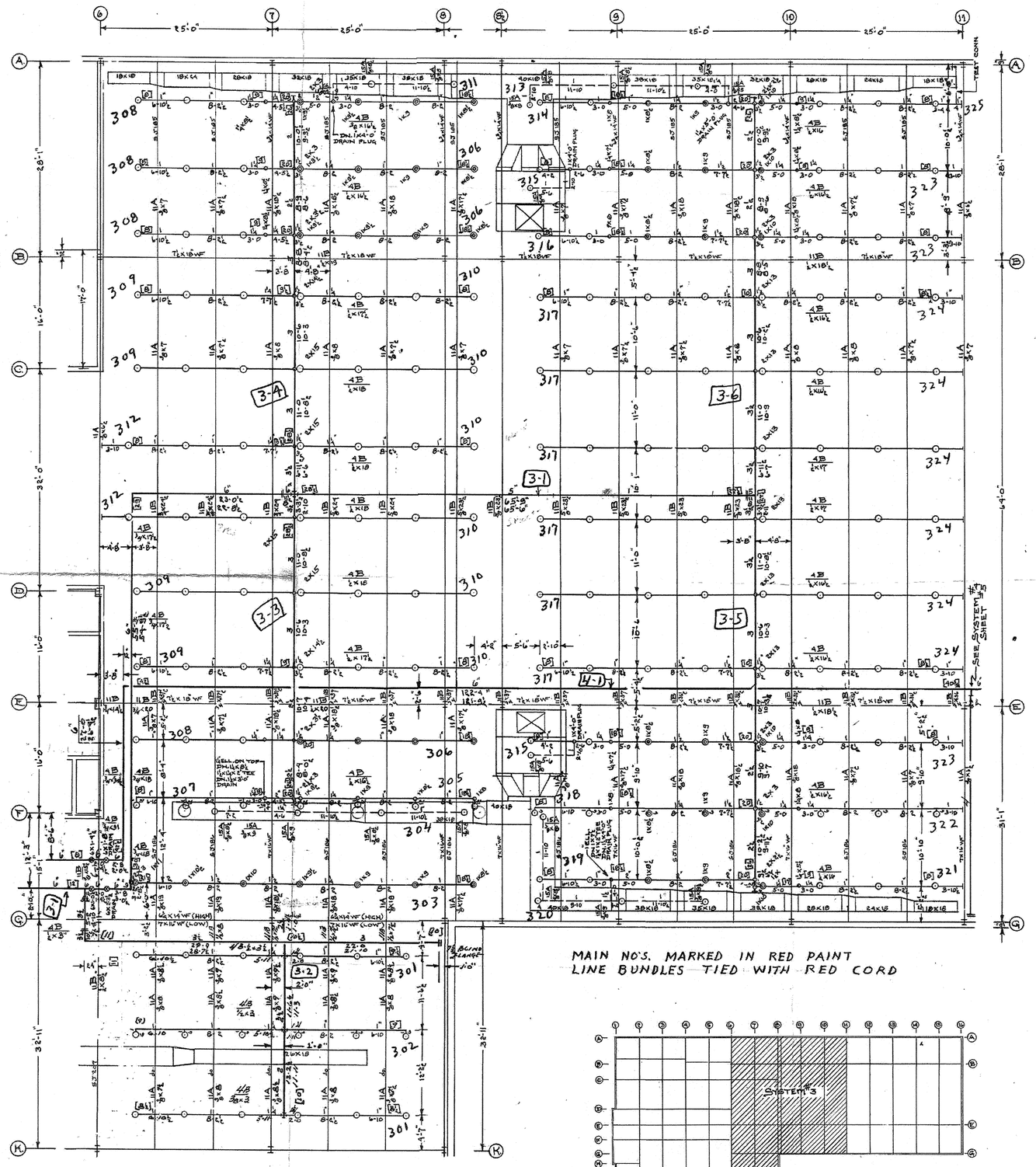
NOTE: FIGURES IN [X] INDICATE DISTANCE DOWN IN INCHES FROM FINISHED CEILING TO ℄ OF PIPE.

24 OF 29 SYSTEM #2

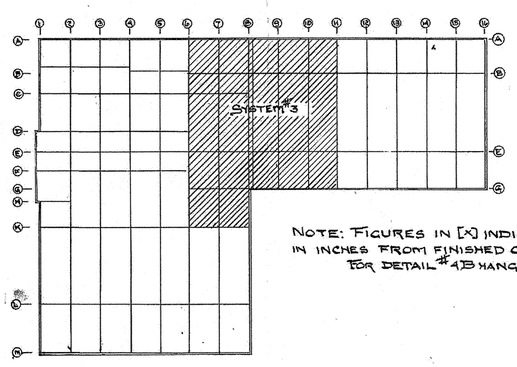
SYMBOL AND DATE	NATURE OF REVISION	SPRINKLER OR WATER FOG HEADS TYPE	NUMBER
	REVISIONS	REQ. 160°	231
		PEND. 160°	6
		TOTAL	237

CONTRACT WITH: MORROW BROS. INC. 2315 N. CHARLES ST., BALTIMORE, MD.
PROPERTY: DELIVERY OF BALTIMORE, INC. KIRK AND BONAPARTE AVES., BALTIMORE, MD.
BLDG.: TRANSFER WAREHOUSE — DATE: JAN. 1950
STORY: FIRST (PART) — SCALE: 1/8=1'-0" UNLESS NOTED
SURVEYED BY: PLANS — SHEET NO. 3
DRAWN BY: A.W.S. — NO. OF SHEETS 5
APPROVAL OF: F.I.A. & MB. BR.
CONTRACT NO. 8126
CUSTOMERS NO. 273
ROCKWOOD SPRINKLER CO.
AUTOMATIC SPRINKLER & WATER FOG SYSTEMS
112 SOUTH 11TH STREET
PHILADELPHIA, PA.

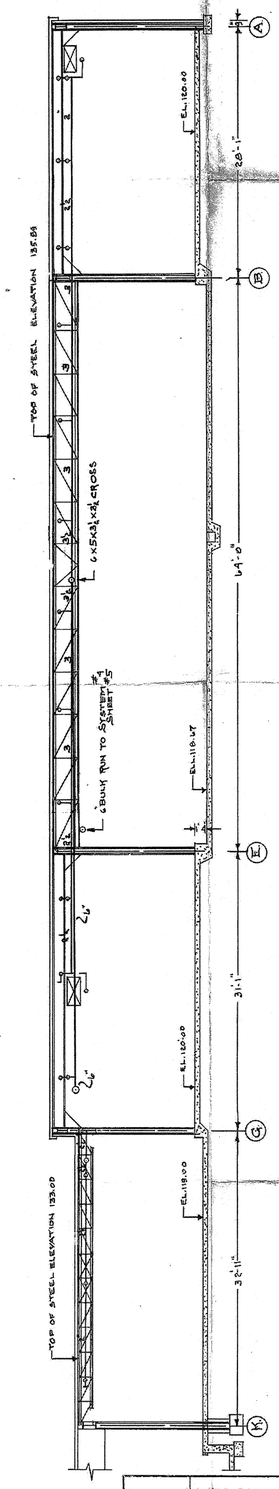
AS

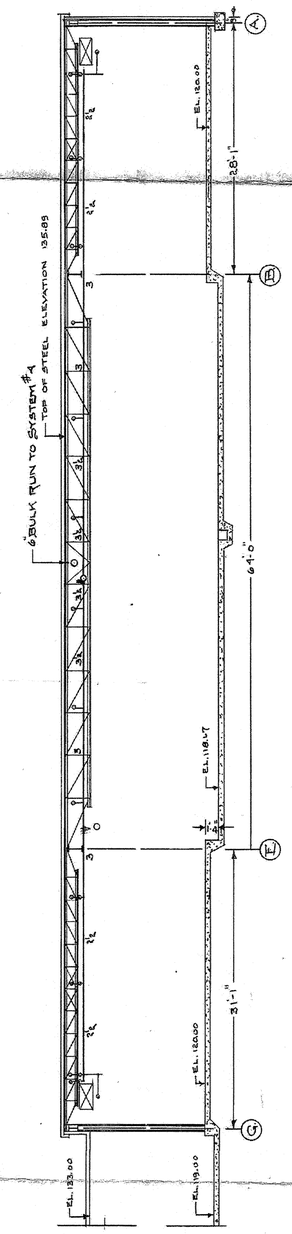


MAIN NO'S. MARKED IN RED PAINT
LINE BUNDLES TIED WITH RED CORD



NOTE: FIGURES IN [X] INDICATE DISTANCE DOWN IN INCHES FROM FINISHED CEILING TO ℄ OF PIPE. FOR DETAIL #4B HANGER SEE SHEET #3





APPROVED
JUN 9 - 1950
HENRY ADAMS, INC.
By

RECEIVED
JUN 12 1950
CROUT, SNYDER & CRANDALL

25 OF 29

SYSTEM #3

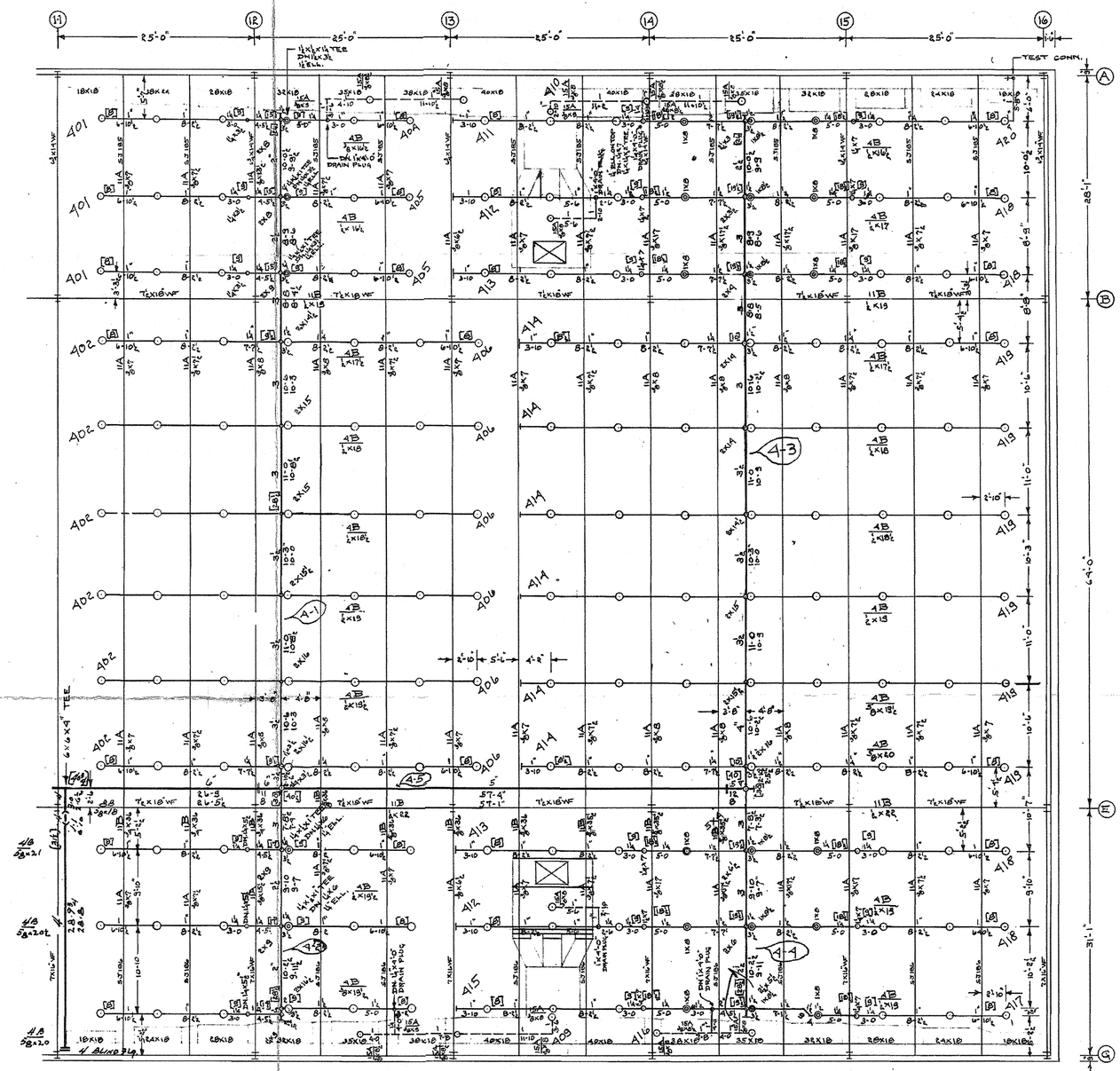
SYMBOL AND DATE	NATURE OF REVISION	SPRINKLER OR WATER FOG HEADS TYPE	REG. 160°
		NUMBER	213
REVISIONS		TOTAL	213

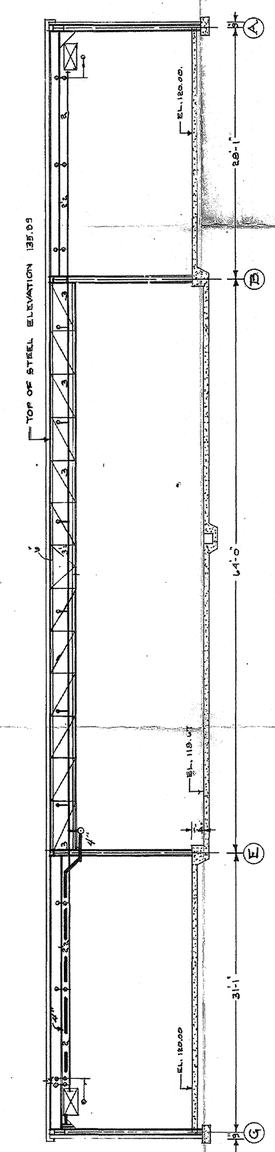
CONTRACTED WITH MORROW BROS., INC. 2215 N. CHARLES ST., BALTIMORE, MD.
PROJECT DELIVERY OF BALTIMORE, INC. KIRK AND BONAPARTE AVES., BALTIMORE, MD.
BLDG. WAREHOUSE DATE JAN. 1950
STORY FIRST (PART) SCALE 1/8"=1'-0" OR AS NOTED
SURVEYED BY PLANS SHEET NO. 4 5
DRAWN BY A.W.S. NO. OF SHEETS
APPROVAL OF F.I.A. + MD. BD.
CONTRACT NO. 8126
CUSTOMERS NO 273

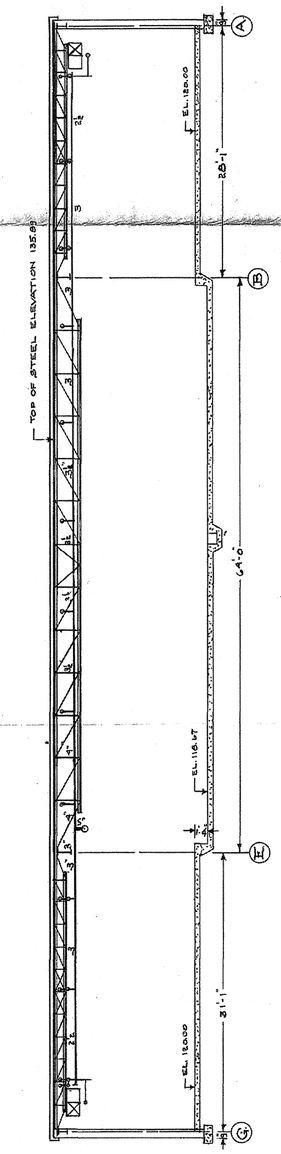
ROCKWOOD SPRINKLER CO.
AUTOMATIC SPRINKLER & WATER FOG SYSTEMS
112 SOUTH 16TH STREET
PHILADELPHIA, PA.

