EAGLECREST LEARNING CENTER

VOLUME II OF III
Divisions 9 - 33

Contract No. E14-076

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ENGINEERING DEPARTMENT

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SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Gypsum board shaft wall assemblies.
   3. Gypsum sound deadening board

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

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

2.2 INTERIOR GYPSUM BOARD

A. Products: Subject to compliance with requirements, provide one of the following:
   1. Georgia-Pacific Building Products.
   2. National Gypsum Company;.
   3. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch (15.9 mm).
   2. Long Edges: Tapered.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
   1. Thickness: 1/2 inch (12.7 mm).
   2. Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.3 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated.

B. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.

1. Depth: 2-1/2 inches (64 mm).
2. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).

C. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches (51 mm) long and matching studs in depth.

1. Minimum Base-Metal Thickness: Matching steel studs.

D. Room-Side Finish: Gypsum board.

E. Shaft-Side Finish (underside of stair): Gypsum shaftliner board, Type X.

2.4 SOUND DEADENING PANELS

A. Laminated gypsum panel sound deadening gypsum board, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide Temple-Inland Building Product by Georgia-Pacific Comfort Guard Sound Deadening Gypsum Board or approved equal.

2. Core: 2 layers 5/16” gypsum board laminated to viscoelastic polymer.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM C473.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Plastic.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.7 AUXILIARY MATERIALS

A. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

B. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing full depth of stud space).

C. Acoustical Joint Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.

D. Products: Subject to compliance with requirements, provide one of the following:

1. Pecora Corporation; AC-20 FTR.
2. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
3. USG Corporation; SHEETROCK Acoustical Sealant.

E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

F. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

1. J Molding Trim: Install in locations indicated on Drawings.

E. Prefill open joints and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: N/A.
3. Level 3: N/A.
4. Level 4: N/A.
5. Level 5: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

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: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Low-Emitting Materials: Acoustical panel ceilings 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. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

C. Acoustical Panel Standard: Comply with ASTM E 1264.

D. Metal Suspension System Standard: Comply with ASTM C 635.

E. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.3 ACOUSTICAL PANELS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.Basis of Design Armstrong Fissured
2. Chicago Metallic Corporation.
3. USG Interiors, Inc.

B. Classification: Type III Form 2 Pattern C.D.

C. Color: White.

D. LR: .81.

E. NRC: .55, Type E-400 mounting according to ASTM E 795.

F. CAC: 30.

G. Edge/Joint Detail: Square.

H. Thickness: 5/8 inch (15 mm).

I. Modular Size: 24 by 24 inches (610 by 610 mm).

2.4 METAL SUSPENSION SYSTEM

A. Products: Subject to compliance with requirements, provide one of the following:

1. Armstrong World Industries, Inc.
2. Chicago Metallic Corporation; 200 Snap Grid.
3. USG Interiors, Inc.

B. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation; with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.

2. End Condition of Cross Runners: butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted white.

C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.
2. Resilient stair accessories.
3. Resilient molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FloorScore Compliance: Resilient base and stair accessories shall comply with requirements of FloorScore certification.

B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 THERMOSET-RUBBER BASE

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
2. Flexco, Corporation.
3. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style B, Cove: Provide in areas with resilient flooring & carpeting.

C. Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Cut lengths 48 inches (1219 mm) long or coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As selected by Architect from full range of industry colors.

2.3 RUBBER STAIR ACCESSORIES

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
3. Johnsonite; A Tarkett Company.
4. Roppe Corporation, USA.

C. Stair Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as rubber base and recommended by manufacturer for installation with carpet treads.

1. Thickness: 0.125 inch (3.2 mm).

D. Colors and Patterns: As selected by Architect from full range of industry colors.

2.4 RUBBER MOLDING ACCESSORY

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. Roppe Corporation, USA.
2. VPI Corporation.

B. Description: Rubber reducer strip for resilient flooring.

C. Profile and Dimensions: Carpet to Sheet Vinyl: Roppe #50 or approved equal. Carpet to concrete: Reducer Strip, dimensions as required for floor transition in compliance with ADA.

D. Locations: Provide rubber molding accessories where different flooring materials abut each other.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

2.5 INSTALLATION MATERIALS

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

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50 g/L or less except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

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

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 6 inches in length.

a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.

a. Miter or cope corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

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

B. Resilient Stair Accessories:
1. Tightly adhere to substrates throughout length of each piece.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.

1. Apply one coat.

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

END OF SECTION 096513

SECTION 096516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes vinyl sheet flooring (Sheet Vinyl SV).

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples: For each exposed product and for each color and texture specified in manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. FloorScore Compliance: Resilient sheet flooring shall comply with requirements of FloorScore certification.

C. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 UNBACKED VINYL SHEET FLOORING

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. Manington Commercial; Assurance II.

B. Product Standard: ASTM F 1913.

C. Thickness: 0.080 inch (2.0 mm).

D. Wearing Surface: Smooth.

E. Sheet Width: As standard with manufacturer.

F. Seamless-Installation Method: Heat welded.

G. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

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

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

1. Adhesives shall have a VOC content of 60 g/L or less.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.

a. Color: As selected by Architect from manufacturer's full range to contrast with flooring.

D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:

    a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.2 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches (152 mm) away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.

B. Floor Polish: Remove soil, adhesive, and blemishes from flooring surfaces before applying liquid floor polish.

1. Apply one coat(s).

C. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 096516

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes modular, tufted carpet tile.
B. Section includes modular, carpet walk off mat.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Type of subfloor.
3. Type of installation.
4. Pattern of installation.
5. Pattern type, location, and direction.
6. Pile direction.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.8 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE (CPT)

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. InterfaceFLOR, LLC. USA.
2. Mannington Mills, Inc.
3. Mohawk Group (The); Mohawk Carpet, LLC.Basis of design Bigelow First One Up BT286

B. Product Type: Modular

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

D. Style: Mohawk First One Up.

E. Surface texture: Textured Pattern Loop

F. Fiber Content: 100 percent nylon 6, 6.

G. Fiber Type: Colorstrand SD Nylon.

H. Pile Characteristic: Tufted pile textured pattern loop.

I. Density: 7266 .

J. Gage: 1/12 per **inch (mm)**.

K. Face Weight: 22 oz./sq. yd. (g/sq. m) for finished carpet tile.

L. Primary Backing/Backcoating: Manufacturer's standard composite materials.

M. Backing System: ECOflexICT.

N. Size: 24 by 24 inches (610 by 610 mm).

O. Applied Soil-Resistance Treatment: Manufacturer's standard material Sentry Plus.

P. Antimicrobial Treatment: Manufacturer's standard material.

Q. Performance Characteristics: As follows:

1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
2. Critical Radiant Flux Classification: Not less than 0.22 W/sq. cm.
3. Dry Breaking Strength: Not less than 100 lbf (445 N) according to ASTM D 2646.
4. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
5. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
6. Resistance to Insects: Comply with AATCC 24.
7. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
8. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.
9. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.
10. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.
11. Emissions: Provide carpet tile that complies with testing and product requirements of CRI's "Green Label Plus" program.

2.2 WALK OFF MAT (WOM)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mannington Recoarse II Re Modular or approved equal.

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

C. Pattern: Textured Pattern Loop.

D. Fiber Content: 100 percent nylon 6, 6.

E. Pile Characteristic: Textured Pattern Loop.

F. Density: Average Density = 7,354 Weight Density = 279,484.

G. Pile Thickness: .186 inches for finished carpet tile.

H. Stitches: 10.33.

I. Gage: 1/12.

J. Tufted Yarn Weight: 38 oz./sq. yd. for finished carpet tile.

K. Primary Backing/Backcoating: 100% woven synthetic.

L. Secondary Backing: Infinity RE Modular Reinforced composite closed cell polymer with recycled content.

M. Primary Precoat: 100% Non Aqueous Closed Cell Polymer Providing lifetime warranty against stain wick back.

N. Size: 24 by 24 inches.

O. Applied Soil-Resistance Treatment: Manufacturer's standard material XGUARD.

P. Antimicrobial Treatment: Manufacturer's standard material.

2.3 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710.

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

D. Installation: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

E. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

F. Maintain dye lot integrity. Do not mix dye lots in same area.

G. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

H. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

I. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

J. Install pattern parallel to walls and borders.

K. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

L. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."

END OF SECTION 096813

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
   1. Steel.
   2. Fiberglass Doors & Frames.
   3. Miscellaneous Exposed Wood.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

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

B. Samples: For each type of paint system and each color and gloss of topcoat.

C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design:

1. Benjamin Moore & Co.

B. 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. ICI Paints.
2. Kelly-Moore Paints.
3. PPG Architectural Finishes, Inc.
4. Pratt & Lambert.
5. Rodda Paint Co.
6. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Provide materials that comply with VOC limits 114 g/l or less.

D. Colors: As selected by Architect from manufacturer's full range.

1. 100 percent of surface area will be painted with deep tones.

2.3 PRIMERS (WOOD, STEEL and FIBERGLASS)

A. Primer, Latex Exterior Paint: MPI #114.

1. Benjamin Moore Premium Impervex Latex High gloss Enamel (N309).

2.4 WATER-BASED PAINTS (WOOD, STEEL and FIBERGLASS)

A. Latex, Exterior (Gloss Level 6): MPI #114.

1. Benjamin Moore Premium Impervex Latex High gloss Enamel (N309).

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

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

3.5 EXTERIOR PAINTING SCHEDULE

A. Shop Primed and Galvanized-Metal Substrates (excluding galvanized guardrails and handrails) :

1. Latex System:

a. Prime Coat: Latex, exterior, matching topcoat.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #114.

B. Fiberglas and Wood Substrates: Including fiberglass doors, trim and exposed wood not receiving stain.

1. Latex System:

a. Prime Coat: Latex, exterior, matching topcoat.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior gloss (Gloss Level 6), MPI #114.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Steel.
3. Galvanized metal.
4. Wood.
5. Gypsum board.
6. ASJ insulation covering.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

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

B. Samples: For each type of paint system and in each color and gloss of topcoat.

C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of

colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Nonflat Paints and Coatings: 150 g/L.
2. Primers, Sealers, and Undercoaters: 200 g/L.
3. Floor Coatings: 100 g/L.

D. Colors: As selected by Architect from manufacturer's full range.

1. 10 percent of surface area will be painted with deep tones.

2.3 PRIMERS/SEALERS

A. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #140.

1. Benjamin Moore Regal Select Pearl Finish 550.

2.4 WATER-BASED PAINTS

A. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3) MPI #140:

1. Benjamin Moore Regal Select Pearl Finish 550.

2.5 FLOOR COATINGS

A. Sealer, Water Based, for Concrete Floors: MPI #99.

1. Benjamin Moore Super spec HP Clear acrylic sealer P27.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Wood: 15 percent.
3. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

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

3.5 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Clear Sealer System:

a. First Coat: Sealer, water based, for concrete floors.
b. Topcoat: Sealer, water based, for concrete floors.

B. Steel Substrates:

1. Latex over Alkyd Primer System:

a. Prime Coat: Shop primer specified in Section where substrate is specified.
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, (Gloss Level 3).

C. Wood Substrates: Including wood trim architectural woodwork wood-based panel products.

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer, latex, for interior wood.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3).

D. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3).

E. Cotton or Canvas and ASJ Insulation-Covering Substrates: Including pipe and duct coverings.

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer sealer, latex, interior.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3).

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of wood finishes on the following substrates:

1. Exterior Substrates:
   a. Dressed lumber (finish carpentry).

2. Interior Substrates:
   a. Dressed lumber (finish carpentry).

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

D. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

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

B. Samples: For each type of finish system and in each color and gloss of finish indicated.

C. Product List: For each product indicated, include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the product proposed for use highlighted.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the category indicated.

2.2 MATERIALS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each finish system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a finish system, provide products recommended in writing by manufacturers of topcoat for use in finish system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior stains and finishes applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
2. Shellacs, Clear: VOC not more than 730 g/L.
3. Stains: VOC not more than 250 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.

D. Stain Colors: As selected by Architect from manufacturer's full range.

2.3 STAINS

A. Stain, Semi-Transparent for Exterior Wood , Water Based : MPI #156.

1. Benjamin Moore Arbor Coat 638 or approved equal.

B. Stain, Semi-Transparent, for Interior Wood: MPI #90.

1. Benjamin Moore Waterborne Stain or approved equal.

2.4 WATER-BASED VARNISHES

A. Varnish, Water Based, Clear, Satin (Gloss Level 4): MPI #128.

1. Benjamin Moore Stays Clear or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.

1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 EXTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood substrates, nontraffic surfaces, including wood trim and wood siding.

1. Semitransparent Stain System:

a. Prime Coat: Stain, exterior, water based, semi-transparent, matching topcoat.
b. Topcoat: Stain, exterior, water based, semi-transparent, MPI #156.

3.6 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Wood substrates, nontraffic surfaces, including wood trim.

1. Water-Based Varnish over Stain System:

a. Stain Coat: Stain, semi-transparent, for interior wood, MPI #90.
b. First Intermediate Coat: Water-based varnish matching topcoat.
c. Second Intermediate Coat: Water-based varnish matching topcoat.
d. Topcoat: Varnish, water based, clear, satin (Gloss Level 4), MPI #128.

END OF SECTION 099300

SECTION 101100 - VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Visual display board assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For visual display units.

1. Include plans, elevations, sections, details, and attachment to other work.
2. Show locations of panel joints.

C. Samples: For each type of visual display unit indicated.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 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.

2.2 VISUAL DISPLAY BOARD ASSEMBLY

A. Products: Subject to compliance with requirements, provide one of the following:

1. AARCO Products, Inc.
2. Architectural School Products Ltd.
3. Claridge Products and Equipment, Inc.

B. Visual Display Board Assembly: factory fabricated.

1. Assembly: markerboard.

2. Corners: Square.
3. Width: As indicated on Drawings.
4. Height: As indicated on Drawings.

C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.

1. Color: White.

D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- (1.57-mm-) thick, extruded aluminum; standard size and shape.

1. Aluminum Finish: Manufacturer's standard baked-enamel or powder-coat finish.

a. Color: As selected by Architect from full range of industry colors and color densities.

E. Chalktray: Manufacturer's standard; continuous.

1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.

F. Display Rail: Manufacturer's standard, extruded-aluminum display rail with plastic-impregnated-cork insert, end stops, and continuous paper holder, designed to hold accessories.

1. Size: 2 inches (50 mm) high by full length of visual display unit.
2. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches (1200 mm) of display rail or fraction thereof.
3. Tackboard Insert Color: As selected by Architect from full range of industry colors.
4. Aluminum Color: Match finish of visual display assembly trim.

G. Paper Holder Display Rail: Extruded aluminum; designed to hold paper by clamping action.

2.3 MARKERBOARD PANELS

A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.

1. Face Sheet Thickness: 0.021 inch (0.53 mm) uncoated base metal thickness.
2. Manufacturer's Standard Core: Minimum 1/4 inch (6 mm) thick, with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.4 MATERIALS

A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.

B. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout with surface-burning characteristics indicated.

C. Extruded Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

D. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

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

2.5 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 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. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches (400 mm) o.c. Secure tops and bottoms of boards to walls.

END OF SECTION 101100

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cutout dimensional characters.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For dimensional letter signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.

C. Samples: For each exposed product and for each color and texture specified.

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

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

A. Cutout Characters: Characters with uniform faces; square-cut, smooth, eased edges; precisely formed lines and profiles; and as follows:

1. Products: Subject to compliance with requirements, provide one of the following:

a. APCO Graphics, Inc.
b. ASI Sign Systems, Inc.
c. InPro Corporation (IPC).
d. Metal Arts.

2. Character Material: Sheet or plate aluminum.

3. Character Height: As indicated.
4. Thickness: As indicated.
5. Finishes:
    a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.
    b. Overcoat: Manufacturer's standard baked-on clear coating.
6. Mounting: Projecting studs.

2.2 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:
    a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
4. Sign Mounting Fasteners:
    a. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.

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

END OF SECTION 101419

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel signs: Room-identification signs.
2. Panel signs: Way finding signs (Directional signs) .

1.2 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. Samples: For each exposed product and for each color and texture specified.

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

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 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.

2.2 SIGNS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Best Sign Systems, Inc.
2. Mohawk Sign Systems.
3. Seton Identification Products.

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

1. Basis-of-Design Product: Mohawk Sign Systems 1000 ADA System.

2. Solid-Sheet Sign: Melamine Polymer sheet: Sand carved to remove background material retaining raised text and Braille characters..

3. Sign-Panel Perimeter: Finish edges smooth.

   a. Edge Condition, Vertical Edges, Horizontal Edges: Square cut.
   b. Corner Condition in Elevation: As indicated.

4. Window Slots: Where indicated provide 1” high window slot to receive clear lexan insert with vinyl applies text.

5. Mounting: Surface mounted to wall with adhesive or two-face tape.

C. Ceiling Double Sided Way finding Signs: Two sided sign with smooth, uniform surfaces; with raised message and characters both sides having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: Office Sign Company 2 sided ceiling mounted sign.

2. Two Sided Silver aluminum plate with Black text both sides –font optima.Directional arrows.

3. Sign-Panel Perimeter: Black Plastic frame.

   a. Edge Condition, Vertical Edges, Horizontal Edges: Square cut.
   b. Corner Condition in Elevation: Round..

4. Mounting: Easy mount metal bracket.

2.3 PANEL-SIGN MATERIALS

A. Melamine Plastic Laminate: NEMA Rated self extinguishing 1/4” thick

2.4 ACCESSORIES

A. Adhesives: As recommended by sign manufacturer and that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. 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.
3. Ceiling mounted bracket: Metal brackets fastened to ceiling soffit or open web steel joists with screws matching bracket finish.

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

END OF SECTION 101423

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.

C. Samples for each type of toilet compartment material indicated.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 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: 450 or less.

B. Regulatory Requirements: 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 toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENTS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. Basis of Design: Bradley Series 400 Sentinel

B. Toilet-Enclosure Style: Overhead braced Floor anchored.

C. Urinal-Screen Style: Floor anchored.

D. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

E. Pilaster Shoes and Sleeves (Caps): Formed 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. Urinal-Screen Post: Manufacturer's standard post design of monolithic phenolic urinal screen cut out at bottom to form a post; with shoe and sleeve (cap) matching that on the pilaster.

G. Brackets (Fittings):

1. Full-Height (Continuous) Type: Manufacturer's standard design; aluminum.

H. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard through-color core matching face sheet.
3. Edge Color: Through-color matching facing sheet color.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: Clear-anodized aluminum.
2. Provide slide type latches and units that comply with regulatory requirements for accessibility 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, 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 compatible with related materials.

2.4 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

E. 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

3.1 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. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

3.2 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.

END OF SECTION 102113.17

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.
3. Underlavatory guards.
4. Custodial accessories.

B. Owner-Furnished Material: Paper Towel dispensers and soap dispensers will be provided by Owner and are to be installed by contractor.

1.2 ACTION SUBMITTALS

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

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

1. Identify locations using room designations indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

1.6 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

2.1 PUBLIC-USE WASHROOM ACCESSORIES

A. Products: Subject to compliance with requirements, provide one of the following:

1. A&J Washroom Accessories, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.

B. Toilet Tissue (Roll) Dispenser:

1. Basis-of-Design Product: Bradley 5269.
2. Description: Double-roll dispenser with shelf.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with standard spindle.
5. Capacity: Designed for 4-1/2- or 5-inch- (114- or 127-mm-) diameter tissue rolls.
6. Material and Finish: Stainless steel, No. 4 finish (satin).

C. Grab Bar:

1. Basis-of-Design Product: Bradley 812.
2. Mounting: Flanges with exposed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

    a. Finish: Smooth, No. 4 finish (satin).

4. Outside Diameter: 1-1/4 inches (32 mm).
5. Configuration and Length: As indicated on Drawings.

D. Sanitary-Napkin Disposal Unit:

1. Basis-of-Design Product: Bradley 4781-15.
2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

E. Mirror Unit:

1. Basis-of-Design Product: Bradley 781.
2. Frame: Stainless-steel channel Stainless steel, fixed tilt Stainless steel, adjustable tilt.

    a. Corners: Manufacturer's standard.

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

    a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.

F. Surface Mounted Shelf:

1. Basis-of-Design Product: Bradley 755.
2. Description: 18 gauge stainless steel shelf with integral end brackets.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

G. Robe Hook:

1. Basis-of-Design Product: Bradley 9124.
2. Description: Double-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

2.2 CHILDCARE ACCESSORIES

A. Diaper-Changing Station:

1. Basis-of-Design Product: Bradley 962.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.

    a. Engineered to support a minimum of 250-lb (113-kg) static load when opened.

3. Mounting: Semirecessed, with unit projecting not more than 1 inch (25 mm) from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: Stainless steel, No. 4 finish (satin), exterior shell with rounded plastic corners; HDPE interior in manufacturer's standard color.
6. Liner Dispenser: Built in.

2.3 UNDERLAVATORY GUARDS

A. Products: Subject to compliance with requirements, provide the following:
1. Truebro by IPS Corporation.

B. Underlavatory Guard:

1. Basis-of-Design Product: Truebro LavGuard 2.
2. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.4 CUSTODIAL ACCESSORIES

A. Products: Subject to compliance with requirements, provide one of the following:

1. A&J Washroom Accessories, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.

B. Mop and Broom Holder:

1. Basis-of-Design Product: Bradley 9933.
2. Description: Unit with shelf, hooks, holders, and rod 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.
b. Rod: Approximately 1/4-inch- (6-mm-) diameter stainless steel.

2.5 FABRICATION

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

PART 3 - EXECUTION

3.1 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.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fire-protection cabinets for portable fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-protection cabinets.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

B. Products: Subject to compliance with requirements, provide one of the following:

1. JL Industries, Inc.; a division of the Activar Construction Products Group.
2. Kidde Residential and Commercial Division.
3. Larsens Manufacturing Company.

C. Cabinet Construction: Nonrated.

D. Cabinet Material: Cold-rolled steel sheet.

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.

F. Cabinet Trim Material: Same material and finish as door.

G. Door Material: Steel sheet.

H. Door Style: Fully glazed panel with frame.

I. Door Glazing: Acrylic sheet.

1. Acrylic Sheet Color: Clear transparent acrylic sheet.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

K. Accessories:

1. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet glazing.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Red.
4) Orientation: Vertical.

L. Materials:

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

a. Finish: Baked enamel or powder coat.
b. Color: As selected by Architect from full range of industry colors and color densities.

2. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 1.5 mm thick, with Finish 1 (smooth or polished).

2.2 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

B. Install fire-protection cabinets in locations and at mounting heights indicated

C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply vinyl lettering at locations indicated.

E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.4 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

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

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

B. Multipurpose Dry-Chemical Type: UL-rated 5lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized 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.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

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

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Fire extinguisher cabinets: Provide fire extinguisher for each cabinet.

2. Mechanical Room 110: Provide fire extinguisher on mounting bracket adjacent door.

3. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb.

END OF SECTION 104416

SECTION 123623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic-laminate countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products and high-pressure decorative laminate.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

C. Samples:

1. Plastic laminates, for each color, pattern, and surface finish.

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

B. Grade: Premium.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

D. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. Formica Corporation.
2. Lamin-Art, Inc.
3. Wilsonart International Holdings, Inc.

E. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As selected by Architect from manufacturer's full range in the following categories:

a. Solid colors, matte finish.
b. Wood grains, matte finish.
c. Patterns, matte finish.

F. Edge Treatment: Same as laminate cladding on horizontal surfaces.

G. Core Material at Sinks: exterior-grade plywood.

H. Core Thickness: 3/4 inch (19 mm).

1. Build up countertop thickness to 1-1/2 inches (38 mm) at front, back, and ends with additional layers of core material laminated to top.