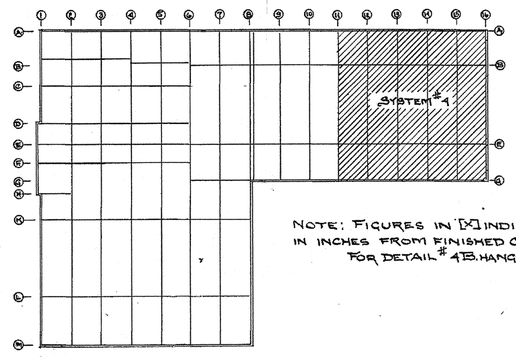
43

BREWER OF NEW ENGLAND, BROOKFIELD, MASS.









NOTE: FIGURES IN [X] INDICATE DISTANCE DOWN IN INCHES FROM FINISHED CEILING TO ℄ OF PIPE. FOR DETAIL #4B HANGER SEE SHEET #3

RECEIVED
JUN 12 1950
CROUT, SNYDER & CRANDALL

APPROVED
JUN 9 - 1950
HENRY ADAMS, INC.
By 26 OF 29

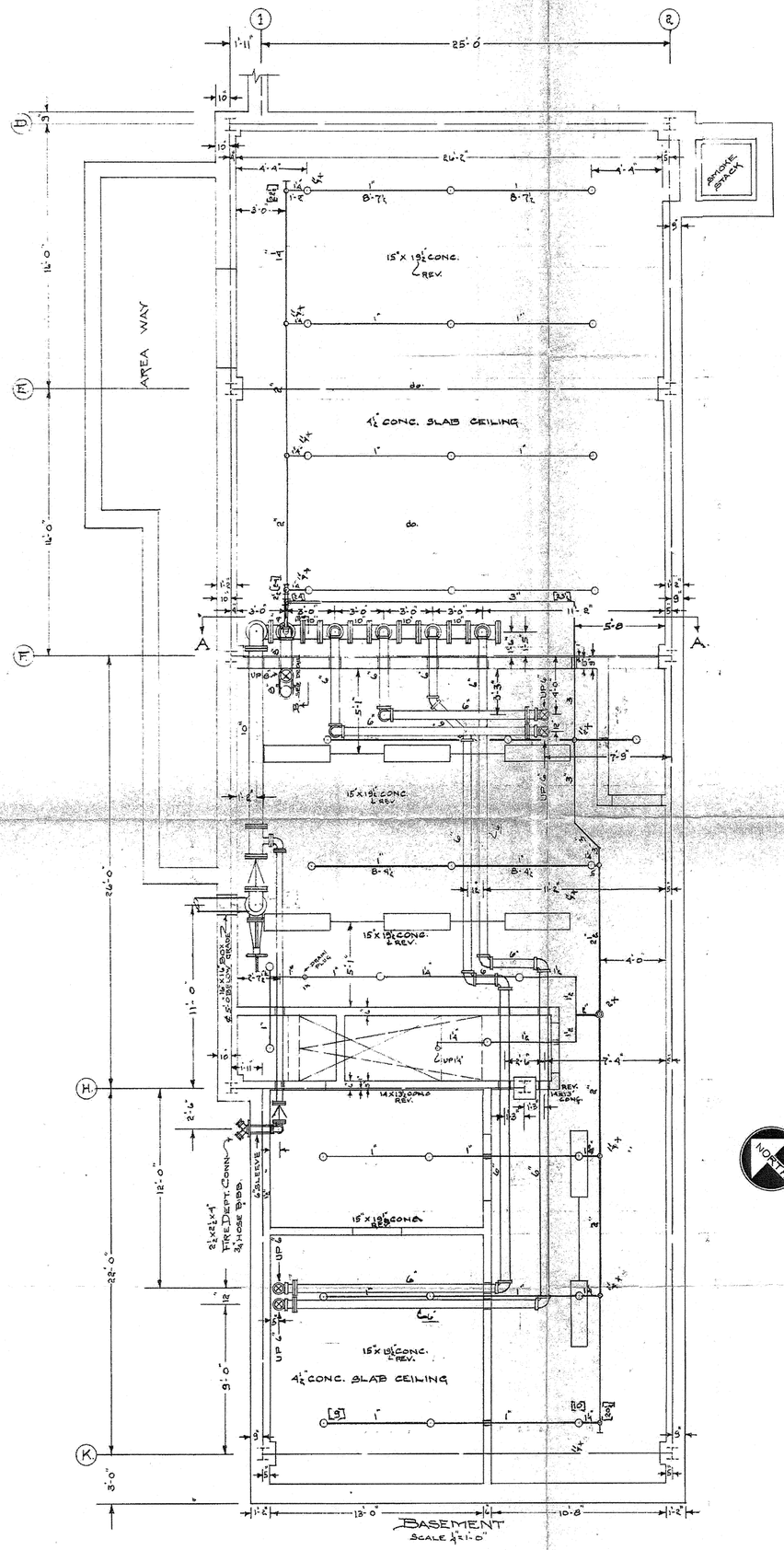
SYSTEM #4

SYMBOL AND DATE	NATURE OF REVISION	SPRINKLER OR WATER FOG HEADS TYPE	NUMBER
	REVISIONS	REG. 160°	192
		TOTAL	192

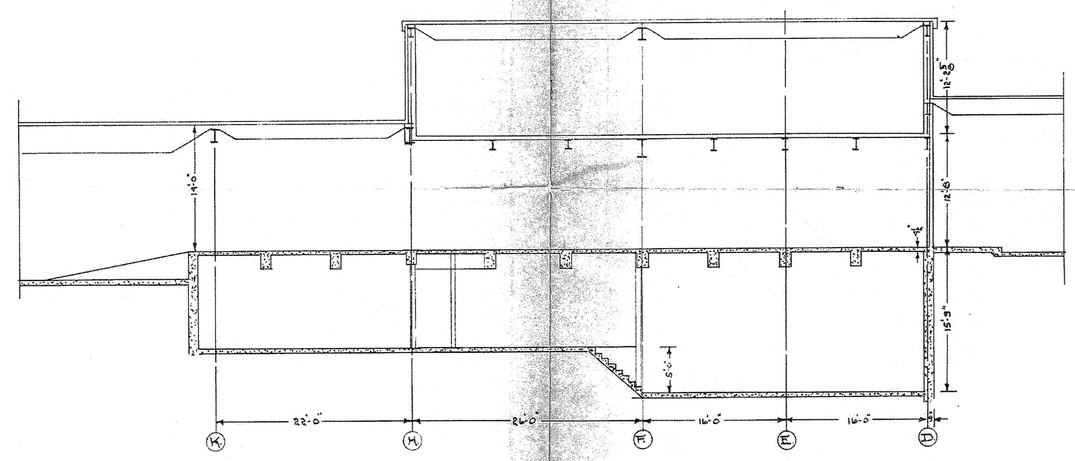
CONTRACT WITH MORROW BROS., INC. 2315 N. CHARLES ST., BALTIMORE, MD.
PROJECT DELIVERY OF BALTIMORE, INC., KIRK AND BONAPARTE AVES., BALTIMORE, MD.
BLDG TRANSFER WAREHOUSE — DATE JAN. 1950
STORY FIRST (PART) — SCALE 1/8"=1'-0" UNLESS NOTED
SURVEYED BY PLANS — SHEET NO. 5
DRAWN BY A.W.S. — NO. OF SHEETS 5
APPROVAL OF F.I.A. & MR. BD.
CONTRACT NO. 8126
CUSTOMERS NO. 273

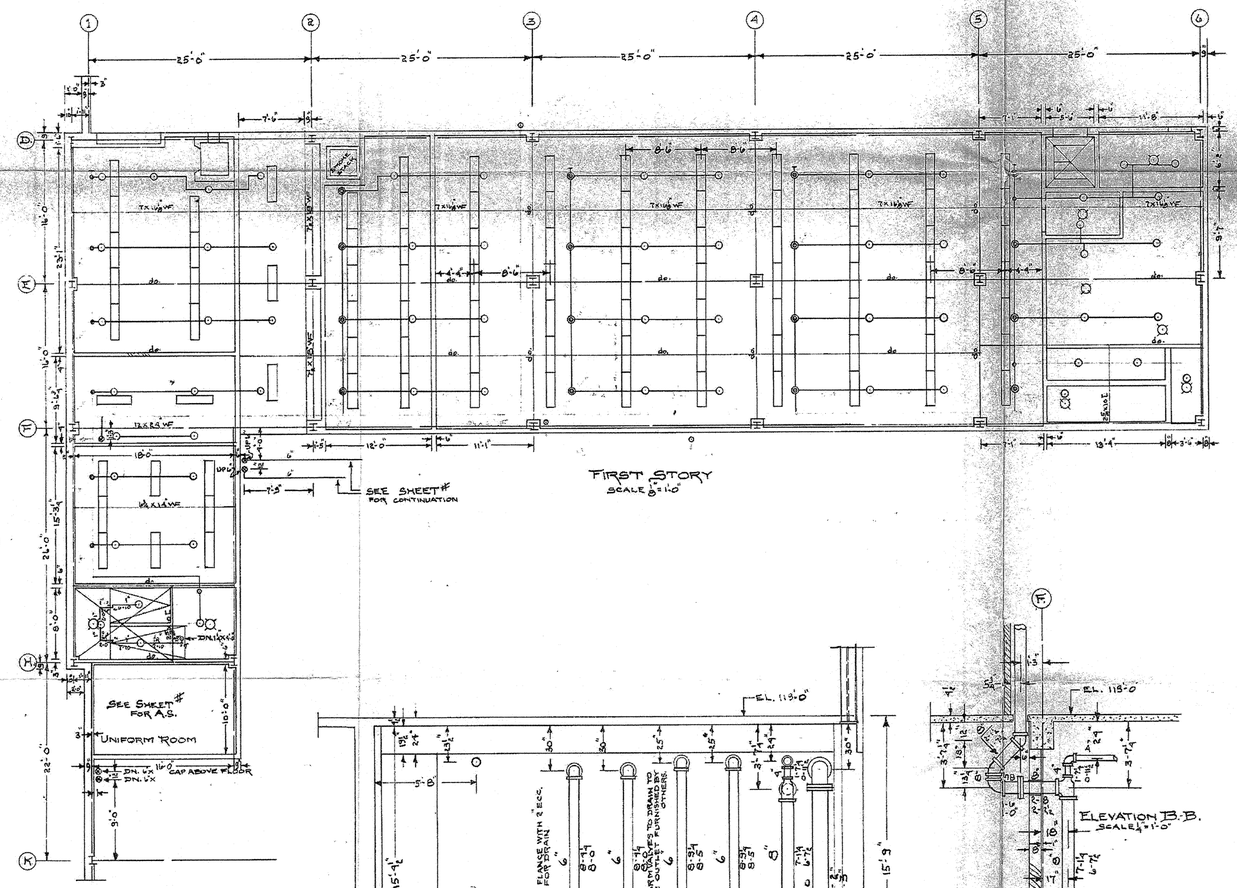
ROCKWOOD SPRINKLER CO.
AUTOMATIC SPRINKLER & WATER FOG SYSTEMS
118 SOUTH 16TH STREET PHILADELPHIA, PA.

BALWIN OF NEW ENGLAND, BRIDGEFIELD, MASS.
ROCKWOOD SPRINKLER CO.



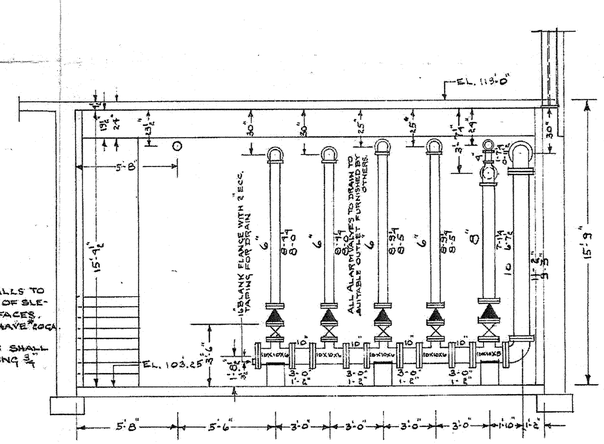
BASEMENT
SCALE ¼"=1'-0"



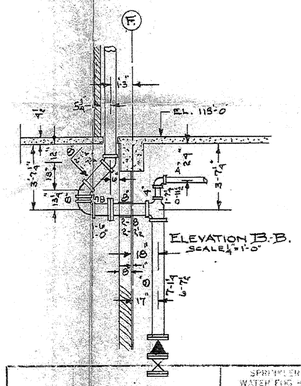


FIRST STORY
SCALE ⅛"=1'-0"

NOTES:- PIPES THRU STRUCTURAL WALLS TO HAVE STEEL PIPE SLEEVES, THE END OF SLEEVES TO BE FLUSH WITH WALL SURFACES. PIPE THRU PARTITIONS TO HAVE 20GA. GALV. IRON THIMBLES
PIPES PASSING THRU FLOORS SHALL HAVE STEEL PIPE SLEEVES EXTENDING ¾" ABOVE FINISHED FLOOR.