I. Paper Backing: Provide paper backing on underside of countertop substrate.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
2. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
3. Softwood Plywood: DOC PS 1.

2.3 ACCESSORIES

A. Grommets for Cable Passage through Countertops: 2-inch (51-mm) OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett & Company, Inc.

2.4 MISCELLANEOUS MATERIALS

A. Adhesives: Do not use adhesives that contain urea formaldehyde.

B. VOC Limits for Installation Adhesives and Sealants: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Structural Wood Member Adhesive: 140 g/L.
4. Architectural Sealants: 250 g/L.

2.5 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch (25 mm) over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch (1.5 mm) unless otherwise indicated.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches (150 mm) of front and back edges and at intervals not exceeding

24 inches (600 mm). Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
2. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c. and to walls with adhesive.
3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

END OF SECTION 123623.13

SECTION 142100 - ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes machine room less electric traction passenger elevators.

1.2 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, coordination with building structure, relationships with other construction, and locations of equipment.

C. Samples: For exposed finishes.

1.3 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and control closet layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

1.5 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:

1. Mitsubishi Electric Corporation.
2. Otis Elevator Co.
3. ThyssenKrupp Elevator. Basis of design,Synergy self supported

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.
1. Provide earthquake equipment required by ASME A17.1/CSA B44.
2. Provide seismic switch required by ASCE/SEI 7.
3. Project Seismic Design Category: D.
4. Elevator Component Importance Factor: 1.0.

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:
1. Machine Type: Gearless traction.
2. Rated Load: 2500 lb (1135 kg).
3. Rated Speed: 150 fpm .
4. Auxiliary Operations:
    a. Battery-powered lowering.
5. Car Enclosures:
    a. Inside Width: 84 inches from side wall to side wall.
    b. Inside Depth: 67 inches from back wall to front wall (return panels).
    c. Inside Height: 88 inches (2235 mm) to underside of ceiling.
    d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish.
    e. Car Fixtures: Satin stainless steel, No. 4 finish.
    f. Side and Rear Wall Panels: Enameled steel.

g. Door Faces (Interior): Enameled steel.
h. Ceiling: Luminous ceiling.
i. Handrails: 1/2 by 2 inches (13 by 50 mm) rectangular satin stainless steel, No. 4 finish, at sides and rear of car.
j. Floor prepared to receive carpet (specified in Section 096816 "Sheet Carpeting").

6. Hoistway Entrances:

a. Width: 42 inches (1067 mm).
b. Height: 84 inches (2134 mm).
c. Type: Single-speed side sliding.
d. Frames: Enameled steel.
e. Doors: Enameled steel.

7. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.
b. Provide hooks for protective pads and one complete set(s) of full-height protective pads.

2.4 TRACTION SYSTEMS

A. Elevator Machines: Variable-voltage, variable-frequency, ac-type hoisting machines and solid-state power converters.

1. Limit total harmonic distortion of regenerated power to 5 percent per IEEE 519.
2. Provide means for absorbing regenerated power when elevator system is operating on standby power.

B. Fluid for Hydraulic Buffers: If using hydraulic buffers, use only fire-resistant fluid.

C. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.

D. Guides: Roller guides or polymer-coated, nonlubricated sliding guides. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.

B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Single-Car Battery-Powered Lowering: If power fails and car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to the

next floor below, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

2.6 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

2.7 CAR ENCLOSURES

A. General: Provide enameled-steel car enclosures to receive removable wall panels, withcar roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Enameled-Steel Wall Panels: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
2. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
3. Sills: Extruded aluminum, with grooved surface, 1/4 inch (6.4 mm) thick.
4. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
5. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Enameled-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
2. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both inside surfaces of hoistway door frames.

3. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
4. Sills: Extruded aluminum, with grooved surface, 1/4 inch (6.4 mm) thick.

2.9 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life lamps and acrylic or other permanent, non-yellowing translucent plastic diffusers or LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Provide "No Smoking" sign matching car-control station, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

E. Hall Push-Button Stations: Provide hall push-button stations at each landing as indicated.

F. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

2.10 FINISH MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

D. Stainless-Steel Bars: ASTM A 276, Type 304.

E. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

B. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.

C. Leveling Tolerance: 1/8 inch (3 mm), up or down, regardless of load and travel direction.

D. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

3.3 PROTECTION

A. Temporary Use: Limit temporary use for construction purposes. Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
3. Engage elevator Installer to provide full maintenance service.
4. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s).

END OF SECTION 142100

SECTION 210500 -COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe, fittings, valves, and connections for wet and dry sprinkler systems.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 – Interior Paint: Preparation and painting of fire protection piping systems.

B. Section 21 0553 - Identification for Fire Suppression Piping and Equipment: Piping identification.

C. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

1.3 REFERENCE STANDARDS

A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2010.

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2005.

C. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

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

E. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers; 2009 (ANSI/ASME B16.5).

F. ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings; The American Society of Mechanical Engineers; 2007.

G. ASME B36.10M - Welded and Seamless Wrought Steel Pipe; The American Society of Mechanical Engineers; 2004.

H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2010.

I. ASTM A135/A135M - Standard Specification for Electric-Resistance Welded Steel Pipe; 2009.

J. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2008.

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

L. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2009 (ANSI/AWWA C151/A21.51).

M. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2010.

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

O. UL 262 - Gate Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

P. UL 312 - Check Valves for Fire-Protection Service; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

C. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. See 211300 for additional requirements.

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

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

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

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Valve Stem Packings: Two for each type and size of valve.

1.5 QUALITY ASSURANCE

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

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

C. Valves: Bear UL label or marking. Provide manufacturer's name and pressure rating marked on valve body.

D. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Conform work to NFPA 13.

B. Welding Materials and Procedures: Conform to ASME Code.

2.2 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 10 (3-inches and over only) or ASTM A53 Schedule 40, black.

1. Steel Fittings: ASME B16.9, wrought steel, buttwelded.
2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
3. Malleable Iron Fittings: ASME B16.3, threaded fittings.
4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe. Couplings to fully encircle pipe and not U-bolt type. Similar to Victaulic Style 75 or 77. Rolled groove type. Cut groove not acceptable.
5. Dry and Exterior piping and fittings shall be galvanized schedule 40.
6. Piping over 3-inch size may be electrically welded, using backing rings and coated rods.

2.3 BACKFLOW PREVENTER

A. Manufacturers:

1. Ames.
2. Febco.
3. Watts.

B. Double Check Valves Assemblies: Bronze or steel body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent, test cocks, valves each side, listed for fire protection systems.

2.4 VALVE TAMPER SWITCH

A. Manufacturers:

1. Potter
2. ADTC.
3. Grinnell.

B. All-metal construction with switch housing and holder secured to valve with anchor bolts. Arranged to sense if valve is closed. Electrical connection furnished under Electrical Divisions.

2.5 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 2 inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2-1/2 inches and Over: Carbon steel, adjustable, clevis.

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

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

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

F. Vertical Support: Steel riser clamp.

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

H. Galvanized: Pipe hangers and supports shall be galvanized where in contact with galvanized piping or installed outside of the building.

I. Accessories: Hanger Rod: Mild steel continuous threads, corrosion resistant coated.

2.6 GATE VALVES

A. Up to and including 2 inches:

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

B. Over 2 inches:

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

C. 4 inches and Over:

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

2.7 BALL VALVES

A. Up to and including 2 inches:

1. Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, full port, teflon seats and stuffing box ring, lever handle, threaded ends.

2.8 BUTTERFLY VALVES

A. Bronze Body:

1. Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.

B. Cast or Ductile Iron Body

1. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated 10 amp at 115 volt AC.

2.9 CHECK VALVES

A. Up to and including 2 inches:

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

B. Over 2 inches:

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

C. 4 inches and Over:

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

2.10 DRAIN VALVES

A. Ball Valve:

1. Brass with cap and chain, 3/4 inch hose thread.
2. Compression Stops: Bronze with hose thread nipple and cap.

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

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

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

3.2 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Provide sway bracing as required by NFPA 13.

C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

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

E. Group piping whenever practical at common elevations.

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

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

H. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

I. Pipe Hangers and Supports:

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

2. Place hangers within 12 inches of each horizontal elbow.
3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
6. Prime coat exposed steel hangers and supports. Refer to Section 09 9000. Hangers and supports located in pipe shafts and above suspended ceiling spaces are not considered exposed.

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

K. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 9123.

L. Do not penetrate building structural members unless indicated.

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

N. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

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

P. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.

Q. Provide gate valves for shut-off or isolating service.

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

S. Coordinate closely with all other Contractors. In general, pitched waste and vent piping and ductwork shall take preference in location within the Project area. Sprinkler piping shall be installed in structural joist space throughout, except where sprinkler main piping is shown to cross below beam. Coordination of all drain valves, and other equipment requiring access and maintenance procedures is required with all building components during construction for maximum accessibility and proper location as intended.

END OF SECTION 210500

SECTION 210553 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.2 REFERENCE STANDARDS

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

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

1.3 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

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

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

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

PART 2 - PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Major Control Components: Nameplates.

B. Piping: Pipe markers.

C. Valves: Tags.

2.2 NAMEPLATES

A. Manufacturers:

1. Kolbi Pipe Marker Co
2. Seton Identification Products

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

1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Thickness: 1/8 inch.
5. Plastic: Conform to ASTM D709.

2.3 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving
2. Brady Corporation
3. Kolbi Pipe Marker Co
4. Seton Identification Products

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

2.4 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation
2. Kolbi Pipe Marker Co
3. MIFAB, Inc
4. Seton Identification Products

B. Color: Conform to ASME A13.1.

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

D. Color code as follows:

1. Fire Quenching Fluids: Red with white letters.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

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

B. Install tags with corrosion resistant chain.

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

D. Use tags on piping 3/4 inch diameter and smaller.

1. Identify service, flow direction, and pressure.
2. Install in clear view and align with axis of piping.
3. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION 210553

SECTION 211300 - FIRE SUPPRESSION SPRINKLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wet-pipe sprinkler system.

B. Dry-pipe sprinkler system

C. System design, installation, and certification.

D. Fire department connections.

1.2 RELATED REQUIREMENTS

A. Section 21 0500 - Common Work Results for Fire Suppression: Pipe, fittings, and valves.

B. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

C. Section 22 0553 - Identification for Plumbing Piping and Equipment.

D. Section 26 2726 – Wiring Devices: Electrical characteristics and wiring connections.

E. Section 28 3111 – Digital Addressable Fire alarm System.

1.3 REFERENCE STANDARDS

A. NFPA 13 - Standard for the Installation of Sprinkler Systems; National Fire Protection Association; 2010.

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

1.4 SUMMARY OF WORK

A. Provide a complete wet sprinkler systems for Eaglecrest Learning Center. In addition:

1. All areas without exposed structural ceilings shall have concealed sprinkler piping with recessed heads.

2. Provide recessed heads in all finished ceilings. Upright, sidewall, and pendent heads are acceptable in exposed structural ceiling areas.

3. All sprinkler piping shall be installed in joist space except where sprinkler main is specifically shown to be located below beam. Where shown located below beam, sprinkler main to be located concealed above ceiling. All other sprinkler piping shall be

installed in joist space.

4. Water supply for the building fire suppression system is from existing 20,000 gallon and 8,000 gallon water storage tanks located approximately 140 feet elevation above the first floor level of the learning center building. Tanks are located approximately 1150 feet pipe length from learning center building. See Civil Drawings for 6-inch PVC water service piping connection location. Verify all existing conditions on-site.

5. Provide coverage of exterior canopies with concealed dry pipe system.

1.5 WORK INCLUDED

A. The Mechanical Work is governed by the entire Specifications and not just Division 21. The entire Specifications must be examined for requirements relating to the Work hereunder. The Work covered by this and all other Mechanical sections consists of furnishing labor, equipment, and materials in accordance with the Specifications or Drawings, or both, together with any incidental items not shown or specified which can be reasonably inferred or taken as belonging to the Work and necessary in good practice to provide a complete system described or shown as intended.

1.6 SUBMITTALS

A. General: Provide submittals according to Conditions of Contract, Division 01 Specifications Sections, and as required hereunder. Drawings and general provisions of the contract including General, Supplementary Conditions, and all Division 01 Specification Sections, apply to this Section. Approval of the data shall not eliminate responsibility for compliance with the Drawings or Specifications unless specific attention has been called in writing to proposed deviations at the time of transmittal of the data and such deviations have been approved, not shall it eliminate the responsibility for freedom of errors of any sort in the data. All Sprinkler submittal data for Project construction is to be turned in for approval at the same time in order for an efficient review process. Partial submittals may be rejected until the full submittal is received.

B. See Division 01 - Submittals, for submittal procedures.

C. Specific Products: Trade names and catalog numbers of manufactured products included herein are intended to indicate the type, size and grade of quality of equipment and materials required and such equipment and materials are approved for installation subject to full compliance with the Specifications. Except where single manufacture is specified for standardization, requires for approval of other manufacturers than those specified must be accompanied by complete descriptions including overall dimensions, performance data, and, if catalog material, identification of specific products or items proposed.

D. Shop Drawings:

1. Submit coordinated shop drawings of the sprinkler system. Provide shop drawings of entire project area including all features, piping, heads, valves, hangers, bracing, accessories, and systems connections. Include separate ceiling plans detailing head locations, lighting,

diffusers, grilles, speakers, and other ceiling obstructions.

2. Indicate pipe material used, joint methods, supports, and floor and wall penetrations seals. Indicate installation, layout, heights, weights, mounting and support details, and piping connections. Show all related systems in light format for coordination such as ductwork, lights, etc. Shop drawings shall be coordinated with all other disciplines for interference prior to submittal to ARCHITECT.
3. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
4. Submit shop drawings to ARCHITECT and then approved shop drawings to authority having jurisdiction for code official approval.

E. Submittal Format: All data shall be submitted at one time in neatly bound loose-leaf three ring binders with pockets and tabulated in order of Specification Division 21. All data shall be typed, minimum 10 point font, not exceptions. Data submitted that is not conforming to these specification requirements will be returned without reviewing and will need to be resubmitted at Contractors sole complete cost.

1. Each binder shall have a set of separators with index tabs A to Z. Tabs are to be printed type. Slip in tabs not acceptable.
2. The first page shall be a cover sheet with project name, address, data, submittal product name, all applicable contractors and contact information, and all applicable consultants and contact information.
3. Second page shall be a submittal manual index of all project Specification sections with respective tab numbers, and respective book number, if applicable.
4. The first page of each manuals section shall be an index of the respective project Specification section and number with each product name, manufacturer name and model number.
5. Each manuals section shall be labeled and certified by mechanical Subcontractor that the data presented is in accordance with project Specifications. Index sheet in front of completed diner listing each piece of equipment or material submitted.
6. Product Data to be utilized shall be flagged and noted and all other data shall be crossed out or otherwise flagged that it is not in the project.
7. Data shall be inserted in binders in order of Specification number. Specification number shall be clearly labeled on the each submittal page.

F. As-Built Drawings: As-Built drawings shall be required at final submittal. As-builts shall accurately show all changes. As-Built drawings shall be updated daily and available for inspection on-site by the ARCHITECT.

G. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. Extra Sprinklers: Type and size matching those installed, in quantity required by referenced NFPA design and installation standard.
2. Sprinkler Wrenches: For each sprinkler type.

F. Operation and Maintenance Data: See Division 01 for the number of sets of data to be provided for submittal and additional requirements. Provide a minimum of four (4) copies. The following data shall be provided to the ARCHITECT for approval 30 days prior to the request for Substantial completion inspection. See requirements under 1.6 E for additional submittal and formatting requirements.

1. Cover and Index sheets as in 1.6 E above.
2. Manufacturers' literature: Manufacturers' instructions for operation and maintenance of all mechanical equipment and specialties, including replacement parts lists, capacity curves or charts, equipment data sheets, manufacturers' literature on the equipment, and as-built wiring diagrams and control drawings, all suitable for side binding to 8-1/2 x 11 inch size. All data not applicable to the job is to be crossed out or deleted. Manuals turned in for review with non-applicable data not crossed out shall be returned to the Contractor.
3. Instructions to Personnel: The sprinkler Subcontractor shall instruct operating personnel in the operation and maintenance of the systems before accepting the responsibility of operation and maintenance of the systems.

G. Submit prior to Substantial Completion Inspection and Final Inspection a detailed list of equipment and systems that will NOT be completed for the completion date. Include status and information of deficiencies from all previous inspection reports.

H. Submit prior to Re-inspections of Substantial Completion Inspections, if applicable, and the Final Inspection a marked copy of the previous Engineers Inspection Reports detailing all items that have been completed and all items that have not been completed with reasons thereof. Re-inspection or Final Inspection will not occur until receipt of this list.

1.7 COOPERATIVE WORK

A. The Work hereunder shall be coordinated between various mechanical Sections and with the Work specified under other divisions or contracts toward rapid completion of the entire Project. If any cooperative Work must be altered due to lack of proper supervision hereunder, or failure to make proper provisions in time, then the Work hereunder shall include all expense of such changes as are necessary to be made in the Work under other divisions and contracts, and such changes shall be directly supervised by the ARCHITECT and shall be made to the satisfaction of the ARCHITECT.

B. In general pitched piping and ductwork shall take preference in location within the Project area. Sprinkler piping shall be installed in structural joist space throughout, except where sprinkler main piping is shown to cross below beam. Coordination of all drain valves, duct access doors, and other equipment requiring access and maintenance procedures is required with all building components during construction for maximum accessibility and proper location as intended. Coordinate closely with all other Contractors.

1.8 QUALITY ASSURANCE

A. Maintain one copy of referenced design and installation standard on site.

B. Conform to UL requirements.

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

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

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

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

1.9 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Sprinklers, Valves, and Equipment:

1. Tyco Fire Suppression & Building Products
2. Viking Corporation
3. Grinnell

2.2 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for entire building.

B. Occupancy: Comply with NFPA 13.

C. Water supply for the building fire suppression system is from existing 20,000 gallon and 8,000 gallon water storage tanks located approximately 140 feet elevation above the first floor level of the learning center building. Tanks are located approximately 1150 feet pipe length from learning center building. See Civil Drawings for 6-inch PVC water service piping connection location. Verify all existing conditions on-site. Contractor shall provide test and measurement flow data as needed. All expenses obtaining the information shall be borne by the Contractor.

D. Revise design when test data is available prior to submittals.

E. Interface system with building fire alarm system.

F. Provide fire department connections.

G. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.

H. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.

5. Other Types: As required.

2.3 SPRINKLERS

A. Suspended Ceiling Type: Recessed pendant type with matching push on escutcheon plate.

1. Response Type: Standard.
2. Coverage Type: Extended.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Chrome plated.
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

B. Exposed Area Type: Pendant or upright type.

1. Response Type: Standard.
2. Coverage Type: Extended.
3. Finish: Chrome plated.
4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.

1. Response Type: Standard.
2. Coverage Type: Extended.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Chrome plated.
5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
6. Dry Type: Plunger rod type for up to 4 feet for locating sprinkler head in cold areas off of a wet system.

D. Guards: Finish matching sprinkler finish.

E. Dry Sprinkler Pendant type with matching push on escutcheon plate.

1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Chrome plated.
4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

2.4 PIPING SPECIALTIES

A. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with accelerator, low pressure switch, and test and drain valve.

B. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.

C. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts;

rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

D. Fire Department Connections:

1. Type: Flush mounted wall type with brass finish.
2. Outlets: Two way with thread size to suit fire department hardware; threaded dust cap and chain of matching material and finish.
3. Drain: 3/4 inch automatic drip, outside.
4. Label: "Sprinkler - Fire Department Connection".

E. Supervisory Switches.

2.5 AIR COMPRESSOR

A. Compressor: Single unit, electric motor driven, motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloader valve.

B. Electrical Characteristics: Contractor responsible for compressor sizing and for provision of power as needed.

1. 1/2 Hp or as needed for dry system design.
2. 120 volts, single phase, 60 Hz.

PART 3 - EXECUTION

3.1 INSTALLATION

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

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

C. Provide approved backflow preventer assembly at sprinkler system water source connection.

D. Locate fire department connection where shown with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.

E. Place pipe runs to minimize obstruction to other work.

F. Place piping in concealed spaces above finished ceilings. Locate piping in joist space.

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

H. Flush entire piping system of foreign matter.

I. Install guards on sprinklers in all mechanical rooms, janitor rooms, storage rooms, crawl space,

and where indicated.

J. Hydrostatically test entire system.

K. Require tests be witnessed by Fire Marshal.

L. Center sprinklers in one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements. Recessed heads shall have all deflectors at same location below ceiling, with tolerance of plus or minus 0.5 inch.

M. Hydrostatically test entire system with not less than 200 psi for two hours, or at 50 psi in excess of maximum static pressure when maximum static pressure is in excess of 150 psi. If danger of freezing exists, the system may be tested with not less than 40 psi air pressure for 24 hours, with not more than 1-1/2 psi drop in pressure. System must be hydrostatically tested again when weather permits. Alarm valves, pressure switches and gages, and all equipment not rated for test pressure protected from damage during test.

N. Submit required test certificates to Fire Marshall. Submit copy of all test certificates to OWNER. Submit copy of all test certificates in O&M Manuals.

O. Install air compressor on vibration isolators.

3.2 INTERFACE WITH OTHER PRODUCTS

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

B. Coordinate testing of related fire alarm components with fire alarm contractor.

3.3 CLEANING

A. Drain and flush entire piping system prior to completion.

B. Clean entire system after all other construction is complete.

END OF SECTION 211300

SECTION 220510 - GENERAL MECHANICAL-PLUMBING

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Mechanical Work is governed by the entire Specifications and not just Division 22. The entire Specifications must be examined for requirements relating to the Work hereunder. The Work covered by this and all other Mechanical sections consists of furnishing labor, equipment, and materials in accordance with the Specifications or Drawings, or both, together with any incidental items not shown or specified which can be reasonably inferred or taken as belonging to the Work and necessary in good practice to provide a complete system described or shown as intended.

1.2 WORDING OF THE SPECIFICATIONS

A. These Specifications are of the abbreviated or streamlined type and frequently include incomplete sentences. However, periods are used for clarity. Words such as "shall", "shall be", "the CONTRACTOR shall", and similar mandatory phrases shall be supplied by inference in the same manner, as they are required for the notes on the drawings.

1.3 CODES AND REGULATIONS

A. All Work hereunder shall be strictly in conformance with applicable codes and regulations. All Work shall be in accordance with the 2009 Uniform Plumbing Code, 2009 International Mechanical Code, 2009 International Building Code, 2009 International Fire Code, the most recent edition of NFPA, City & Borough of Juneau and State of Alaska code modifications insofar as minimum requirements are concerned, but the Drawings and Specifications shall govern in case the minimum requirements are exceeded. All electrical equipment shall bear the UL label.

1.4 SUBMITTALS

A. General: Provide submittals according to Conditions of Contract, Division 01 Specifications Sections, and as required hereunder. Drawings and general provisions of the Contract, including General, Supplementary Conditions, and all Division 01 Specification Sections, apply to this Section. Approval of the data shall not eliminate responsibility for compliance with the Drawings or Specifications unless specific attention has been called in writing to proposed deviations at the time of transmittal of the data and such deviations have been approved, nor shall it eliminate the responsibility for freedom of errors of any sort in the data. All Mechanical submittal data for Project construction is to be turned in for approval at the same time in order for an efficient review process. Partial submittals may be rejected until the full submittal is received.

B. Specified Products: Trade names and catalog numbers of manufactured products included

herein are intended to indicate the type, size, and grade of quality of equipment and materials required and such equipment and materials are approved for installation, subject to full compliance with the Specifications. Except where single manufacture is specified for standardization, requests for approval of other manufacturers than those specified must be accompanied by complete descriptions including overall dimensions, performance data, and, if catalog material, identification of specific products or items proposed.