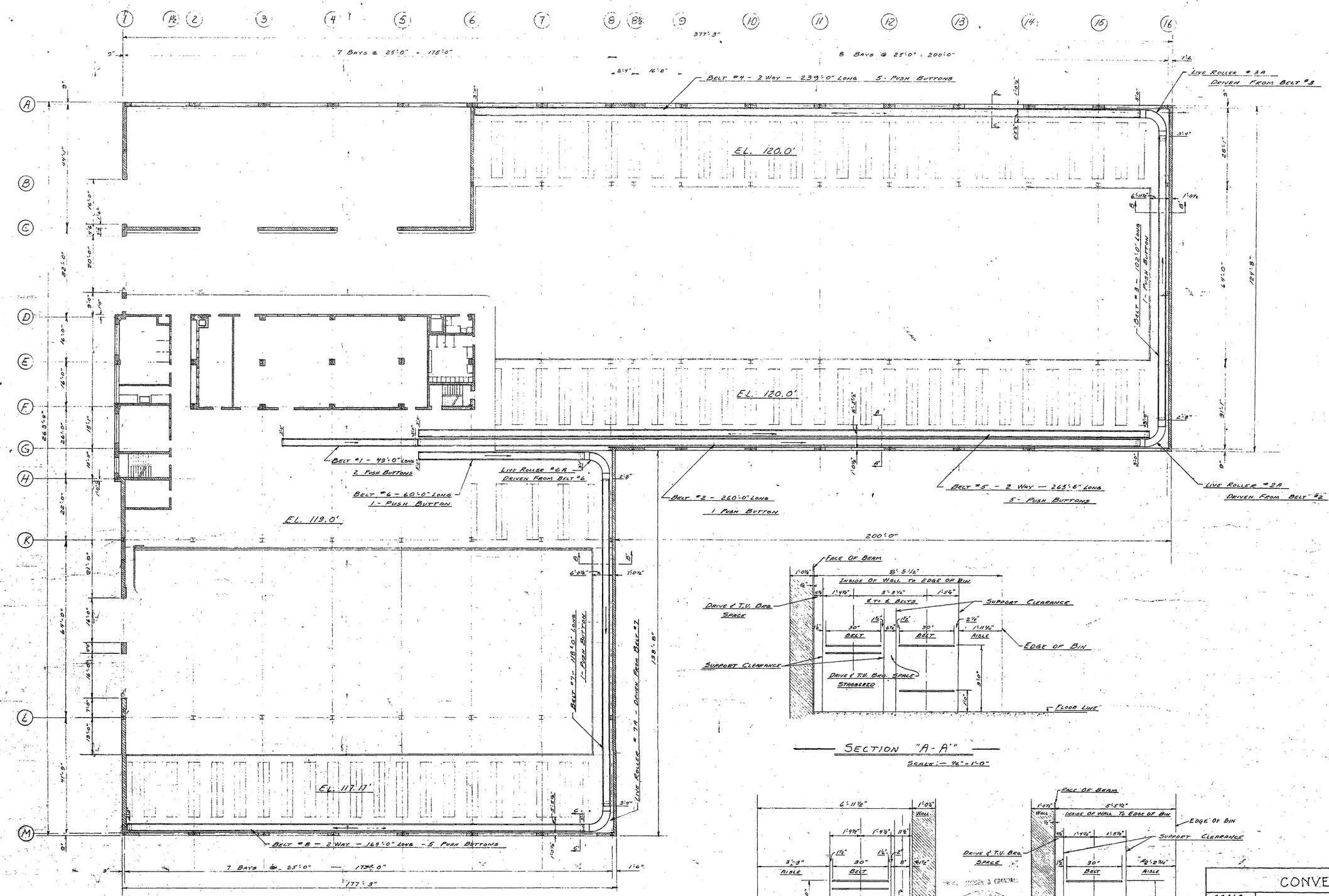
CROSS SECTION A-A.
LOOKING SOUTH-EAST
SCALE ¼"=1'-0"



ELEVATION B-B.
SCALE ¼"=1'-0"

27 OF 29
AS6

SPRINKLER OR WATER FOG HEADS TYPE	NUMBER		
		CO.	MORROW BRO'S INC. 2315 N. CHARLES ST., BALTIMORE, MD.
		PL.	DELIVERY OF BALTIMORE, INC. KIRK AND BONAPARTE AVES., BALTIMORE MD.
		BLDG.	TRANSFER WAREHOUSE DATE JAN. 1950
		STORY	AS NOTED SCALE AS NOTED
		SURVEYED BY	PLANS SHEET NO.
		DRAWN BY	A.W.S.
		APPROVED BY	F.I.A. & MR. DE.
STAMP INCLUDE	NATURE OF REVISION	CONTRACT NO. 8126	ROCKWOOD SPRINKLER CO. AUTOMATIC SPRINKLER WATER FOG SYSTEMS 115 SOUTH 17TH STREET PHILADELPHIA, PA.
REVISIONS	TOTAL	CUSTOMERS NO. 273	

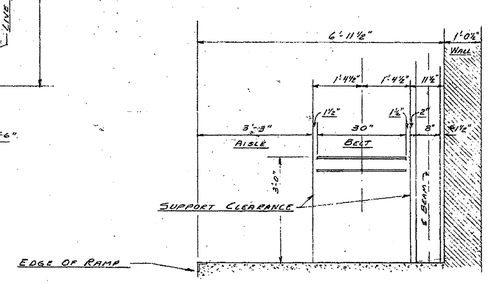


PLAN

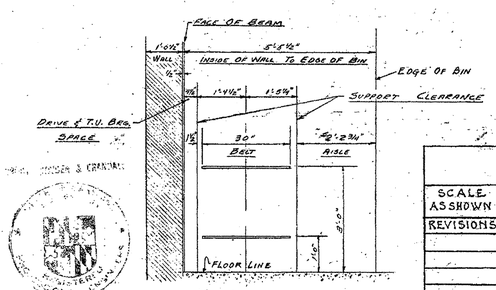
SCALE:- 1/16" = 1'-0"

SECTION "A-A"

SCALE:- 1/16" = 1'-0"



SECTION "B-B"

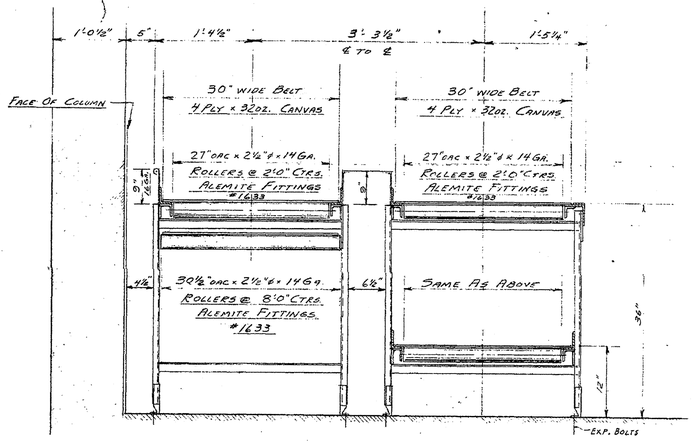


SECTION "C-C"

28 OF 29

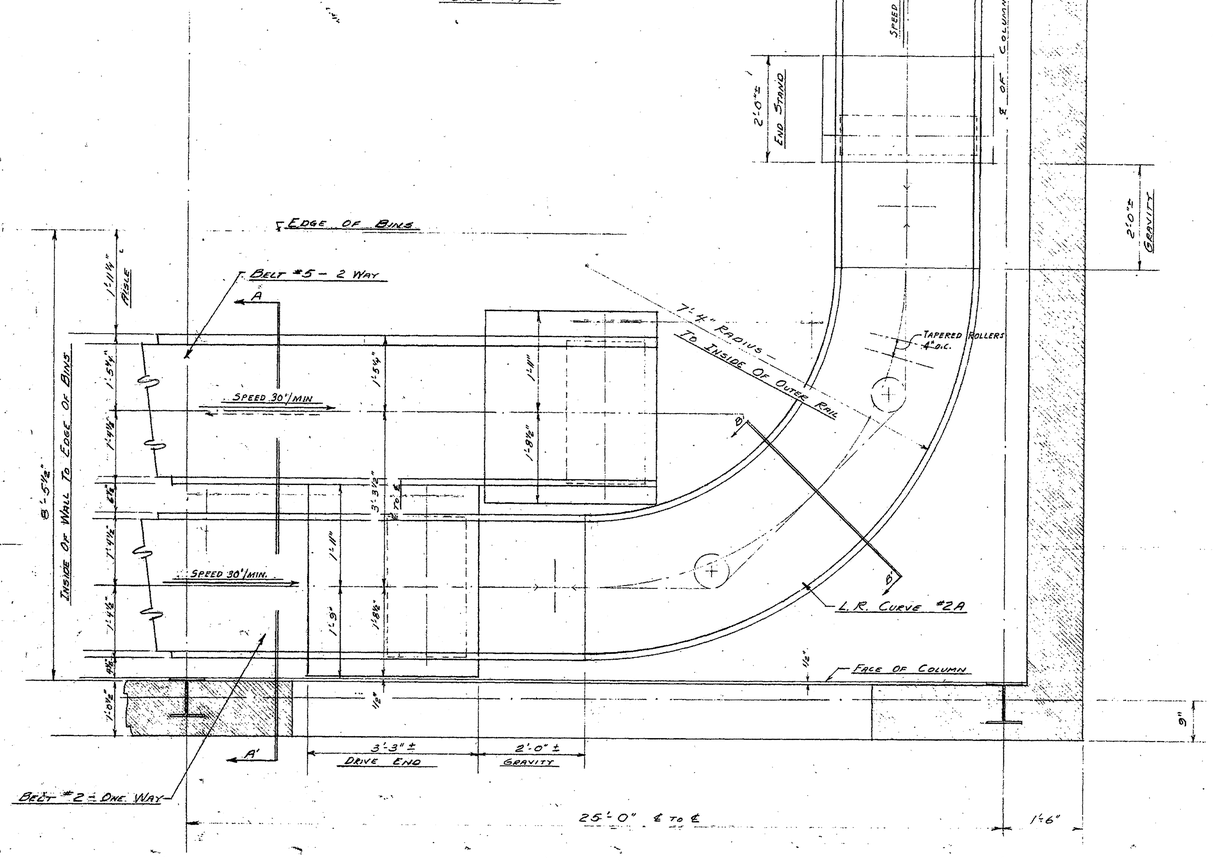
CONVEYOR LAYOUT		
SCALE AS SHOWN	DELIVERY OF BALTIMORE INC.	SHEET NO.
REVISIONS	TRANSFER STATION	C1
	KIRK & BONAPART AVE. BALTIMORE, MD.	OF SHEETS
DATE	CROUT, SNYDER & CRANDALL REGISTERED ENGINEERS	DRAWING NO.

T-0705-0140



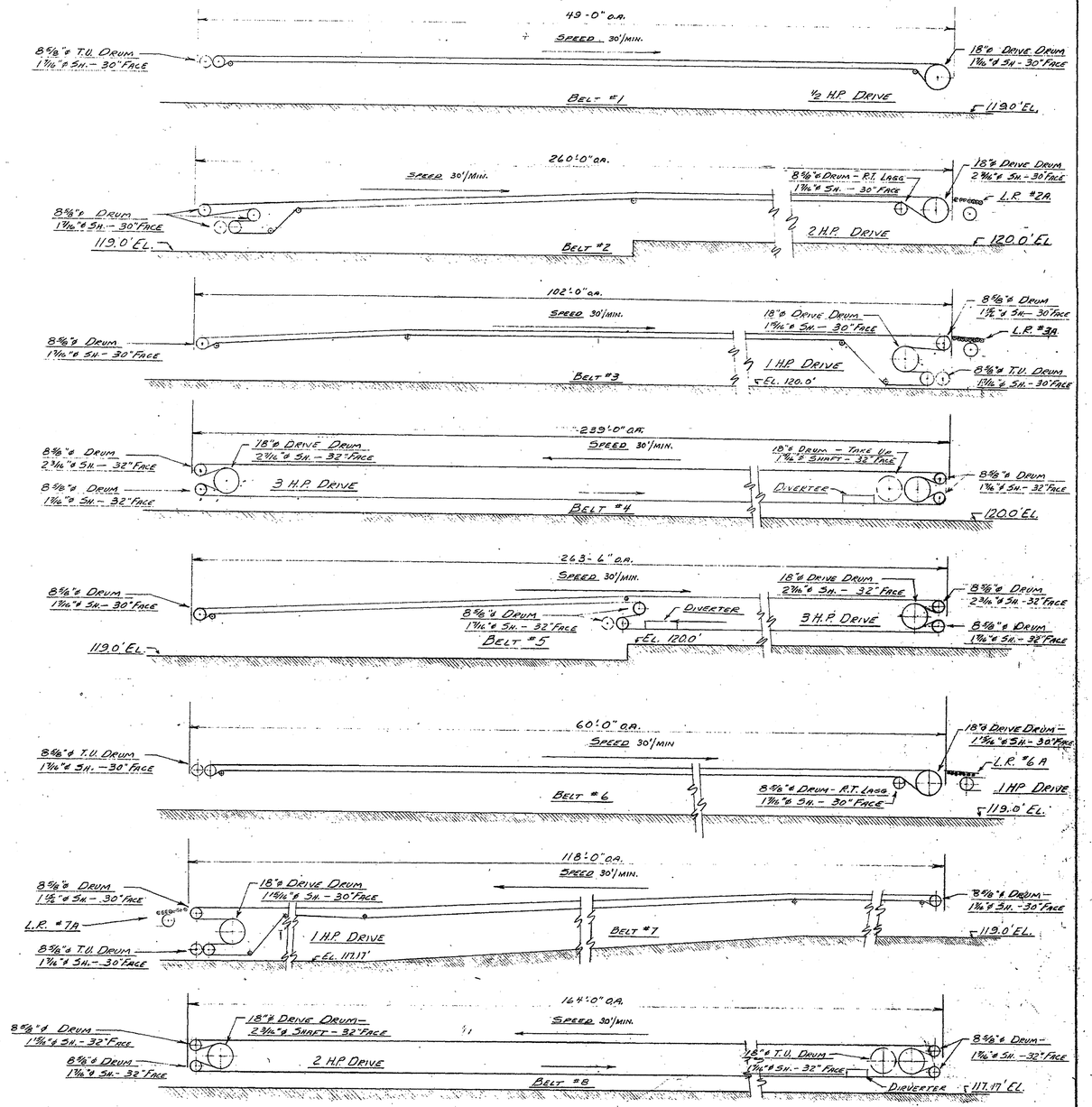
SECTION "A-A"

Scale:- 3/4" = 1'-0"



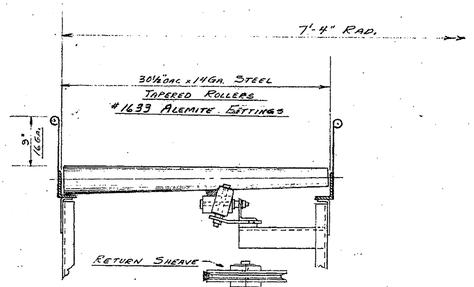
PLAN

Scale:- 3/4" = 1'-0"



BELT ELEVATIONS

Scale:- 1/4" = 1'-0"



SECTION "B-B"

Scale:- 1½" = 1'-0"

29 OF 29

	DETAILS OF CONVEYORS	
SCALE AS SHOWN REVISIONS	DELIVERY OF BALTIMORE INC. TRANSFER STATION KIRK & BONAPART AVE. BALTIMORE, MD.	SHEET NO. C2 OF SHEETS
DATE Apr. 1950	CROUT, SNYDER & CRANDALL REGISTERED ENGINEERS 20 E. LEXINGTON ST. BALTIMORE, MD.	COMM. NO. 1307-C