C. Submittal Format: All data shall be submitted at one time in neatly bound loose-leaf three ring binders with pockets and tabulated in the same order of Specification Division section. All data shall be typed, minimum 10 point font, no exceptions. Data submitted that is not conforming to these specification requirements will be returned without reviewing and will need to be resubmitted at Contractors sole complete cost.

1. Each binder shall have a set of separators with index tabs A to Z. Tabs are to be printed type. Slip-in tabs not acceptable.
2. The first page shall be a cover sheet with project name, address, date, submittal product name, all applicable contractors and contact information, and all applicable consultants and contact information.
3. Second page shall be a submittal manual index of all project Specification sections with respective tab numbers, and respective book number, if applicable.
4. The first page of each manuals section shall be an index of that respective project Specification section and number with each product name, manufacturer name and model number.
5. Each manuals section shall be labeled and certified by mechanical Subcontractor that the data presented is in accordance with project Specifications. Index sheet in front of completed binder listing each piece of equipment or material submitted.
6. Product Data to be utilized shall be flagged and noted and all other data shall be crossed out or otherwise flagged that it is not in the project.
7. Data shall be inserted in binders in order of Specification number. Specification number shall be clearly labeled on each submittal page.

D. As-built Drawings: As-built drawings shall be required from all Mechanical Subcontractors and shall accurately show all changes from Contract Documents for all piping, ductwork, and equipment. As-built drawings shall show all underground piping whether changed or not, dimensioned from building lines. As-built drawings shall be updated daily and available for inspection on-site by the ARCHITECT.

E. Operating and Maintenance Data: See Division 1 for the number of sets of data to be provided for submittal and additional requirements. Provide a minimum of four (4) copies. The following data shall be provided to the ARCHITECT for approval 30 days prior to the request for Substantial Completion inspection. Except for the valve directory and nameplate directory, the data shall be provided complete at one time. Partial or separate data will be returned for completion. The valve directory and nameplate directory may be provided for approval previous to the other data. The first section of the O&M manual shall be as listed in the following subparagraphs in order presented hereunder. All of the following subparagraphs sections shall be furnished with permanent plastic see through covers. See requirements under 1.4.C for additional submittal and formatting requirements.

1. Cover and Index sheets as in 1.4.C. above.

2. Description of systems and operating instructions: The Contractor shall prepare a brief type written description of all new and modified systems, explaining how the systems operate and indicating the proper settings of controls and switches. The instructions are to include all information required for the proper settings of controls and switches. The instructions are to include all information required for the proper operation of the systems. Technical knowledge on controls or adjustments requiring specialized technicians should not be included in the instructions.
3. Nameplate directory: List of all new boilers, HRV's, fans, coils, water heaters, expansion tanks, thermostatic mixing valves, pumps, and other equipment nameplates, giving manufacturer's nameplate data, nameplate designation, location of equipment, area served, switch location, and normal position of the switch. Motor data must include the horsepower, voltage, full load amperage, phase, etc. See Section 220553 - Mechanical Identification.
4. Manufacturers' literature: Manufacturers' instructions for operation and maintenance of all mechanical equipment and specialties, including replacement parts lists, capacity curves or charts, equipment data sheets, manufacturers' literature on the equipment, and as-built wiring diagrams and control drawings, all suitable for side binding to 8-1/2 x 11 inch size. All data not applicable to the job is to be crossed out or deleted. Manuals turned in for review with non-applicable data not crossed out shall be returned to the Contractor.
5. Maintenance instructions: Typewritten instructions for the maintenance of the systems, listing each service required on all of the mechanical equipment, including inspections, lubrication, cleaning, checking, and all other operations required. The list is to include all types of bearings installed on the equipment and the type of lubricant required.
6. Maintenance schedule: List of each item of mechanical equipment requiring inspection, lubrication, cleaning, or service including the type of bearings and type of lubricating means for each piece of equipment. Each item of equipment is to be listed separately with the service required. List to include the times during the year when such inspection and maintenance shall be performed. The specific maintenance required shall be referenced back to the maintenance instructions.
7. Valve directory: Indicating valve number, size, location, function, and normal position for each numbered valve. The directory shall be provided and approved before installation of the valve tags. A sample arrangement will be furnished upon request. Two copies required for the preliminary list. See Section 220553 - Mechanical Identification.

F. Guide Documents: Sample operating and maintenance instructions and maintenance schedule may be obtained from the ARCHITECT upon request, to assist in properly setting up the data.

G. Instructions To Personnel and Training: The mechanical Subcontractor shall instruct operating personnel in the operation and maintenance of the systems before accepting the responsibility of operation and maintenance of the systems. Each training session shall be signed off by Project Manager.

H. Qualification Data: For sheet metal installers. For pipe fitters.

I. Submit prior to Substantial Completion Inspection and Final Inspection a detailed list of equipment and systems that will not be completed for the completion date. Include status and information of deficiencies from all previous inspection reports.

J. Submit prior to Re-inspections of Substantial Completion Inspections, if applicable, and the Final Inspection a marked copy of the previous Engineers Inspection Reports detailing all items that have been completed and all items that have not been completed with reasons thereof. Re-inspection or Final Inspection will not occur until receipt of this list.

1.5 COOPERATIVE WORK

A. The Work hereunder shall be coordinated between various mechanical Sections and with the Work specified under other divisions or contracts toward rapid completion of the entire Project. If any cooperative Work must be altered due to lack of proper supervision hereunder, or failure to make proper provisions in time, then the Work hereunder shall include all expense of such changes as are necessary to be made in the Work under other divisions and contracts, and such changes shall be directly supervised by the ARCHITECT and shall be made to the satisfaction of the ARCHITECT.

B. In general pitched piping and ductwork shall take preference in location within the Project area. Coordination of all drain valves, duct access doors, and other equipment requiring access and maintenance procedures is required with all building components during construction for maximum accessibility and proper location as intended. Piping mains, piping branches, and sprinkler piping, as well as 2nd floor ducts will need to be installed in the joist space. Coordinate closely with all other Contractors.

1.6 QUALITY ASSURANCE

A. Perform Work in conformance with all applicable codes, regulations, local ordinances, contract documents, and generally accepted good practice. If discrepancies exist between Specifications and Contract Drawings then the solution that provides the Owner with the highest quality of product or installation shall be deemed as intended by the Contract Documents.

B. All sheet metal workers shall have a minimum documented sheet metal fabrication and installation experience in commercial or industrial facilities of three years or be enrolled in an Alaska Department of Labor approved Sheet Metal Apprentice program. The ratio of on-site workers shall not exceed 3 apprentices or sheet metal workers for every one foreman. A foreman is defined as a sheet metal worker with minimum three years experience as detailed above or is an approved Journeyman.

C. All Plumbers and Pipe Fitters shall have a minimum documented installation experience in commercial or industrial facilities of three years or be enrolled in an Alaska Department of Labor approved Plumbers and Pipe Fitters Apprentice program. The ratio of on-site workers shall not exceed 2 apprentices or pipe fitters for every one Journeyman.

1.7 FIELD MEASUREMENTS

A. See Division 01 for specific requirements.

B. Verifications: All measurements shall be verified at the site and prior to fabrications of

equipment and systems. The existing conditions shall be fully observed before beginning the Work hereunder, and the Work hereunder executed in full coordination with the existing conditions observed. All hazardous material including asbestos materials that are discovered during the course of construction shall be immediately brought to the attention of the ARCHITECT for action. All Work performed with hazardous materials not approved by the Owner shall be at the full responsibility of the contractor and not the Owner.

C. Changes: Variations apparently necessary due to existing conditions shall be made only on approval in writing by the ARCHITECT.

1.8 WARRANTY

A. See Division 01 for specific requirements regarding: Product warranties and product Bonds.

B. The contractor shall provide continuous and generally trouble-free operation of the mechanical systems for the time period listed in Division 01 or for one year after Substantial Completion whichever time period is longer. The operation and maintenance of systems other than incidental operations such as room thermostat settings or changing of air filters, shall be the sole responsibility of the contractor and shall be addressed by the contractor immediately if deficiencies are present. Leaking of valves, flanges, or air vents shall be addressed immediately by the contractor during the warranty period. Control settings, noise problems, and other deficiencies resulting in unsatisfactory environmental conditions shall be addressed immediately.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 220510

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and pressure gage taps.

B. Thermometers and thermometer wells.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 23 0926 - Building Automation System and Controls.

1.3 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 2005.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2007.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2007.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

1. Manufacturer’s data indicating use, operating range, total range, accuracy, and location for manufactured components.
2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
4. Submit schedule of pressure gage and thermometers detailing service and scale.

C. Project Record Documents: Record actual locations of components and instrumentation.

D. Operation and Maintenance Data.

E. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Pressure Gages and Thermometers: One of each type and size.

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers:

1. Dwyer Instruments, Inc
2. Moeller Instrument Co., Inc
3. Omega Engineering, Inc

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi and KPa.

2.2 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc
2. Omega Engineering, Inc
3. Weksler Glass Thermometer Corp

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

2.4. SOLAR POWERED THERMOMETERS

A. Manufacturers:

1. Weiss
2. Weksler
3. FNW brand not acceptable.

B. Thermometer: Adjustable angle, digital solar powered thermometer, with positive locking device.

1. Stem: Brass, 3/4 inch NPT, 3-1/2 inch long.
2. Accuracy: 2 percent.
3. Calibration: Both degrees F and degrees C.

2.5 THERMOMETER SUPPORTS

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

2.6 TEST PLUGS

A. Test Plug: 1/4 inch NPT or 1/2 inch NPT brass self sealing fitting and screw type sealing cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gages, one gage adapters with 1/8 inch (3 mm) probes, two 1 inch (25 mm) dial thermometers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide two pressure gages per pump, installing taps before strainers and on suction and discharge of pump.

C. Provide gage cock to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets. Refer to Section 23 0923.

F. Coil and conceal excess capillary on remote element instruments.

G. Provide instruments with scale ranges selected according to service with largest appropriate scale.

H. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

I. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

J. Locate test plugs adjacent thermometers and thermometer sockets.

END OF SECTION 220519

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.2 REFERENCE STANDARDS

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

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

1.3 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

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

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

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

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Kolbi Pipe Marker Co
2. Seton Identification Products.

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

1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Plastic: Conform to ASTM D709.

2.2 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving
2. Brady Corporation
3. Kolbi Pipe Marker Co
4. Seton Identification Products

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

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

2.3 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation
2. Kolbi Pipe Marker Co
3. MIFAB, Inc
4. Seton Identification Products

B. Comply with ASME A13.1.

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

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

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Symbols, numbers, and all mechanical identification shall match and be in accordance with Contract Documents.

3.2 INSTALLATION

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

B. Install tags with corrosion resistant chain.

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

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

E. Identify HRV's, fans, pumps, boilers, water heaters, heat transfer equipment, heat exchangers, tanks, backflow preventers, coils, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

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

G. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers.

1. Plastic pipe markers are to be used on uninsulated piping only.
2. Identify service, flow direction, and pressure.
3. Install in clear view and align with axis of piping.
4. Locate identification not to exceed 15 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
5. Install identifying devices after completion of coverings and painting.

END OF SECTION 220553

SECTION 220719 -PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2010.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007.

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007.

D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2007e1.

F. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2007.

G. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System); 2010.

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

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.

J. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2010.

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

L. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

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

1.5 QUALITY ASSURANCE

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

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.2 GLASS FIBER

A. Manufacturers:

1. Knauf Insulation
2. Johns Manville Corporation
3. Owens Corning Corp
4. CertainTeed Corporation

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

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

F. Vapor Barrier Lap Adhesive:

1. Water based insulation adhesive, UL classified. Compatible with insulation.

2.3 JACKETS

A. PVC Plastic.

1. Manufacturers:

a. Johns Manville Corporation
b. Proto/Knauf
c. Speedline

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

a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.