T-0705-0140

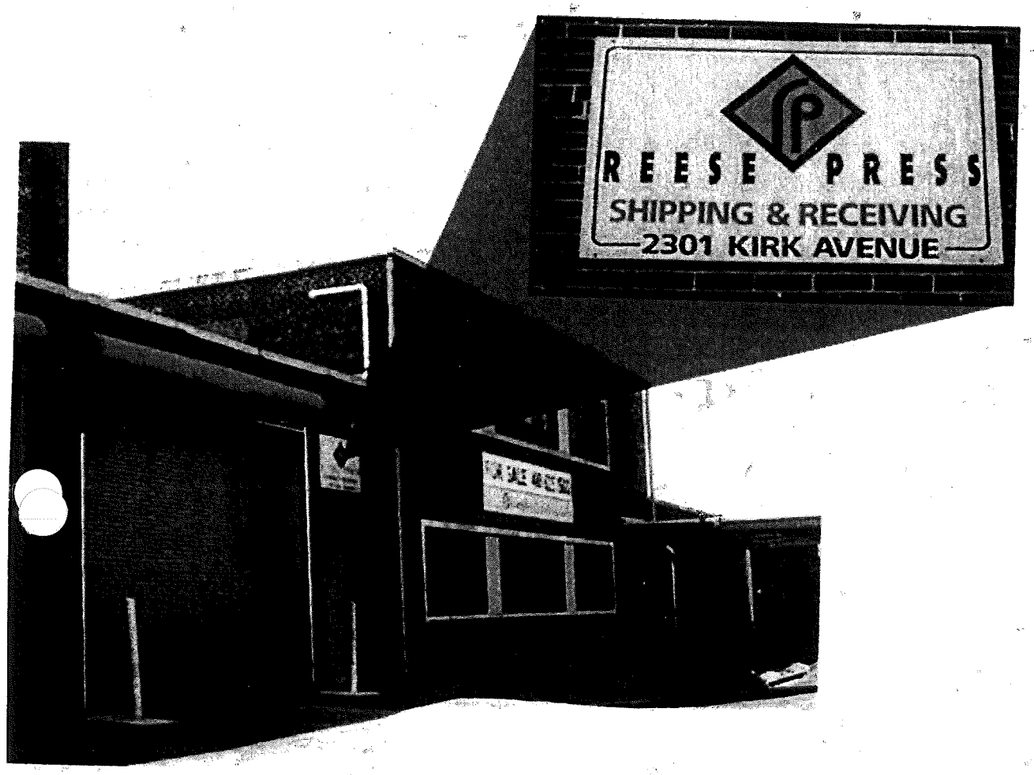
APPENDIX J

EXISTING REESE PRESS BUILDING – ENVIRONMENTAL INFORMATION - FOR INFORMATIONAL PURPOSES ONLY

T-0705-0140

KIRK BUS DIVISION MODERNIZATION - PHASE 1

Reese Press Building
Hazardous Material Survey
Draft



Prepared for
Whitman Requardt & Associates, LLP
801 South Caroline Street
Baltimore, MD 21231

ared by
PEER Consultants, P.C.
12300 Twinbrook Pkwy Suite 410
Rockville, MD 20852
T-0705-0140

July 2006

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2.1 Asbestos Sampling 1
2.2 Asbestos Results 3
2.3 Conclusions and Recommendations 13
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3.2 Lead-based Paint Laboratory Results 18
3.3 Lead-based Paint Hazard Assessment 25
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APPENDIX C – LABORATORY REPORTS
APPENDIX D – CERTIFICATION
APPENDIX E – BULK SAMPLING LOGSHEETS

1.0 Site Description

The Reese Press property is located at 2301 Kirk Avenue, Baltimore Maryland. The property is bordered by Kirk Avenue to the west, Garret Avenue to the north, and Curtain Avenue to the south. The Reese property contains an area of 188,220 square feet, or 4.3 acres.

Improvements on the property include a two-story brick building (main building) with a basement, sub-basement and four warehouses (See Figures 1 through 8, Appendix A). The main building was constructed in 1941 and is approximately 75,950 square feet. The first floor of the main building houses a main lobby/reception area, two conference areas, filing/record room, coping /fax room, several enclosed offices and several office cubicles, electrical and storage closets, an employee lunch room and a women restroom. The main building is surrounded by four one-story warehouses. The second floor includes several offices cubicles, a board/conference room, men and women restrooms, kitchen/lunch room and an elevator room. The basement includes a locker area with several showers, lavatory and urinal stalls, weight lifting and strengthening facilities. Three furnaces of varying ages are located in the sub-basement.

The Reese Press, Inc. printing company has owned the property since 1984 and has conducted printing press operations at the site. At present the printing operations have ceased and Aurora Paving is leasing a part of the building. Aurora Paving occupies the 1st floor. The 2nd floor, basement and sub-basement are not occupied. The Delivery of Baltimore, Inc. formerly owned the property.

2.0 Asbestos Survey

2.1 Asbestos Sampling

On May 30 through June 5, 2006 PEER Consultants PC employees performed asbestos and lead based paint surveys to identify potentially hazardous materials that may be disturbed during the proposed building renovation. PEER conducted an inventory of potential asbestos-containing material (ACM) throughout the Reese Press Property and sampled the homogeneous areas. Homogeneous areas consist of surfacing materials, thermal system insulation, or miscellaneous materials that are uniform in color and texture, and apparent date of installation.

Representative samples were collected randomly from homogeneous areas throughout the accessible sections of the building. Standard practices were used to minimize any type of fiber release or significant damage to the area. Samples taken from friable materials were wetted down prior to sampling, and sealed with duct tape after sampling. The samples were placed in zip-seal plastic bags that were labeled with the date and location of the sample. A standardized Bulk Sampling log sheet was used to record the location, friability, condition, and accessibility of each sample. All samples were submitted with a chain of custody form to Analytics

Laboratory (NVLAP accredited lab). All samples were analyzed by Polarized Light Microscopy (PLM).

Suspect Asbestos Containing Materials observed throughout the main building and warehouses included ceiling tiles, wall plaster, vinyl floor tiles (VFT) and mastic, baseboard molding, pipe/fitting insulation, duct vibration dampers, window caulking and asphalt roof system.

Thermal system insulation (TSI) was present on various pipes, elbows and fittings, furnaces/boilers, and duct work. TSI was observed above the drop ceiling on the first and second floors of the main building, the warehouses, the basement and sub-basement. In the sub-basement boiler/furnace area some TSI were in poor condition. Samples of TSI were collected from accessible areas throughout the building.

In many locations on first floor, the office floor was covered by carpet. In most instances the carpet was intact and it was impossible to obtain a non-destructive sample of the carpet glue or mastic.

The following areas have suspect materials that were assumed to be asbestos, but were inaccessible for sampling:

- A 3-inch (3") diameter insulated cement pipe with one elbow was observed on the 1st floor of the open office area/conference room that is located, to the east of the central hallway. This pipe appears to run horizontally above the drop ceiling in an east to west direction
- A 3-inch diameter insulated pipe was observed above the dropped ceiling in small circuit room on the first floor. The insulated pipe is approximately 10 feet long and has one fitting.
- One 2-inch and one 4-inch insulated pipe were observed above the drop ceiling in Work Station Area1 on the first floor.
- Several 6-inch, 4-inch and 3-inch diameter insulated cement pipe were observed above the dropped ceiling on the 1st floor records/filing room. Most insulated pipes in that area was inaccessible. One asbestos sample was collected from a 6-inch pipe. The pipes appear to run horizontally in a north/south direction. One 6-inch pipe appears to run throughout entire 1st floor in a north-south and terminates above the ceiling in the women's bathroom next to the reception area.
- A 3-inch insulated pipe was observed above the drop ceiling in the workspace of the computer/fax room on the first floor. This pipe runs horizontally in an east-west direction throughout the entire office length.

- Several insulated pipes and fittings of various sizes were observed above the drop ceiling in the first floor kitchen/lunch room. The pipes vary in length from 8 to 12 feet and run horizontally in a north to south direction. These pipes were 3", 4" and 8" in diameter and fitted with several elbows and Ts. The pipes were in-accessible and no TSI sample was collected from the 1st floor kitchen.

- Several insulated pipes and fittings of various sizes were observed above the drop ceiling in the first floor meeting/conference room. The pipes vary in length from 1 foot to 18 feet and run horizontally in a north to south direction and vertically. The insulated pipes were fitted with several elbows and Ts. This area was also carpeted and the carpet was intact. No sample of the carpet mastic was collected.

- The TSI on the inner surfaces of the doors of the three boilers in the sub-basement are assumed to be ACM.

- The air duct in the sub-basement boiler room is wrapped with TSI and is identified as ACM consisting of 80% chrysotile. The dimensions are 19'x1'x4'.

A network of TSI was observed in the basement bathroom/locker room area and the sub-basement boiler room.

2.2 Asbestos Results

A total of 89 samples of suspect asbestos containing materials were collected and submitted for analysis.

The analytical results indicated that asbestos was present in 28 out of the 89 samples collected at the Reese Press Property. Results are summarized in Table 1. Plans of the structure showing the locations of each sample are attached in Appendix A, Figures 1 through 4. The complete sample database is included in Appendix B; laboratory reports from Analytics Laboratory in Appendix C, the inspector/laboratory certifications in Appendix D, and the bulk sampling log sheets in Appendix E.

Table 1 – Summary of Asbestos Samples

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-001	9x9 burgundy floor tile	2nd floor entrance to the women's bathroom	Good	Non-friable	ND
2301-ACM-002	Floor tile mastic	2nd Floor entrance to the women's bathroom taken from underneath burgundy tile	Good	Non-friable	ND
2301-ACM-003	Black 9x9 floor tile with white streaks and mastic	2nd Floor women bathroom	Good	Non-friable	Floor tile and mastic– 15% chrysotile
2301-ACM-004	Black floor tile mastic	2nd Floor entrance to the women's bathroom taken from underneath black tile	Good	Non-friable	ND
2301-ACM-005	Vinyl wall border/trim	2nd Floor hallway	Good	Non-friable	ND
2301-ACM-006	Glue/mastic	2nd Floor near entrance to the office area. Taken from the back of wall border	Good	Non-friable	ND
2301-ACM-007	Brick mortar	2nd Floor near entrance to the office area. Taken from between bricks.	Good	Non-friable	ND
2301-ACM-008	Window caulking	2nd Floor hallway near entrance to the office area.	Good	Non-friable	ND

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-009	Mastic	2nd Floor board room. Taken from underneath carpet	Good	Non-friable	ND
2301-ACM-010	White 2" diameter cement pipe insulation	2nd floor boardroom near the radiator vent	Poor	Friable	Pipe insulation 20% chrysotile and 20% amosite
2301-ACM-011	Window caulk	2nd floor – Collected from the window in the Board Room	Fair	Non-friable	Caulk 5% chrysotile
2301-ACM-012	White 2"cement pipe insulation	2nd floor – Under radiator in back room on wall B/South wall	Fair	Friable	Pipe insulation – 20% chrysotile & 20% amosite
2301-ACM-013	White 2" cement pipe insulation	2nd floor – Under radiator in back room on wall C/East wall	Fair	Friable	Pipe insulation – 70% chrysotile; 10% amosite
2301-ACM-014	Window caulk	2nd floor Back room- interior window caulk from wall B	Fair	Friable	Window caulk 5% chrysotile
2301-ACM-015	Window caulk	2nd floor Back room- interior window caulk from wall C	Fair	Friable	ND
2301-ACM-016	White 2" diameter cement pipe insulation	2nd Floor Back room- underneath radiator in far right corner of wall C	Fair	Friable	Pipe insulation – 20% chrysotile & 20% amosite

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-017	Grey vibration cloth	2nd Floor – Taken from the corner of Back room-air handler unit	Good	Non-Friable	ND
2301-ACM-018	White vibration cloth	2nd Floor Back room - taken from air handler unit connection in the closet of backroom ceiling area	Good	Non-Friable	Vibration cloth 80% chrysotile
2301-ACM-019	Ceiling tile	2nd Floor – Sample taken from hallway leading to back work area	Good	Non-Friable	ND
2301-ACM-020	Black vinyl floor border	2nd Floor – Sample taken from hallway	Good	Non-Friable	ND
2301-ACM-021	Brown floor tile & mastic	2nd Floor – Sample taken from hallway leading to back work area	Good	Non-Friable	ND
2301-ACM-022	Window Caulk	2nd Floor – Work area office #1 window	Fair	Non-Friable	Caulk > 1-5% chrysotile
2301-ACM-023	Window Caulk	2nd Floor – Work area office #2 window	Fair	Non-Friable	Caulk > 1-5% chrysotile
2301-ACM-024	Window Caulk	2nd Floor – Open work area window	Fair	Non-Friable	Caulk > 1-5% chrysotile

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-025	Window Caulk	2nd Floor – work area back wall window	Fair	Non-Friable	ND
2301-ACM-026	Mastic	2nd Floor – Work area. Sample taken form underneath carpet	Good	Non-Friable	ND
2301-ACM-027	Light grey 12x12 vinyl floor tile with white specks	2nd Floor work area kitchen	Good	Non-Friable	ND
2301-ACM-028	Window Caulk	2nd Floor – Work area hallway south wall/wall D window	Fair	Non-Friable	Caulk TR< 1% chrysotile
2301-ACM-029	Window Caulk	2nd Floor – Stair way landing east	Fair	Non-Friable	ND
2301-ACM-030	Brown 12x12 vinyl floor tile	2nd Floor – Work area hallway south wall/wall D window	Fair	Non-Friable	ND
2301-ACM-031	Brown vinyl stair thread	Stairway landing between 1st & 2nd floor	Good	Non-Friable	ND
2301-ACM-032	Brown vinyl border	Stairway landing between 1st & 2nd floor	Good	Non-Friable	ND
2301-ACM-033	Black carpet mastic	2nd Floor- East stairway landing underneath blue/grey carpet	Good	Non-Friable	Carpet mastic – 20% chrysotile

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-034	Ceiling tile	1st Floor- Open area to the east of central hallway	Fair	Non-Friable	ND
2301-ACM-035	Carpet mastic	1st Floor- Back office to the right	Good	Non-Friable	ND
2301-ACM-036	Dark brown wall border	1st Floor- Back office to the right	Good	Non-Friable	ND
2301-ACM-037	Brown wall border	1st Floor- Open Area 1	Good	Non-Friable	ND
2301-ACM-038	Carpet mastic	1st Floor- Open Area 1	Good	Non-Friable	ND
2301-ACM-039	Brown vinyl wall border	1st Floor- Station Work Area 2	Fair	Non-Friable	ND
2301-ACM-040	Ceiling tile	1st Floor- Station Work Area 1	Fair	Non-Friable	ND
2301-ACM-041	Brown carpet mastic	1st Floor- Station Work Area 3	Fair	Non-Friable	ND
2301-ACM-042	Grey fleck 12x12 vinyl floor tile	1st Floor- small Work Room	Fair	Non-Friable	ND
2301-ACM-043	Brown vinyl floor border	1st Floor- Work Area 2	Fair	Non-Friable	ND