3. Covering Adhesive Mastic:

a. Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:

1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

H. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

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

J. Pipe Exposed in Mech/Elec 110 (less than 5 feet above finished floor): Finish with PVC jacket and fitting covers.

K. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

L. Fill joints, cracks, seams, and depressions with cement to form smooth surface.

M. Finish insulation at supports, protrusions, and interruptions.

N. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

O. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

P. Factory Insulated Equipment: Do not insulate.

3.3 SCHEDULES

A. Piping Systems:

1. Domestic Hot and Cold Water Supply and Hot Water recirculation: Mineral fiber pipe insulation, 1 inch thick. 1/2-inch thick may be used on plumbing piping branches 3/4-inch and smaller diameter when located inside walls.
2. Rain Leaders (Including Overflow Rain Leaders): Mineral fiber pipe insulation, 1 inch thick. Insulate entire length.
3. Plumbing Vents within 10 feet of the Vent Through Roof: Mineral fiber pipe insulation, 1 inch thick.
4. Roof Drain Bodies: Mineral Fiber Insulation 1-1/2 inches thick. See Architectural roof drain detail.

END OF SECTION 220719

SECTION 221005 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.

1. Sanitary sewer.
2. Domestic water.
3. Storm water (Roof Drainage).

1.2 RELATED REQUIREMENTS

A. Section 31 2001 - Excavation.

B. Section 31 2002 - Trenching

C. Section 08 3113 - Access Doors and Frames.

D. Section 09 9123 – Interior Paint.

E. Section 22 0553 - Identification for Plumbing Piping and Equipment.

F. Section 22 0719 - Plumbing Piping Insulation.

G. Section 26 2726- Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).

B. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005) (ANSI B16.18).

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

E. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2002.

F. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2007.

G. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2009.

I. ASTM B32 - Standard Specification for Solder Metal; 2008.

J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

K. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2009.

L. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2009a.

M. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2004 and errata.

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

O. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2009 (ANSI/AWWA C151/A21.51).

P. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).

Q. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2005.

R. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; Cast Iron Soil Pipe Institute; 2004.

S. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

T. MSS SP-70 - Cast Iron Gate Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2006.

U. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2005.

V. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2008.

W. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2002.

X. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1996.

Y. ASTM D 1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2006.

Z. ASTM D 2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2006.

AA. ASTM D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2004.

BB. ASTM D 2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2008.

CC. ASTM D 2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2003.

DD. ASTM D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2006.

EE. ASTM F 477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2007.

FF. ASTM F 679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings; 2006A.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

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

D. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Valve Repacking Kits: One for each type and size of valve.

1.5 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

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

C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

E. Store piping and equipment in clean, enclosed from weather, location at all times. Materials are not to be stored in direct contact with dirty surfaces or on dirt floor. If piping, equipment, and components are found to be improperly stored they shall be removed from the project immediately and new, clean materials shall be used.

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 SANITARY SEWER AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.

1. Fittings: Cast iron.
2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.

2.2 SANITARY SEWER AND VENT PIPING, ABOVE GRADE

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

1. Fittings: Cast iron.
2. Joints (Under 3-inch size): CISPI 301, neoprene gaskets and stainless steel clamp-and-shield assemblies. Standard duty.
3. Joints (3-inch and larger): CISPI 301, neoprene gaskets and stainless steel clamp-and-shield assemblies. Heavy Duty Coupling Assembly; Clamp-All or Anoco Husky Series 4000 couplings. No substitutions.

B. Copper Tube: ASTM B306, type DWV. Acceptable only on 2-inch and under horizontal waste and vent piping located inside plumbing walls.

1. Fittings: ASME B123, cast bronze, or ASME B129, wrought copper.
2. Joints: ASTM B32, solder, Grade 50B

2.3 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B42, Type K, hard drawn, 1 inch and smaller pipe size may be annealed continuous length, annealed. For trap priming lines.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
2. Joints: AWS A5.8, BCuP silver braze.

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

1. Fittings: Ductile or gray iron, standard thickness.
2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods.

2.4 WATER PIPING, ABOVE GRADE

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

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B32, solder, Grade 95TA. Mechanical press fit joint with gasket equivalent to PROPRESS acceptable.

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

1. Fittings: Ductile or gray iron, standard thickness.
2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods.

2.5 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 extra heavy weight.

1. Fittings: Cast iron.
2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets.

2.6 STORM WATER PIPING, ABOVE GRADE

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

1. Fittings: Cast iron.
2. Joints: All sizes, CISPI 301, neoprene gaskets and stainless steel clamp-and-shield assemblies. Heavy Duty Coupling Assembly; Clamp-All or Anoco Husky Series 4000 couplings. No Substitutions.

2.7 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches and Under:

1. Ferrous pipe: Class 150 malleable iron threaded unions.
2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets. Gasket material shall meet or exceed the temperature and pressure rating of the system.
2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

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

D. Dielectric Connections: Union thermoplastic-lined steel construction, water impervious isolation barrier, threaded end or Pro-press type compression fittings. IAMPO/UPC Listed.

2.8 PIPE HANGERS AND SUPPORTS

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

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.
5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.

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

1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
2. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
3. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
4. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:

1. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.
2. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
3. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.
4. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
5. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
6. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
7. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
8. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.9 GATE VALVES

A. Manufacturers:

1. Tyco Flow Control
2. Conbraco Industries
3. Nibco, Inc

4. Milwaukee Valve Company

B. Up To and Including 3 Inches:

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

C. 2 Inches and Larger:

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

2.10 BALL VALVES

A. Manufacturers:

1. Tyco Flow Control
2. Conbraco Industries
3. Nibco, Inc
4. Milwaukee Valve Company

B. Construction, 3 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder or threaded ends. Solder ends only on smaller than 1-inch,

2.11 FLOWSETTER VALVES

A. Manufacturers:

1. Armstrong International, Inc.
2. ITT Bell & Gossett.
3. Myson, Inc.

B. Angle or straight pattern, rising stem, inside screw globe valve for 125 psi working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

C. Spare: Provide minimum of two spare caps and one set of probes suitable to test the valve.

2.12 SWING CHECK VALVES

A. Manufacturers:

1. Hammond Valve.
2. Nibco, Inc.
3. Milwaukee Valve Company.

B. Up to 3 Inches:

1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, threaded ends. 1-inch and smaller valves may have soldered ends.

C. Over 3 Inches:

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

2.13 SPRING LOADED CHECK VALVES

A. Manufacturers:

1. Hammond Valve.
2. Crane Co.
3. Milwaukee Valve Company.

B. 2-1/2 inches and over: Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

C. Up To and Including 2 inches: Class 125, bronze body. Stainless steel stem and 316 Stainless steel spring with rubber seat, threaded ends. 1-inch diameter and smaller valves may have soldered ends.

2.14 WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Amtrol Inc
2. Cla-Val Co
3. Watts Regulator Company

B. Up to 2 Inches:

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

2.15 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers:

a. Tyco Flow Control
b. Cla-Val Co
c. Henry Technologies
d. Watts Regulator Company

2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief:

1. Manufacturers:

a. Cla-Val Co
b. Henry Technologies
c. Watts Regulator Company

2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labelled.

2.16 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc
2. Green Country Filtration
3. WEAMCO

B. Size 2 inch and Under:

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

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

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

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

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

E. Group piping whenever practical at common elevations.

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

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3113.

I. Establish elevations of buried piping outside the building to ensure not less than 5 ft of cover.

J. Install vent piping penetrating roofed areas to maintain integrity of roof assembly; coordinate with Architectural.

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

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

M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 9123.

N. Excavate in accordance with Section 31 2001 and 31 2002.

O. Backfill in accordance with Section 31 2002.

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

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

R. Install water piping to ASME B31.9.

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

U. Extend vent through roofs (VTR) minimum 24-inches above roof with fabricated flashing and counter flashing as detailed in Architectural.

V. Piping Tests: All drainage, sanitary waste and vent piping tested hydrostatically by filling piping to highest point for a minimum of one hour. Leaks developed during tests shall be corrected without caulking in threaded piping or additives and test restarted until a perfectly tight system is obtained. Enclosed piping tested before concealing. Tests performed in presence of ARCHITECT.

W. Piping Tests: All domestic water piping tested hydrostatically at 125 psi for a minimum of one hour. Equipment, gages, and thermometer wells rated for a lesser pressure suitably protected during tests. Leaks developed during tests shall be corrected without caulking in threaded piping or additives and test restarted until a perfectly tight system is obtained. Enclosed piping tested before concealing. Tests performed in presence of ARCHITECT.

X. Coordinate piping locations closely with other trades.

Y. Mechanically extracted collars acceptable on pipe sizes 2-inch and over. Installed by contractor with previous documented experience utilizing methods, machines and tools required by manufacturer.

Z. Where piping penetrates wall, run insulation through penetration.

AA. Inserts:

1. Provide inserts for placement in concrete formwork.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

AB. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. Provide hangers adjacent to motor driven equipment with vibration isolation.
11. Support cast iron drainage piping at every joint.
12. Provide pipe anchors at all elbows and offsets of water service main.
13. All hangers are to be installed on the outside of the insulated piping.

3.4 APPLICATION

A. Use grooved mechanical couplings and fasteners only in accessible locations.

B. Install unions downstream of valves and at equipment or apparatus connections.

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

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

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

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

G. Provide flowsetter in water recirculating systems where indicated.

3.5 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system.

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

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

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

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

F. Maintain disinfectant in system for 24 hours.

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

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

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.7 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing. Coordinate with Civil Work.

B. Provide new water service.

1. Provide sleeve in wall/floor for service main and support at wall with reinforced concrete

bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall or to structure. Provide anchors at all elbows and offsets.

2. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.8 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

a. Pipe size: 1/2 inches to 1-1/4 inches:
   1) Maximum hanger spacing: 6.5 ft.
   2) Hanger rod diameter: 3/8 inches.
b. Pipe size: 1-1/2 inches to 2 inches:
   1) Maximum hanger spacing: 10 ft.
   2) Hanger rod diameter: 3/8 inch.
c. Pipe size: 2-1/2 inches to 3 inches:
   1) Maximum hanger spacing: 10 ft.
   2) Hanger rod diameter: 1/2 inch.
d. Pipe size: 4 inches to 6 inches:
   1) Maximum hanger spacing: 10 ft.
   2) Hanger rod diameter: 5/8 inch.

2. Cast-Iron Waste and Vent:

a. Pipe size: All Sizes:
   1) Maximum hanger spacing: 5 ft and at joints.
   2) Hanger rod diameter: 1/2 inches.

END OF SECTION 221005

SECTION 221006 - PLUMBING PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Floor drains.

B. Floor sinks.

C. Cleanouts.

D. Hose bibbs.

E. Hydrants.

F Backflow preventers.

G. Backflow devices.

H. Water hammer arrestors.

I. Trap priming valves.

J. Thermostatic mixing valves.

1.2 RELATED REQUIREMENTS

A. Section 01 1000 – Summary.

B. Section 22 1005 - Plumbing Piping.

C. Section 22 4000 - Plumbing Fixtures.

D. Section 22 3000 - Plumbing Equipment.

E. Section 26 2726 – Wiring Devices: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers; 2001 (R2007).

B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; The American Society of Mechanical Engineers; 2003.

C. ASSE 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering; 2004 (ANSI/ASSE 1011).

D. ASSE 1012 - Backflow Preventer with Intermediate Atmospheric Vent; American Society of Sanitary Engineering; 2002 (ANSI/ASSE 1012).

E. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire

Protection Principle Backflow Preventers; American Society of Sanitary Engineering; 2005.

F. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering; 2004, and Errata 2005 (ANSI/ASSE 1019).

G. PDI-WH 201 - Water Hammer Arresters; Plumbing and Drainage Institute; 2006.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Manufacturer's Instructions: Indicate Manufacturer's Installation Instructions: Indicate assembly and support requirements.

D. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

E. Operation Data: Indicate frequency of treatment required for interceptors.

F. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

G. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Loose Keys for Outside Hose Bibbs (WH): One.
3. Extra Hose End Vacuum Breakers for Hose Bibbs: Two.
4. Service kit for hydrants.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 DRAINS

A. Manufacturers:

1. Josam Company
2. Jay R. Smith Manufacturing Company
3. Zurn Industries, Inc

B. Floor Drain (FD-1):

1. ASME A112.6.3; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable 5-inch nickel-bronze strainer. 2-inch size. With priming line connection.