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-044	Cream carpet mastic	1st Floor-Work Area 1	Fair	Non-Friable	ND
2301-ACM-045	Carpet mastic	1st Floor-Corridor next to Work Station 4	Fair	Non-Friable	ND
2301-ACM-046	Cream 12x12 vinyl floor tile with brown fleck	1st Floor-Corridor between Area3 &Area 5	Fair	Non-Friable	ND
2301-ACM-047	Brown wooden panel	1st Floor-Area3	Good	Non-Friable	ND
2301-ACM-048	Brown vinyl floor border	1st Floor- Area 5	Fair	Non-Friable	ND
2301-ACM-049	Black painted panel board	1st Floor- Area 5	Fair	Non-Friable	ND
2301-ACM-050	Ceiling tile	1st Floor-Open Area 1	Fair	Non-Friable	ND
2301-ACM-051	White 4" insulated pipe	1st Floor – Electric closet in reception area	Poor	Friable	Pipe insulation - 20% chrysotile & 20% amosite
2301-ACM-052	Brown vinyl floor border with white streaks	1st Floor – corridor next to record area	Good	Non-Friable	ND
2301-ACM-053	Cream 12x12 vinyl floor tile with brown & white fleck	1st Floor-Corridor between Area3 &Area 5	Good	Non-Friable	ND
2301-ACM-054	White 6" insulated pipe	1st Floor – Records area	Fair	Friable	Pipe insulation - 20% chrysotile & 20% amosite

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-055	Carpet mastic	1st Floor-Work Space computer/fax room	Fair	Non-Friable	ND
2301-ACM-056	Vinyl floor border	1st Floor-Middle office	Good	Non-Friable	ND
2301-ACM-057	Cream 12x12 vinyl floor tile with brown & white fleck	1st Floor-Kitchen	Good	Non-Friable	ND
2301-ACM-058	Tile mastic	1st Floor-Kitchen	Fair	Non-Friable	ND
2301-ACM-059	Brown vinyl border	1st Floor-Women bathroom	Good	Non-Friable	ND
2301-ACM-060	Brown vinyl floor tile with white streaks	1st Floor-Entrance	Fair	Non-Friable	ND
2301-ACM-061	Brown vinyl floor border	1st Floor-Entrance	Fair	Non-Friable	ND
2301-ACM-062	Brown vinyl stairway thread	Stairway leading from the 1st floor to the basement	Good	Non-Friable	ND
2301-ACM-063	Beige 12x12 vinyl floor tile with grey streaks	Basement – Bathroom next to shower area	Fair	Non-Friable	ND
2301-ACM-064	Blue vinyl floor border	Basement – Bathroom	Fair	Non-Friable	ND
2301-ACM-065	Tile mastic	Basement – Locker room	Fair	Non-Friable	ND
2301-ACM-066	Black 9x9 vinyl floor tile with white streaks	Basement – Bathroom closet underneath stairs	Poor	Non-Friable	Floor tile – 15% chrysotile

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-067	Black tile mastic	Basement – Bathroom closet underneath stairs	Poor	Non-Friable	ND
2301-ACM-068	2" diameter white insulated pipe	Basement-Shower area	Good	Friable	Pipe insulation – 30% chrysotile
2301-ACM-069	White pipe insulation - 4" Pipe elbow	Basement-Shower area	Good	Friable	Pipe insulation – 80% chrysotile
2301-ACM-070	White pipe insulation - 4" Pipe T	Basement-Shower area	Good	Friable	Pipe insulation – 80% chrysotile
2301-ACM-071	White wrapped air duct insulation	Sub-Basement-Boiler room	Fair	Friable	Air duct insulation – 80% chrysotile
2301-ACM-072	White wrapped furnace #1 insulation	Sub-Basement-Boiler room	Fair	Friable	Furnace insulation – 80% chrysotile
2301-ACM-074	White wrapped insulation on air handler	Sub-Basement-Boiler room	Fair	Friable	Air handler insulation – 20% chrysotile & 20% amosite
2301-ACM-075	White wrap insulation on furnace #2	Sub-Basement-Boiler room	Fair	Friable	Furnace insulation – 20% chrysotile & 20% amosite
2301-ACM-076	White 3" pipe insulation	Sub-Basement-Boiler room	Poor	Friable	Pipe insulation – 80% chrysotile
2301-ACM-077	White brick mortar	Sub-Basement-Boiler room brick foundation of furnace	Poor	Friable	ND
2301-ACM-078	Grey brick mortar	Sub-Basement-Boiler room brick foundation of furnace	Poor	Friable	ND

Table 1 – Summary of Asbestos Samples (Continued)

Sample Identification	Description	Location	Condition	Friable/ Non-Friable	Asbestos Level (%)
2301-ACM-079	Air handler cloth	Warehouse 2 office area north wall	Good	Non-Friable	ND
2301-ACM-080	Brick mortar	Warehouse 2 office area north wall	Poor	Friable	ND
2301-ACM-081	Black marble 12x12 vinyl floor tile	Warehouse 2 office stairway landing	Good	Friable	ND
2301-ACM-082	Grey wavy 12x12 vinyl floor tile	Warehouse 2 - Bathroom	Good	Friable	ND
2301-ACM-083	Black Vinyl floor border	Warehouse 2 - Bathroom	Good	Friable	ND
2301-ACM-084	Ceiling tile	Warehouse 2 - Bathroom	Good	Friable	ND
2301-ACM-85	White 4" diameter vertical cement pipe insulation	North warehouse #2 garage area	Poor	Friable	Pipe insulation - 20% chrysotile & 20% amosite
2301-ACM-86	White 2" diameter vertical cement pipe insulation	Warehouse #3	Poor	Friable	Pipe insulation - 30% chrysotile
2301-ACM-87	White 2" diameter vertical cement pipe insulation	Warehouse #4	Fair	Friable	Pipe insulation - 30% chrysotile
2301-ACM-88	Brick mortar	Warehouse #4	Fair	Friable	ND
2301-ACM-89	White 4" diameter vertical cement pipe insulation	Warehouse #4	Fair	Friable	Pipe insulation – 20% chrysotile and 20% amosite

2.3 Conclusions and Recommendations

Vinyl floor tile and mastic, carpet mastic, pipe insulation or mudded elbows and Ts, window caulking, air handler vibration cloth and wrapped TSI on the boilers/furnaces and duct work were identified to be asbestos containing material (ACM).

- Black 9x9 vinyl floor tile with white streaks containing 15% chrysotile asbestos was identified in the following areas: the 2nd floor men's and women's bathroom, and the basement closet underneath the stairway.

- Black mastic underneath the Black 9x9 floor tile with white streaks containing 15% chrysotile asbestos was identified in the 2nd floor women's bathroom.

- ACM was identified in 6 out of the 10 samples collected from the window caulking on the 2nd floor. The laboratory results ranged from trace percent of chrysotile asbestos to 5%. The caulking on all the windows appears to be homogenous throughout in terms of color, texture and date of material application.

- Several insulated pipes were identified as asbestos containing material in the basement of the main building. ACM was identified in 2-inch and 4-inch diameter vertical and horizontal insulated pipes in the basement. ACM insulated pipes were identified in the basement shower area containing 30 to 80% chrysotile asbestos.

- ACM was identified in 2-inch, 3-inch, 4-inch, 6-inch and 12-inch diameter insulated vertical and horizontal pipes in the sub-basement boiler room and the basement locker room and shower area. Additional pipe fittings and pipe insulation were identified in other areas of the building.

- Due to the inaccessibility of some of these areas, the number of elbows and fittings were estimated. Pipe insulation was identified above the ceilings in the warehouses, the lunchroom, the copying /fax room and the meeting/conference room on the 1st floor. The elevator area on the 2nd floor was closed. Due to the inaccessibility of these areas no samples were collected. Based on our visual observations, the pipe insulation and fittings are assumed to be positive for ACM.

- Alternating layers of fiberglass felt and asphalt were identified on the roof, but were not accessible. The roofing system should be assumed to contain asbestos until sampled.

It is recommended that identified or assumed ACM be removed by a licensed contractor. During removal additional ACM may be found in areas that were inaccessible during the inspection, such as the areas above the dropped ceiling in the kitchen/lunch room, computer/fax room, meeting/conference room, the record/filling room and the electrical closet on the 1st floor reception area.

The owner of the building is required to make contractors, building occupants and maintenance workers aware of the presence of ACM. Any removal or demolition of ACM must be conducted by a certified asbestos contractor working under the supervision of a certified asbestos supervisor, prior to the beginning of any renovations or demolitions that have the potential to disturb identified ACM. Asbestos removal/demolition activities must comply with the State of Maryland, US EPA, and all OSHA (29 CFR 1926.1101) regulations pertaining to worker safety and health training, asbestos removal work practices and procedures, and disposal of asbestos. All ACM to remain in place should be placed in an asbestos operations and maintenance program.

2.4 Cost Estimate for Abatement

Table 2 – Abatement Cost Schedule

Material	Location	Quantity	Units
Black 9x9 vinyl floor tile & mastic	2nd floor- Women's bathroom	144	SF
Black 9x9 vinyl floor tile & mastic	2nd floor- Men's bathroom	72	SF
Black 9x9 vinyl floor tile & mastic	Basement – Bathroom closet underneath stairway	24	SF
Black carpet mastic	2nd Floor – East stairway landing underneath blue/grey carpet	64	SF
3" insulated cement pipe	1st floor – Open office area	30	LF
3" insulated cement pipe	1st floor – Small circuit room	22	LF
Pipe fitting	1st floor – Small circuit room	2	Each
6" insulated cement pipe	1st Floor- Record/filing room	22	SF
4" insulated cement pipe	1st Floor- Record/filing room	6	SF
3" insulated cement pipe	1st Floor- Record/filing room	18	LF

Table 2 – Abatement Cost Schedule (Continued)

Material	Location	Quantity	Units
Pipe fittings	1st Floor- Record/filing room	5	Each
2" and 4" diameter insulated cement pipe	1st floor – work Station Area 1	40	LF
3" and 6"diameter insulated cement pipe	1st floor- Meeting/Conference room	51	LF
Pipe fittings	1st floor- Meeting/Conference room	11	Each
3" diameter insulated cement pipe	1st floor – Work space computer/fax area	30	SF
3", 4" & 8" diameter insulated cement pipe	1st floor – Kitchen/lunch room	60	LSF
Pipe fittings	1st floor – Kitchen/lunch room	8	LSF
2", 4', 6" and 8" diameter insulated cement pipe	Basement – Locker/Shower/Bathroom	349	LF
Pipe fittings	Basement – Locker/Shower/Bathroom	103	Each
2",3" 4', 6," 8"& 12" diameter insulated cement pipe	Basement Boiler room	193	LF
Pipe fittings	Basement Boiler room	60	Each
4" and 8"diameter insulated cement pipe	Warehouse #2	80	LF

Table 2 – Abatement Cost Schedule (Continued)

Material	Location	Quantity	Units
Pipe fittings	Warehouse #2	16	Each
2", 3", 4" and 8"diameter insulated cement pipe	Warehouse #1	372	LF
Pipe fittings	Warehouse #1	35	Each
2", 3", 4" and 6"diameter insulated cement pipe	Warehouse #3	860	LF
Pipe fittings	Warehouse #3	108	Each
2", 3", 4" and 6"diameter insulated cement pipe	Warehouse #4	491	LF
Pipe fittings	Warehouse #4	40	Each
Total			

[1]All quantities are estimates and must be field verified by an abatement contractor.
[2] Standard contingencies have not been considered in this cost estimate.

3.0 LEAD-BASED PAINT

3.1 Lead-based Paint Sampling

PEER conducted paint-chip sampling at the Reese Press Property, to identify and verify the presence of lead in paint. Under the guidelines of the Department of Housing and Urban Development, and the US EPA, results at or above 0.5% by weight are considered to be lead-based paint. The State of Maryland also considers results greater than 0.5% by weight to be lead-based paint.

3.2 Lead-based Paint Laboratory Results

A total of 123 paint chip samples were collected from the Reese Press Property and analyzed for lead based paint. All samples were submitted to an accredited laboratory (Analytics Laboratory) for analysis. The sample results were reported in percent by weight. A total of 31 samples contained lead at levels exceeding Maryland guidelines. The sample results are summarized in Table 3.

Table 3 –
Summary of Lead Based Paint Laboratory Results

Sample Identification	Description	Location	Lead Level (%)
2301-LBP-001	Beige brick wall	Top floor hallway	0.146
2301-LBP-002	White metal door	Top floor men's bathroom	0.155
2301-LBP-003	White metal door casing	Top floor, men's bathroom	0.117
2301-LBP-004	Sea foam metal door casing	Top floor boardroom	0.113
2301-LBP-005	White brick wall	Top floor	0.258
2301-LBP-006	Sea foam metal door casing	Top floor interior of board room	0.273
2301-LBP-007	Sea foam metal window frame	Top floor board room	0.485
2301-LBP-008	Beige brick wall	Top floor back room	0.072
2301-LBP-009	Beige concrete window sill	Top floor hallway near entrance	0.088

Table 3 –
Summary of Lead Based Paint Laboratory Results (Continued)

Sample Identification	Description	Location	Lead Level (%)
2301-LBP-010	Dark grey metal closet door	Top floor back room closet	0.138
2301-LBP-011	Dark grey metal door casing	Top floor closet in back room	0.483
2301-LBP-012	Dark grey brick wall	Top floor closet in back room	0.072
2301-LBP-013	Light grey metal door	Top floor hallway to work area	0.286
2301-LBP-014	Light grey drywall	Top floor closet work area hallway	< 0.005
2301-LBP-015	Light grey metal door casing	Top floor hallway to work area	0.361
2301-LBP-016	Light grey metal door casing	Top floor work area office #1	< 0.005
2301-LBP-017	White drywall	Top floor work area office #1	< 0.005
2301-LBP-018	White metal radiator	Top floor work area office #1	0.087
2301-LBP-019	Sea foam metal door casing	Top floor work area office #2	< 0.029
2301-LBP-020	White metal window frame	Top floor work area office #2	0.114
2301-LBP-021	Light grey drywall	Top floor work area	< 0.005
2301-LBP-022	Light grey metal door casing	Exit door of work area/top floor	0.267
2301-LBP-023	Light grey metal door	Work area exit door	0.388
2301-LBP-024	Light grey metal window frame	Back of work area station #2	0.12
2301-LBP-025	Blue brick wall	Strip of wall in work area	0.109
2301-LBP-026	Light grey metal pipe	Pipe in kitchen/break room	< 0.005
2301-LBP-027	Cream metal door	Circuit closet/room	0.674
2301-LBP-028	Cream metal door casing	Circuit closet/room	0.525
2301-LBP-029	Cream brick wall	Circuit closet/room	0.165

Table 3 –
Summary of Lead Based Paint Laboratory Results (Continued)

Sample Identification	Description	Location	Lead Level (%)
2301-LBP-030	Black wallboard	Back of small work room	0.008
2301-LBP-031	Tan wooden door	Small work room	0.041
2301-LBP-032	Cream wooden door casing	Work area #2	< 0.027
2301-LBP-033	Yellow wallboard	Work area #2	0.005
2301-LBP-034	Tan wooden door	Work area #1	< 0.016
2301-LBP-035	Tan wooden door casing	Work area #1	0.017
2301-LBP-036	Light grey brick wall	Work area #1	0.778
2301-LBP-037	Cream wallboard	Work station/ cubical area	0.005
2301-LBP-038	Cream metal wall partition	Work station/ cubical area	< 0.024
2301-LBP-039	Yellow brick wall	Work area #3	0.005
2301-LBP-040	Cream metal door	Work area #3	1.25
2301-LBP-041	Maroon metal door casing	Work area #3	1.52
2301-LBP-042	Cream brick wall	Work area #4	0.044
2301-LBP-043	Black brick wall	Work area #4	0.013
2301-LBP-044	Cream brick wall	Work area #5	0.772
2301-LBP-045	Cream wallboard	Open area/workspace	< 0.005
2301-LBP-046	Cream metal door	Open area exit door	0.007
2301-LBP-047	Tan door casing	Open area/workspace	< 0.006
2301-LBP-048	Beige wallboard	Back office #1	< 0.020
2301-LBP-049	Beige metal door casing	Back office #1	< 0.059
2301-LBP-050	Beige metal door casing	Back office #2	< 0.007
2301-LBP-051	Beige wallboard	Back office #2	0.006
2301-LBP-052	Beige wallboard	Back of office area	< 0.019
2301-LBP-053	Beige metal door casing	Back of office area door	< 0.067
2301-LBP-054	Beige wallboard	Fax machine and workplace area	<0.006
2301-LBP-055	Beige wallboard	Middle office	< 0.016

Table 3 –
Summary of Lead Based Paint Laboratory Results (Continued)

Sample Identification	Description	Location	Lead Level (%)
2301-LBP-056	Beige wallboard	Main office 1	< 0.024
2301-LBP-057	Beige metal door casing	Main office #1	< 0.107
2301-LBP-058	Blue wallboard	Back of main office #1	< 0.015
2301-LBP-059	Beige wallboard	Kitchen of main level	0.411
2301-LBP-060	Beige metal door casing	Kitchen of main level	< 0.010
2301-LBP-061	White brick wall	Women's restroom	0.201
2301-LBP-062	White metal door	Women's bathroom	0.074
2301-LBP-063	White wallboard	Meeting room	< 0.005
2301-LBP-064	Green wooden wall border	Meeting room border	< 0.030
2301-LBP-065	Cream concrete window sill	Meeting room	0.034
2301-LBP-066	Cream metal door	Records room	0.995
2301-LBP-067	Cream metal door casing	Records room	0.785
2301-LBP-068	Beige concrete window sill	Records room	0.17
2301-LBP-069	Beige brick wall	Records room	0.303
2301-LBP-070	White wallboard	Main office # 2	< 0.006
2301-LBP-071	Beige metal door casing	Main office #2	0.326
2301-LBP-072	Beige concrete window sill	Main office #2	0.11
2301-LBP-073	Beige wallboard	Hallway to warehouse	< 0.008
2301-LBP-074	Beige metal door casing	Hallway to warehouse	< 0.071
2301-LBP-075	Beige wallboard	Entrance/reception area	< 0.005
2301-LBP-076	Beige metal door casing	Entrance/reception area	1.23
2301-LBP-077	Beige wallboard	Hallway to back office area	< 0.027
2301-LBP-078	Beige metal door casing	Hallway to back office area	< 0.041

Table 3 –
Summary of Lead Based Paint Laboratory Results (Continued)

Sample Identification	Description	Location	Lead Level (%)
2301-LBP-079	Green/cream brick wall	Basement under stairs closet	0.166
2301-LBP-080	Green metal door	Basement under stairs closet	0.94
2301-LBP-081	Beige metal door	Basement under stairs closet	0.703
2301-LBP-082	Cream brick wall	Basement urinal area	0.987
2301-LBP-083	Beige brick wall	Basement bathroom area	0.631
2301-LBP-084	Blue metal wall	Basement shower stalls	0.695
2301-LBP-085	Blue metal casing	Basement shower area	0.781
2301-LBP-086	Beige concrete wall	Basement shower area	0.856
2301-LBP-087	Blue metal shower wall	Basement shower stall	0.987
2301-LBP-088	Blue metal lockers	Basement locker room	0.09
2301-LBP-089	White brick wall	Basement near lockers	0.048
2301-LBP-090	Light blue metal door	Basement door to sub-basement	1.6
2301-LBP-091	Light green brick wall	Sub-basement near entrance	0.016
2301-LBP-092	Dark green metal door casing	Sub-basement entrance door	5.22
2301-LBP-093	Light green concrete wall	Sub-basement	0.012
2301-LBP-094	Grey metal door	Sub-basement door to exterior	0.131
2301-LBP-095	Blue metal garage door	Warehouse office area #2/sub-garage	0.006
2301-LBP-096	Cream brick wall	Warehouse #2 office area/sub-garage	2.17
2301-LBP-097	Grey metal door casing	Warehouse #2 office area	< 0.033

Table 3 –
Summary of Lead Based Paint Laboratory Results (Continued)

Sample Identification	Description	Location	Lead Level (%)
2301-LBP-098	Maroon concrete floor	Warehouse #2 office area	0.018
2301-LBP-099	White brick wall	Warehouse office area #2	0.711
2301-LBP-100	Grey concrete stairs	Warehouse/office area #2	0.038
2301-LBP-101	White concrete wall	Shower/bathroom warehouse #2	0.006
2301-LBP-102	Metal door	Warehouse area #1 to area #2	1.94
2301-LBP-103	Cream brick wall	Warehouse area #1	2.01
2301-LBP-104	Cream brick wall	Warehouse area #3	2.74
2301-LBP-105	Cream/ green brick wall	Warehouse area #4	14.2
2301-LBP-106	Green metal staircase	Warehouse area #4 near exit	0.136
2301-LBP-107	Grey concrete floor	Warehouse area #4	0.272
2301-LBP-108	White brick wall	Front stairwell to basement	0.469
2301-LBP-109	Cream metal door casing	Front stairwell to basement	0.145
2301-LBP-110	White brick wall	Front stairwell wall near entrance	< 0.133
2301-LBP-111	Navy blue metal handrail	Front stairwell common area	0.021
2301-LBP-112	Blue metal entrance door	Front stairwell/ entrance	3.72
2301-LBP-113	White brick wall	Front stairwell main level	0.133
2301-LBP-114	Brown metal riser	Front stairwell, middle level	0.719
2301-LBP-115	White brick wall	Front stairwell, top level	0.494
2301-LBP-116	White metal door casing	Front stairwell, top level	0.719
2301-LBP-117	White concrete window sill	Front stairwell, top level	0.494

Table 3 –
Summary of Lead Based Paint Laboratory Results (Continued)

Sample Identification	Description	Location	Lead Level (%)
2301-LBP-118	White metal entrance door	Front stairwell, top level	0.402
2301-LBP-119	Cream metal door to storage area	Back stairwell, bottom level	0.319
2301-LBP-120	Green metal railing on top floor	Back stairwell	1.09
2301-LBP-121	Cream brick wall in common area	Back stairwell	0.545
2301-LBP-122	Cream metal stringer in common area	Back stairwell	1.32
2301-LBP-123	Cream metal door casing in common area	Back stairwell	0.115

ND – The concentration of % lead detected was less than the laboratory quantitation limit

3.3 Lead-based Paint Hazard Assessment

The OSHA standard for lead-in-construction (29 CFR 1926.62) regulates the work practices for lead-containing materials. Under this standard the employer is required to make an initial determination if any employee's exposure to lead will exceed the action level of $30\mu/m^3$ averaged over an 8-hour day. This initial determination requires the employer to monitor worker's exposure unless he or she has objective data that can demonstrate conclusively that no employee will be exposed to lead in excess of the action level. The following table (Table 4) summarizes the standard's requirements based on the level of lead in air detected.

The action level for lead in construction in state of Maryland is $30\mu g/m^3$ which is the same as the OSHA standard for lead-in-construction (29 CFR 1926.62).

Table 4 – Lead Action Levels

$30\mu/m^3$	$30\mu/m^3$ - $50\mu/m^3$	over $50\mu/m^3$
• train employees • conduct exposure monitoring • maintain records	• provide respirator at employees request • conduct exposure monitoring every 6 months • conduct blood lead monitoring	• enforce respirator use • enforce use of protective clothing • conduct exposure monitoring every 3 months • enforce housekeeping • provide hygiene facilities and enforce washing

During any renovations at the Reese Press building that result in the disturbance of the lead containing materials identified, the contractor must ensure that workers are protected in compliance with the OSHA standards discussed above. Toxic Characteristic Leaching Procedure (TCLP) analysis of each lead containing building component and representative sample of construction debris will be required to determine the appropriate disposal procedure for that component. The results of the TCLP analysis would determine whether these materials should be disposed of as hazardous waste. Any lead containing material that meets the requirements for hazardous waste must be disposed in accordance with Maryland State and Federal Hazardous Waste disposal regulations.

4.0 Sediment Assessment

One sediment sample was collected from a floor drain located in Warehouse Area 4 on June 5, 2006. The sample was submitted to Analytics Laboratory, a Maryland state certified laboratory and analyzed by the toxicity characteristic leaching procedure (TCLP) for metals, organics, inorganic, pesticide and herbicides. In addition the sample was analyzed for total petroleum hydrocarbons (TPH), diesel range organics (TPH-DRO) and total petroleum hydrocarbons gas range organics (THP-GRO). The floor drain is reportedly connected to the city storm drain system.

Table-5 presents a summary of the analytical laboratory results for TCLP compounds and the total petroleum hydrocarbons. The results of the semi-volatile organics and TCLP metals were compared to the TCLP regulatory levels, while the volatile organic and pesticides compounds were compared to RCRA non-hazardous waste standards. The results of the herbicides were compared to the soil clean-up objectives. No compound was detected at concentrations above their respective regulatory levels.

The laboratory analytical results indicated that the concentration of TPH-GRO and TPH-DRO detected in the sediment sample is above the Risk-Based Cleanup Levels for TPH in groundwater. The results indicated that the concentration of TPH-DRO and THP-GRO detected in the sediment sample is below the risk-based cleanup levels in soils (See Table 5).

Table 5 –
Sediment Sample Analytical Results

Compounds	Concentration (mg/L)	Regulatory Levels (mg/L)
Semivolatiles Organics		
1,4-Dichlorobenzene	<0.100	7.5
2,4,5-Trichlorophenol	<0.100	400.0
2,4,6-Trichloropheno	<0.100	2.0
2,4-Dinitrotoluene	<0.100	0.13
Cresols	<0.100	200
Hexchlorobenzene	<0.100	0.13
Hexchlorobutadiene	<0.100	0.5
Hexchloroethane	<0.100	3.0
Nitrobenzene	<0.100	2.0
Pentachlorophenol	<0.100	100.0
Pyridine	<0.100	5.0
Volatile organic Compounds	**Results(mg/L)**	**RCRA Non-Hazardous Waste Standard (mg/L)**
1,2-Dichloroethane	<0.0500	<0.50
Chlorobenzene	<0.0500	<100
tetrachloroethene	<0.0500	NA

Table 5 –
Sediment Sample Analytical Results (Continued)

Compounds	Concentration (mg/L)	Regulatory Levels (mg/L)
Carbon tetrachloride	<0.0500	<0.50
Chloroform	<0.0500	6.0
Benzene	<0.0500	<0.50
Vinyl Chloride	<0.0500	<0.20
1,1-Dichloroethene	<0.0500	NA
Methyl ethyl ketone (MEK)	<0.250	<200
Trichloroethene	<0.0500	NA
TCLP Metals		
Arsenic	<0.500	5.0
Barium	<10.00	100.0
Cadmium	<0.100	1.0
Chromium	<0.500	5.0
Lead	<0.500	5.0
Selenium	<0.100	1.0
Silver	<0.500	0.5
Mercury	<0.00200	0.2
Herbicides	**Results(mg/L)**	**Soil Cleanup Objectives (mg/kg)**
2,4-D	<0.0500	0.5
2,4,5-TP(Silvex)	<0.0500	0.7
Organochlorine Pesticides	**Results(mg/L)**	**RCRA Non-Hazardous Waste Standard (mg/L)**
Chlordane (Technical)	<0.0100	<0.0300
Endrin	<0.0100	<0.0200
Gamma-BHC (Lindane)	<0.0100	<0.40
Heptachlor	<0.0100	<0.008
Heptachlor epoxide	<0.0100	NA
Methoxychlor	<0.0100	<10.00
Toxaphene	<0.100	<0.50
Total Petroleum Hydrocarbons	**Result**	**Risk-based Cleanup Levels in Groundwater(mg/L)**
TPH-GRO	2.96 (mg/L)	1.0
THP-DRO	30.1 (mg/L)	1.0
	Result	**Risk-based Cleanup Levels in Soil(mg/kg)**
TPH-GRO	2.96 (mg/kg)	50
THP-DRO	30.1 (mg/kg)	2500