C. Floor Sink (FS-1):

1. Nominal dimensions; 12” x 6” x 8” deep. White acid-resisting porcelain enamel interior galvanized cast iron body with acid-resisting interior dome strainer and seepage flange. 1/2 loose set grate with square. 3-inch drain. With priming line connections.

2.2 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company
2. Josam Company
3. Zurn Industries, Inc

B. Cleanouts at Exterior Surfaced Areas (YCO):

1. Round cast nickel bronze access frame and non-skid cover with vandal proof secured top. Set in concrete.

C. Cleanouts at Interior Finished Floor Areas (FCO):

1. Galvanized cast iron body with anchor flange, reversible clamping collar, threaded top assembly. Round scored cover with gasket in service areas. Round cover used in tiled areas.

D. Cleanouts at Interior Finished Wall Areas (WCO):

1. Line type with galvanized cast iron body and round gasketed cover, and round stainless steel access cover secured with machine screw.

E. Cleanouts at Interior Unfinished Accessible Areas (CO): Line type with galvanized cast iron body and tapered thread plug with gasket. Provide bolted stack cleanouts on vertical rainwater leaders.

2.3 HOSE BIBBS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company
2. Watts Regulator Company
3. Zurn Industries, Inc

B. Interior Concealed Hose Bibbs: (HB-1)

1. Bronze or brass, wall mounted, faucet with hose thread spout, integral stops. Chrome plated lockable box cover, and vacuum breaker in conformance with ASSE 1011. Cold water only. Install HB-1 at approximately 16-inches above finished floor

2.4 HYDRANTS (WH)

A. Manufacturers:

1. Zurn.
2. Josam.
3. Woodford.

B. Wall Hydrant: ANSI/ASSE 1019; non-freeze, self-draining type with chrome plated lockable recessed box, hose thread spout, locks shield and removable key, and integral vacuum breaker.

C. Contractor responsible for providing actual wall thickness at each wall hydrant to manufacturer for proper sizing of non-freeze assemblies. Sized to allow vertical pipe elbow to be installed between electrical panel and exterior wall. Coordinate.

D. Install wall hydrants between 24 and 30-inches above grade.

E. Coordinate location closely with Electrical Contractor.

2.5 BACKFLOW PREVENTERS

A. Manufacturers:

1. Conbraco Industries
2. Watts Regulator Company
3. Zurn Industries, Inc

B. Reduced Pressure Backflow Preventers:

1. ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks. Suitable for 150 psi working pressure. Unions on inlet and outlet. Funnel drain with air gap installed under relief vent.

2.6 BACKFLOW DEVICES

A. Manufacturers:

1. Watts

B. Description: Device designed to prevent back-siphonage of contaminated water to potable water in applications not subject to continuous pressure.

C. Hose Connection Vacuum Breakers: Removable single check with brass body and atmospheric vacuum breaker vent. Manual draining feature included where freezing conditions exist.

2.7 WATER HAMMER ARRESTORS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company.
2. Josam.
3. Watts Regulator Company.
4. Zurn Industries, Inc.

B. Description:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

C. Capacity:

1. WHA-1: PDI Unit A. Similar to Zurn 100, 3/4-inch threaded connections.
2. WHA-2: PDI Unit B. Similar to Zurn 200, 1-inch threaded connections.
3. WHA-3: PDI Unit C. Similar to Zurn 300, 1-inch threaded connections.
4. WHA-4: PDI Unit D. Similar to Zurn 400, 1-inch threaded connections.

D. Accessibility: Where water hammer is concealed, locate WHA and isolating valve accessibly behind 16x16 access door.

E. Location in walls: Locate centerline of 16x16 access door serving WHA behind walls at 64-inches AFF. Coordinate this location with ARCHITECT.

2.8 TRAP PRIMING VALVE

A. Manufacturers:

1. MIFAB M-500
2. Watts T20.
3. PPP not acceptable.

B. All brass, 1/2-inch IPS, spring-loaded, pressure differential activated with vacuum breaking means. Provide appropriate trap primer and distribution unit sized for 1-8 priming lines as required. See drawings for number of priming lines served by single trap priming valve.

C. Accessibility: Where trap priming valve is concealed, locate with priming valve, distribution unit, valve, and all unions centered accessibly behind 16x16 access door.

D. Location in walls: Locate centerline of 16x16 access door serving trap priming valve and distribution behind walls at 16-inches AFF. Coordinate location with Architect.

2.9 TEMPERING VALVES (TV-1)

A. Manufacturers:

1. Powers

B. Valve: Cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment. Thermostatic water mixing valve. Shall meet ASSE 1070 Requirements.

C. Capacity:

1. TV-1: Building Hot Water (Mech/Elec 110): 5 GPM at 20psi differential. Set at 115F.

D. Accessories:

1. Check valve on inlets.
2. Volume control shut-off valve on outlet.
3. Stem thermometer on outlet.
4. Strainer stop checks on inlets.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor. Install cleanout with top set flush in finished surface. Surrounding surface shall match with cleanout cover top. Incorrect installation will be rejected. Plumbing Contractor to be on-site during concrete pour and shall be responsible for proper leveling of cleanouts.

E. Install approved portable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, interior and exterior hose bibbs.

F. Pipe relief from backflow preventer to nearest drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to water closets, lavatories, sinks. Install behind access doors. Coordinate exact location of access doors with ARCHITECT.

H. Install drains with top set flush in finished surface. Surrounding surface shall match with floor drain top for proper drainage. Incorrect installation will be rejected. Plumbing Contractor to be on-site during concrete pour and shall be responsible for proper leveling of drains.

I. Provide access where valves and fittings are not exposed.

J. Install vacuum breaker and cap on all drain valves.

K. Locate backflow preventers at a maximum of five feet above finished floor for servicing and testing. Backflow preventer secured to structure or wall and piping extended as required.

L. Pipe relief from valves, back-flow preventers and drains to nearest floor drain. Pipe relief valve outlets separately to nearest drain.

M. Install trap primers fully accessible behind access doors if applicable with unions at all connections. Install isolating valve on supply side.

END OF SECTION 221006

SECTION 223000 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water heaters.

B. Domestic Water Expansion Tanks.

C. Sump Pumps.

1.2 RELATED REQUIREMENTS

A. Section 26 2726 – Wiring Devices: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittals procedures.

B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
2. Provide electrical characteristics and connection requirements.

C. Shop Drawings:

1. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.

2. Provide wiring diagram of electric water heaters (DWH-1).

D. Manufacturer's Instructions.

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

F. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

G. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Provide 2 spare magnesium anode sets for DWH-1.

1.5 QUALITY ASSURANCE

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

1.6 CERTIFICATIONS

A. Water Heaters: NSF approved.

B. Electric Water Heaters: UL listed and labeled to UL 174 or UL 1453.

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

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 WARRANTY

A. See Section 01 6000 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturer warranty for domestic water heaters.

C. Submit manufacturer warranty and ensure forms have been completed in OWNER's name and registered with manufacturer.

PART 2 - PRODUCTS

2.1 COMMERCIAL ELECTRIC WATER HEATERS (DWH-1)

A. Manufacturers:

1. American Water Heater Group.
2. AO Smith Custom DVE-52-9 (Design Manufacturer)
3. Patterson-Kelley Co.

B. Type: Factory-assembled and wired, electric, vertical storage.

C. Performance:

1. Storage capacity: 50 gal.

2. Total wattage: 9.0 kW.
3. Number of Elements: 3.
4. Minimum recovery rate: 37 gph with 100 degrees F temperature rise.
6. Maximum working pressure: 150 psig.

D. Electrical Characteristics:

1. 208 volts, three phase, 60 Hz.

E. Tank: Glass lined welded steel; thermally insulated, encased in corrosion-resistant steel jacket; baked-on enamel finish.

F. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 140 degrees F, flanged or screw-in elements, high temperature limit thermostat. Linear sequencing control

G. Accessories: Brass water connections and dip tube, drain valve, anodes, and ASME rated temperature and pressure relief valve.

2.2 DIAPHRAGM-TYPE DOMESTIC WATER EXPANSION TANKS (ET-2)

A. Manufacturers:

1. Amtrol Inc
2. ITT Bell & Gossett
3. Taco, Inc

B. Construction: Welded steel, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank. Pipe mounted. For domestic water. NSF rated.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 40 psig.

D. Sizes: See Drawings.

2.3 SUBMERSIBLE SUMP PUMPS (SP-1)

A. Manufacturers:

1. Armstrong Pumps Inc.
2. Goulds Pumps.
3. Hydromatic.
4. Zoeller Pump Company.
5. Weil.

B. Type: Completely submersible, vertical, centrifugal.

C. Casing: Cast iron pump body and oil filled motor chamber.

D. Impeller: Cast iron; open non-clog, stainless steel shaft.

E. Bearings: Ball bearings.

F. Accessories: Oil resistant 6 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.

G. Servicing: Slide-away coupling consisting of discharge elbow.

H. Controls: Integral floats

I. Performance: See Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Install water heaters in accordance with UL requirements.

C. Coordinate with plumbing piping and related electrical Work to achieve operating system.

D. Secure tanks to concrete pad and wall structure.

E. Clean and flush tanks prior to after installation. Seal until pipe connections are made.

F. Pipe Relief valves to floor.

3.2 DEMONSTRATION AND TRAINING

A. Demonstrate operation and maintenance procedures.

END OF SECTION 223000

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water closets.

B. Dual flush water closets valves.

C. Urinals.

D. Lavatories.

E. Sinks.

F. Service sinks.

G. Electric drinking fountain/bottle filler.

1.2 RELATED REQUIREMENTS

A. Section 01 1000 - Summary

B. Section 06 4116 – Architectural Cabinets: Preparation of counters for sinks.

C. Section 07 9200 - Joint Sealants: Seal fixtures to walls and floors.

D. Section 22 1005 - Plumbing Piping.

E. Section 22 1006 - Plumbing Piping Specialties.

F. Section 22 3000 - Plumbing Equipment.

G. Section 26 2726 – Wiring Devices: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2009.

D. ASME A112.18.1 - Plumbing Supply Fittings; The American Society of Mechanical Engineers; 2005.

C. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures; The American Society of Mechanical Engineers; 1994 (R2004).

D. ASME A112.19.2 - Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water

Closets and Urinals; The American Society of Mechanical Engineers; 2008.

E. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; The American Society of Mechanical Engineers; 2008.

F. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals; The American Society of Mechanical Engineers; 2005.

G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.

1.4 SUBMITTALS

A. See Section 01 3300 – Submittal Procedures.

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

C. Manufacturer's Instructions: Indicate installation methods and procedures.

D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in OWNER's name and registered with manufacturer.

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

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Faucet Washers: One set of each type and size.
3. Extra Lavatory Supply Fittings: One set of each type and size.
4. Extra Toilet Seats: One of each type and size.
5. Flush Valve Service Kits: One for each type and size.
6. Provide (2) flush valve assemblies for each type of water closet and urinal.
7. Provide (2) complete faucet assemblies for Lavatory L-1.
8. Provide two spare cartridge assemblies for each type of sink.

1.5 QUALITY ASSURANCE

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

1.6 REGULATORY REQUIREMENTS

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

1.7 DELIVERY, STORAGE, AND HANDLING

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

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

1.8 WARRANTY

A. See Division 1 - Closeout Submittals, for additional warranty requirements.

B. Provide one year manufacturer warranty for electric drinking fountain.

PART 2 - PRODUCTS

2.1 FLOOR MOUNT FLUSH VALVE WATER CLOSETS – ADA (WC-1)

A. Manufacturers:

1. American Standard Inc
2. Eljer
3. Kohler Company

B. Bowl: ASME A112.19.2; floor mounted, siphon jet vitreous china closet bowl, 16-1/2 inches high with elongated rim, 1-1/2 inch top spud, china bolt caps. ADA Height. Similar to Kohler Highcrest.