NA – Not available

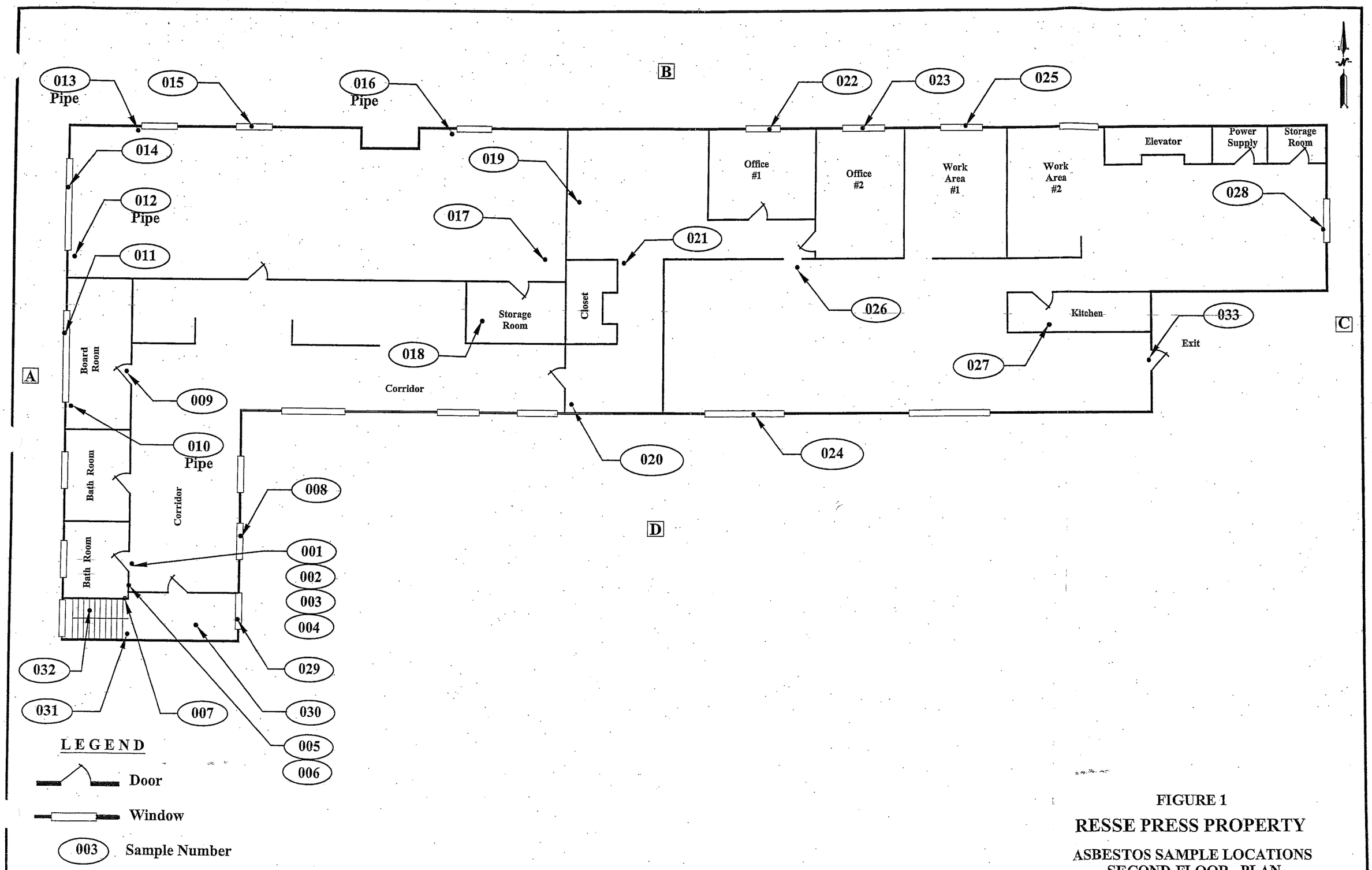

FIGURE 1

RESSE PRESS PROPERTY

ASBESTOS SAMPLE LOCATIONS
SECOND FLOOR PLAN

T-0705-0140

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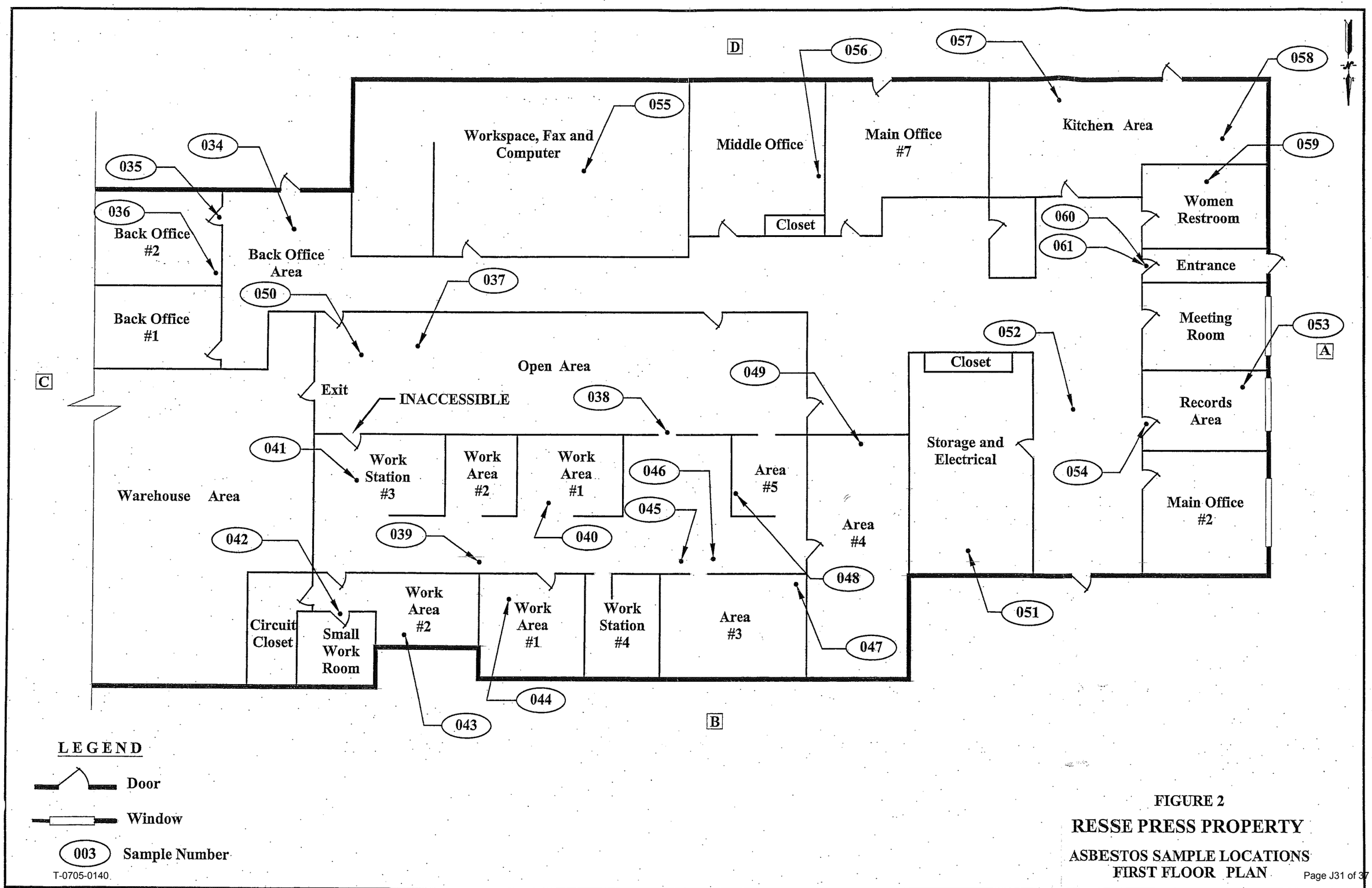

T-0705-0140

FIGURE 2

RESSE PRESS PROPERTY

ASBESTOS SAMPLE LOCATIONS
FIRST FLOOR PLAN

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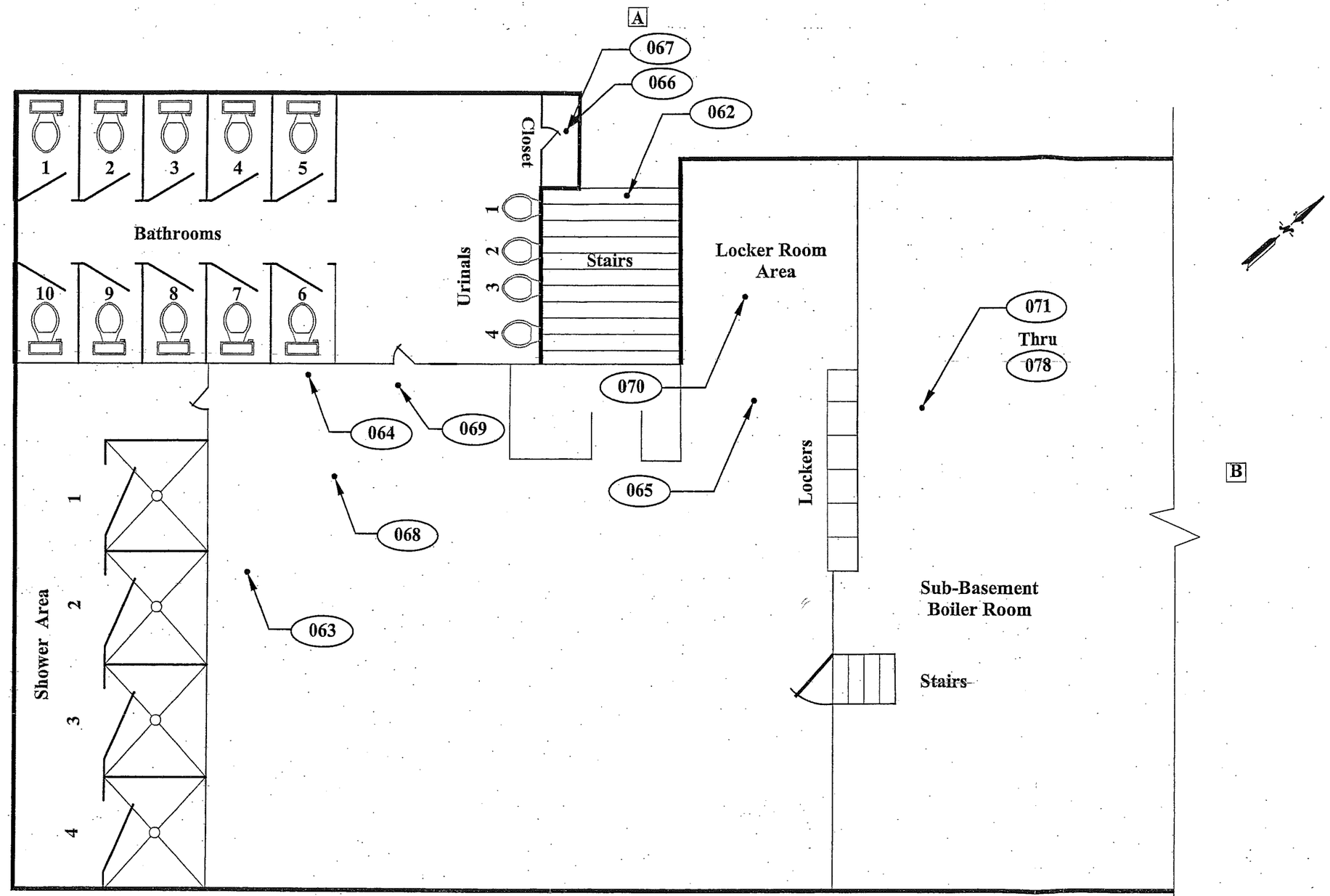

LEGEND

Door

Window

003 Sample Number

T-0705-0140

FIGURE 3

RESSE PRESS PROPERTY

ASBESTOS SAMPLE LOCATIONS
BASEMENT PLAN

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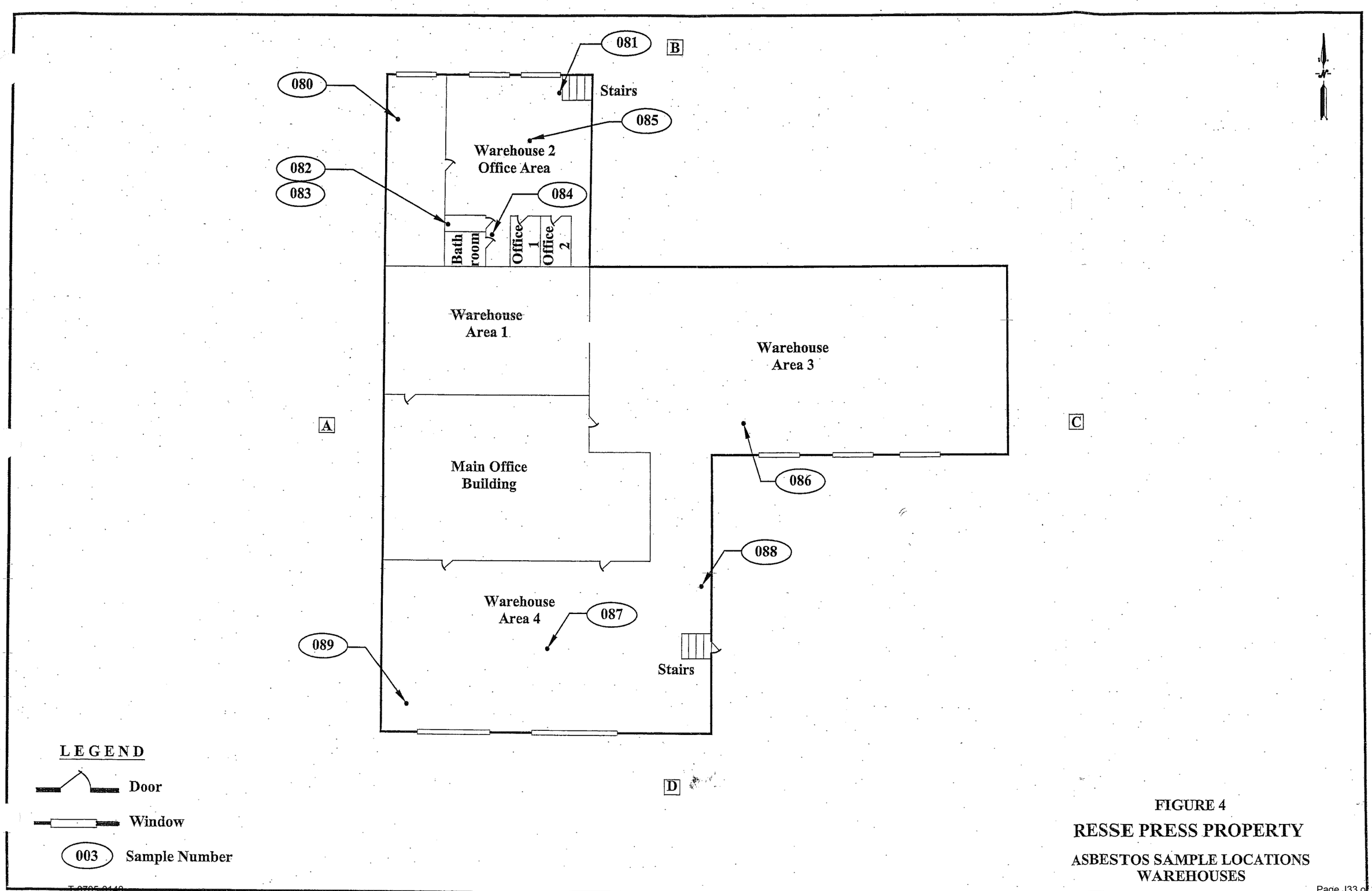

FIGURE 4

RESSE PRESS PROPERTY

ASBESTOS SAMPLE LOCATIONS
WAREHOUSES

T-0705-0140

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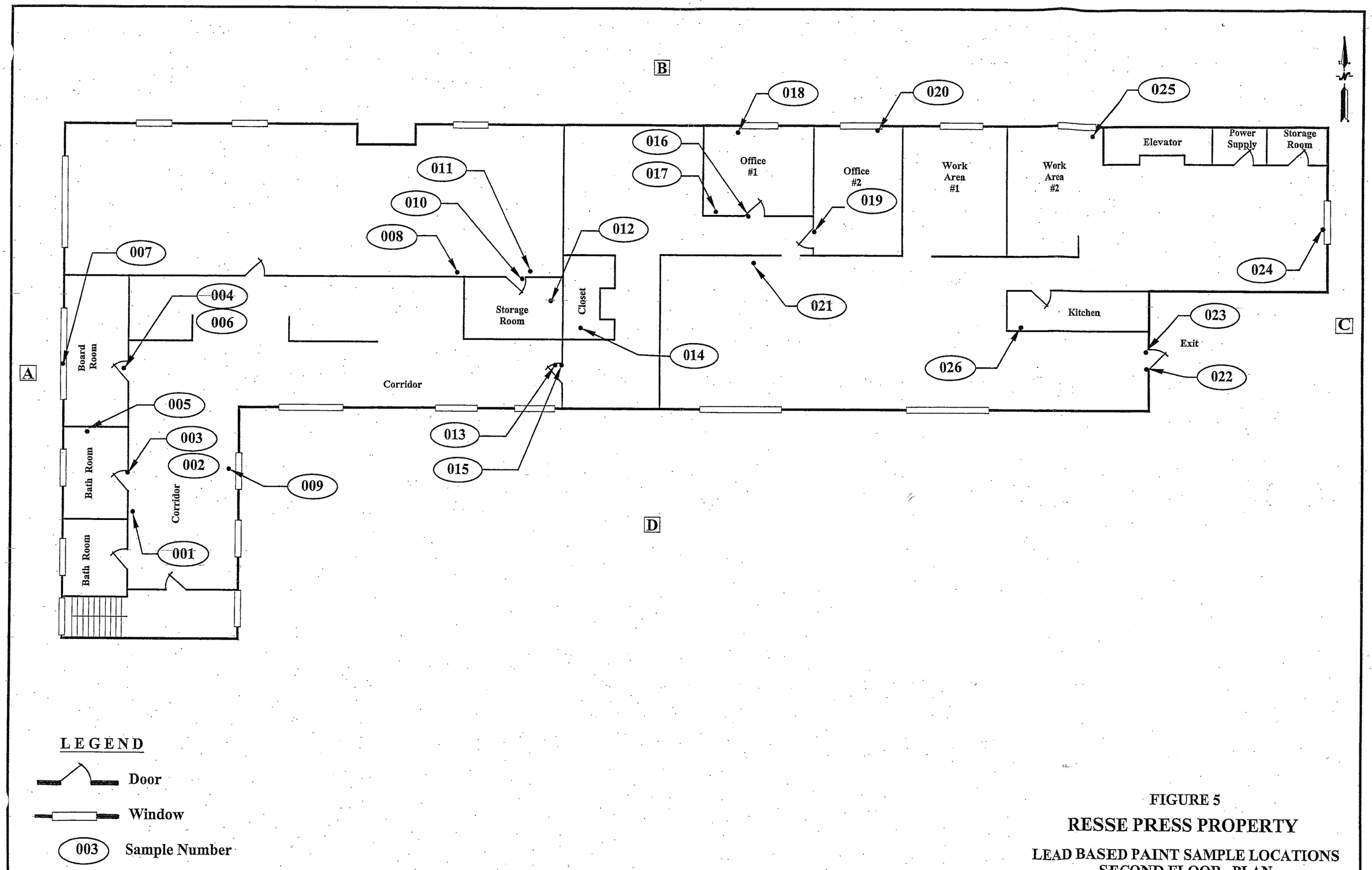

T-0705-0140

FIGURE 5

RESSE PRESS PROPERTY

LEAD BASED PAINT SAMPLE LOCATIONS
SECOND FLOOR PLAN

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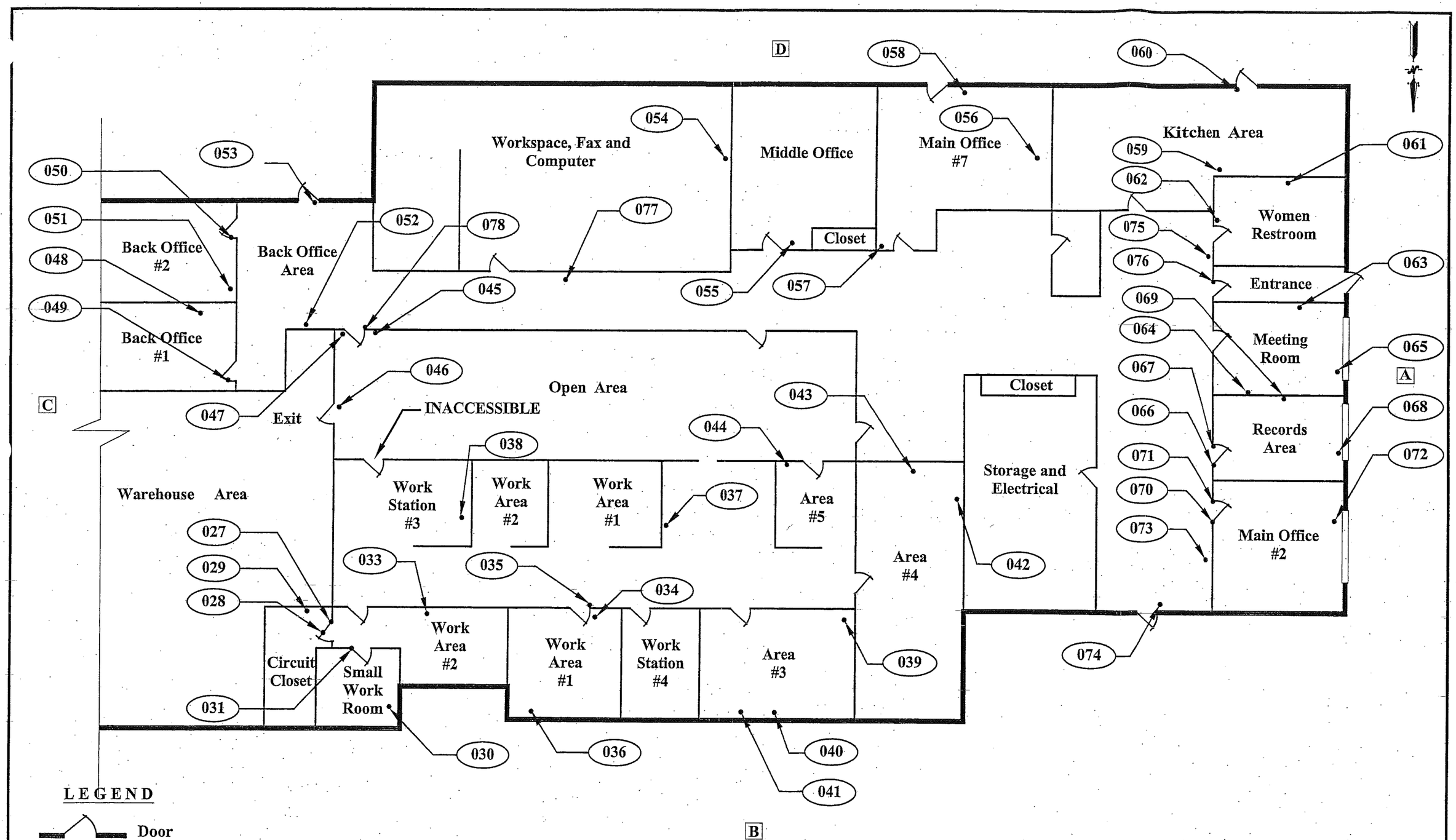

T-0705-0140

FIGURE 6

RESSE PRESS PROPERTY

LEAD BASED PAINT SAMPLE LOCATIONS
FIRST FLOOR PLAN

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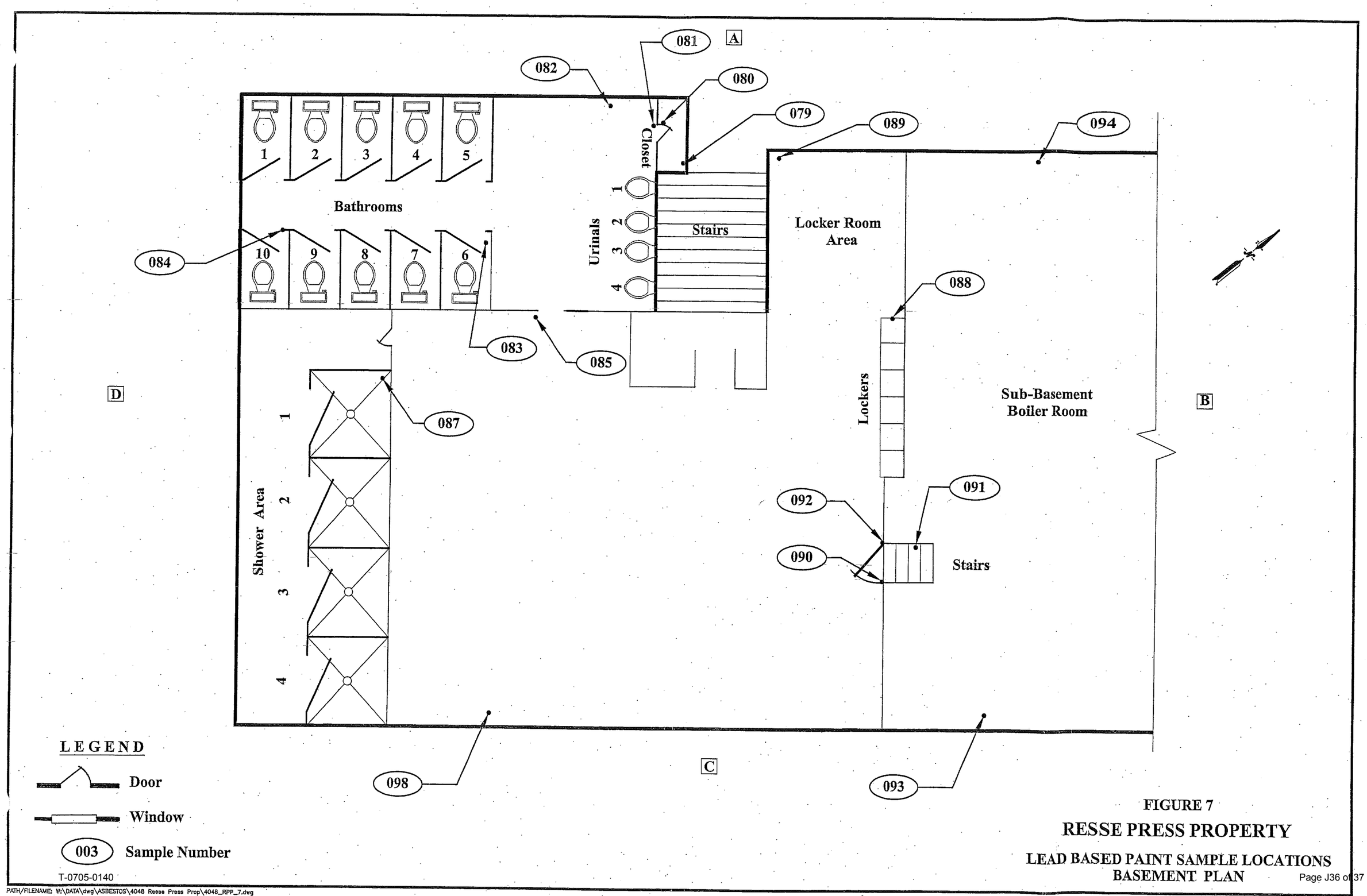

T-0705-0140

FIGURE 7

RESSE PRESS PROPERTY

LEAD BASED PAINT SAMPLE LOCATIONS
BASEMENT PLAN

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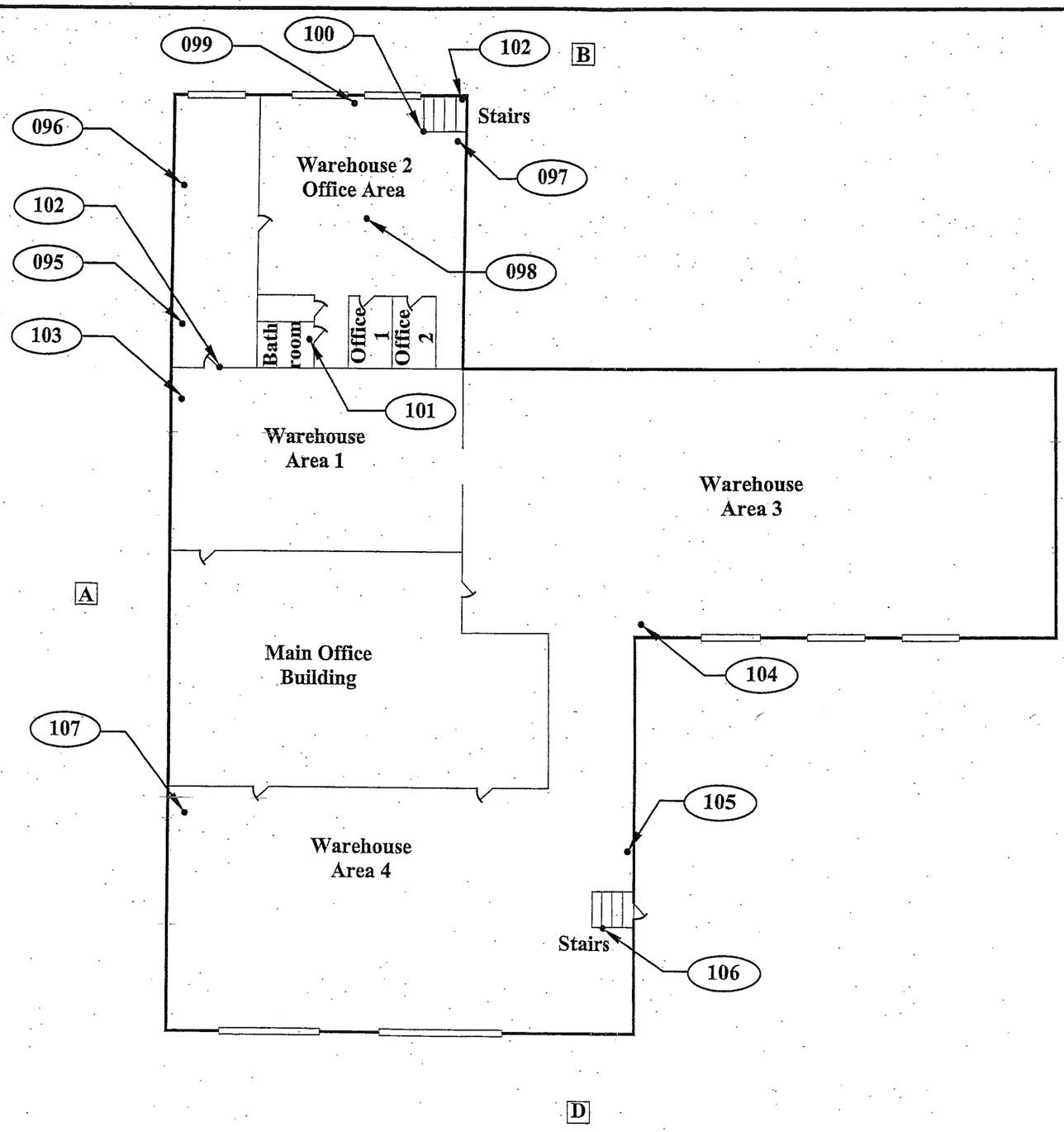

LEGEND

Door

Window

003 Sample Number

FIGURE 8

RESSE PRESS PROPERTY

LEAD BASED PAINT SAMPLE LOCATIONS
WAREHOUSES

PATH/FILENAME: W:\DATA\dwg\ASBESTOS\4048 Resse Press Prop\4048_RPP_6.dwg
LAST UPDATE: June 29, 2006 @ 11:29:17 am