C. Exposed Manual Dual-Flush Valve: ASME A112.19.2; exposed polished chrome, diaphragm type, screwdriver stop and vacuum breaker; maximum 1.6 gallon flush volume. Dual Flush type with 1.1 gallon (up position) and 1.6 gallon (down position) flush options. Similar to Sloan Uppercut WES-111. Coordinate left hand/ right hand handle location with ADA requirements. Provide and install adhesive metal wall plates with instructions.

D. Seats:

1. Manufacturers:

a. American Standard Inc
b. Beneke Magnolia
c. Bemis Manufacturing Company
d. Church Seat Company
e. Olsonite

2. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

2.1 FLOOR MOUNT FLUSH VALVE WATER CLOSETS (WC-2)

A. Manufacturers:

1. American Standard Inc
2. Eljer
3. Kohler Company

B. Bowl: ASME A112.19.2; floor mounted, siphon jet vitreous china closet bowl, 14-1/2 inches high with elongated rim, 1-1/2 inch top spud, china bolt caps.WC-2 installed at standard height. Similar to Kohler Wellcomme.

C. Exposed Manual Dual-Flush Valve: ASME A112.19.2; exposed polished chrome, diaphragm type, screwdriver stop and vacuum breaker; maximum 1.6 gallon flush volume. Dual Flush type with 1.1 gallon (up position) and 1.6 gallon (down position) flush options. Similar to Sloan Uppercut WES-111. Coordinate left hand/ right hand handle location with ADA requirements. Provide and install adhesive metal wall plates with instructions.

D. Seats:

1. Manufacturers:

a. American Standard Inc
b. Beneke Magnolia
c. Bemis Manufacturing Company
d. Church Seat Company
e. Olsonite

2. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, without cover.

2.2 WALL HUNG URINALS (U-1 and U-2)

A. Manufacturers:

1. American Standard Plumbing.
2. Eljer
3. Kohler Co.

B. Urinal:

1. ASME A112.19.2; vitreous china, wall hung washout urinal with shields, integral trap, 3/4 inch top spud, elongated rim, removable stainless steel strainer, steel supporting hanger. ADA approved. Similar to Kohler Bardon. U-1 installed at ADA height. U-2 installed at standard height.
2. Exposed Manual Flush Valve: ASME A112.19.6; exposed polished chrome, diaphragm type, screwdriver stop and vacuum breaker; maximum 0.5 gallon flush volume. Similar

to Sloan Royal 186-0.5. Coordinate left hand/ right hand handle location with ADA requirements.

C. Carriers:

1. Manufacturers:

a. JOSAM Company
b. Zurn Industries, Inc

2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.3 LAVATORIES (L-1)

A. Manufacturers:

1. American Standard Plumbing.
2. Kohler Co.
3. Moen.
4. Grohe.
5. Sloan Valve Co.
6. Eljer.

B. Lavatory L-1 (Wall Mount Lavatory with Manual Blade Handle Faucet):

1. Vitreous China Wall Hung Basin: ASME A112.19.2; vitreous china wall mounted lavatory, 20 x 18 inches with drillings on 4 inch centers, front overflow. Insulation shields on plumbing piping for ADA compliance. Similar to Kohler Greenwich.
2. ASME A112.18.1; concealed, polished chrome plated brass supply with 4-1/2 inch reach (4-inch height) faucet and single handle indexed control lever. Water economy softflo aerator with maximum 2.0 gpm flow. 4-inch centers. Rigid supplies. Similar to Kohler K-15592-P-CP.
3. Accessories:

a. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
b. Offset waste with perforated open strainer.
c. Loose key stops.
d. Rigid supplies.
e. Removable insulation shields on plumbing piping for ADA compliance where exposed.
f. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

2.5 SINKS (S-1)

A. Sink Manufacturers:

1. American Standard Inc
2. Kohler Company
3. Just
4. Elkay

B. (S-1 ADA Sink) Single Compartment Bowl: ASME A112.19.3; 19" by 21" (front-back by left-right) by 6-1/2 inch outside dimensions 18 gage thick, Type 302 or 304 stainless steel. All corners rounded and all welds ground and polished. Self-rimming and undercoated, ledge back drilled for faucet supply fitting. Center rear drain outlet. Similar to Just SL-ADA-1921-A-GR.

1. Trim for sinks: ASME A112.18.1; concealed chrome plated brass supply with swivel gooseneck faucet (5-1/2 inch reach, 9-inch deck to aerator) and water economy softflo aerator with maximum 2.0 gpm flow, indexed 4 inch wrist blade handles. Quarter turn cartridges. 8-inch centers. Rigid supplies. Similar to Chicago 201A-GN2BH13-E3-2-317.
2. Accessories Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon. Quarter turn Mini-Ball stops. ADA offset. Removable insulation shields on plumbing piping for ADA compliance where exposed.

2.6 DRINKING FOUNTAIN (DF-1)

A. Manufacturers:

1. Elkay Manufacturing Company
2. Haws Corporation
3. Tri Palm International/Oasis

B. Drinking Fountain DF-1: Two level drinking fountain for handicapped and general public. Integral recessed water bottle filler. Without Cooler. Similar to EZWS-EDFP217K.

1. Wall hung, 18 gage, 304 stainless steel unit with stop valve and trap accessible through bottom cover plate. Rounded rectangular shaped bowls. Integral wall plate.
2. Chrome plated brass bubbler with flexible shield.
3. ADA approved self-closing, frontal push buttons for fountain
4. Integral P-trap and drain. Integral 3/8” in-line quarter turn Mini-Ball stops.
5. Inlet strainer
6. ADA stainless steel skirt for upper unit.
7. Bottom Plate.
8. Mounting Frame.
9. Reverse bi-level where required. See Architectural elevations.
10. Recessed integral water bottle filler. Quick fill 1.5 gpm. Interface display.
11. Electrical: 115V, 60 Hz compressor, 6 foot cord and plug for connection to electric wring system including grounding connector.
12. Bottle filler sensor operated with 20-second shut off timer.
13. Front access panels (below and above) for access to bottle filler electrical and drains.

2.7 SERVICE SINKS (SS-1)

A. Service Sink Manufacturers:

1. American Standard Inc
2. Kohler
3. Elkay Manufacturing Company

B. Bowl Floor Mounted: 28 x 28 x 8 inch high enameled cast iron corner design, with rim guard and 3 inch drain. Stainless steel strainer. Similar to Kohler Whitby.

C. Trim: ASME A112.18.1 exposed wall type combination supply with lever handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Similar to Chicago 897.

D. Accessories:

1. 3 feet of 1/2 inch diameter plain end reinforced plastic hose.
2. Hose clamp hanger.
3. Mop hanger.
4. Pail Hook.
5. Stainless steel wall coverings minimum 24 inches high and the length of each of the SS back and sides.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify dimension of all custom sized fixtures before ordering.

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

D. See Architectural documents for all mounting heights.

E. Verify that electric power is available and of the correct characteristics.

3.2 PREPARATION

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

3.3 INSTALLATION

A. Install WORK in accordance with State standards.

B. Install each fixture with chrome-plated trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall supports and bolts with sufficient strength to prevent movement of fixture when subjected to a force of 200 pounds in any direction.

F. Seal fixtures to wall and floor surfaces with sealant as specified in Division 7, color to match fixture. Sealant shall have a convex bead in order to prevent water from accumulating on the finished surface.

G. Solidly attach water closets to floor with lag screws.

H. All supply piping to fixture anchored to wall.

I. All sink and lavatory supply spouts with aerators as specified for each fixture.

J. All trip levers for disabled type fixtures such as water closets and urinals are to be coordinated with disabled code requirements for proper accessible side location and configuration.

K. Stops installed in each supply pipe at each fixture, accessibly located. Exposed stops of the loose key type, unless quarter turn Mini-Ball stop or screwdriver type is specified, with threaded chrome-plated brass nipple and escutcheon. Where stops are not specified with the fixture, standard globe or angle valves shall be used, located in accessible, concealed space such as cabinetwork, pipe spaces, or unfinished rooms.

L. Suitable protective cover placed over fixtures immediately after installation. Damaged fixtures replaced at no additional cost to the OWNER.

M. Brass or plastic nipples used for connection of urinals.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

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

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. Verify in writing that main thermostatic mixing valves have been set to provide 115F as scheduled.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 224000

SECTION 230510 - GENERAL MECHANICAL HVAC

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The Mechanical Work is governed by the entire Specifications and not just Division 23. The entire Specifications must be examined for requirements relating to the Work hereunder. The Work covered by this and all other Mechanical sections consists of furnishing labor, equipment, and materials in accordance with the Specifications or Drawings, or both, together with any incidental items not shown or specified which can be reasonably inferred or taken as belonging to the Work and necessary in good practice to provide a complete system described or shown as intended.

1.2 WORDING OF THE SPECIFICATIONS

A. These Specifications are of the abbreviated or streamlined type and frequently include incomplete sentences. However, periods are used for clarity. Words such as "shall", "shall be", "the CONTRACTOR shall", and similar mandatory phrases shall be supplied by inference in the same manner, as they are required for the notes on the drawings.

1.3 CODES AND REGULATIONS

A. All Work hereunder shall be strictly in conformance with applicable codes and regulations. All Work shall be in accordance with the 2009 Uniform Plumbing Code, 2009 International Mechanical Code, 2009 International Building Code, 2009 International Fire Code, the most recent edition of NFPA, City & Borough of Juneau and State of Alaska code modifications insofar as minimum requirements are concerned, but the Drawings and Specifications shall govern in case the minimum requirements are exceeded. All electrical equipment shall bear the UL label.

1.4 SUBMITTALS

A. General: Provide submittals according to Conditions of Contract, Division 1 Specifications Sections, and as required hereunder. Drawings and general provisions of the Contract, including General, Supplementary Conditions, and all Division 1 Specification Sections, apply to this Section. Approval of the data shall not eliminate responsibility for compliance with the Drawings or Specifications unless specific attention has been called in writing to proposed deviations at the time of transmittal of the data and such deviations have been approved, nor shall it eliminate the responsibility for freedom of errors of any sort in the data. All Mechanical submittal data for Project construction is to be turned in for approval at the same time in order for an efficient review process. Partial submittals may be rejected until the full submittal is received.

B. Specified Products: Trade names and catalog numbers of manufactured products included herein are intended to indicate the type, size, and grade of quality of equipment and materials

required and such equipment and materials are approved for installation, subject to full compliance with the Specifications. Except where single manufacture is specified for standardization, requests for approval of other manufacturers than those specified must be accompanied by complete descriptions including overall dimensions, performance data, and, if catalog material, identification of specific products or items proposed.

C. Submittal Format: All data shall be submitted at one time in neatly bound loose-leaf three ring binders with pockets and tabulated in the same order of Specification Division section. All data shall be typed, minimum 10 point font, no exceptions. Data submitted that is not conforming to these specification requirements will be returned without reviewing and will need to be resubmitted at Contractors sole complete cost.

1. Each binder shall have a set of separators with index tabs A to Z. Tabs are to be printed type. Slip-in tabs not acceptable.
2. The first page shall be a cover sheet with project name, address, date, submittal product name, all applicable contractors and contact information, and all applicable consultants and contact information.
3. Second page shall be a submittal manual index of all project Specification sections with respective tab numbers, and respective book number, if applicable.
4. The first page of each manuals section shall be an index of that respective project Specification section and number with each product name, manufacturer name and model number.
5. Each manuals section shall be labeled and certified by mechanical Subcontractor that the data presented is in accordance with project Specifications. Index sheet in front of completed binder listing each piece of equipment or material submitted.
6. Product Data to be utilized shall be flagged and noted and all other data shall be crossed out or otherwise flagged that it is not in the project.
7. Data shall be inserted in binders in order of Specification number. Specification number shall be clearly labeled on each submittal page.

D. As-built Drawings: As-built drawings shall be required from all Mechanical Subcontractors and shall accurately show all changes from Contract Documents for all piping, ductwork, and equipment. As-built drawings shall show all underground piping whether changed or not, dimensioned from building lines. As-built drawings shall be updated daily and available for inspection on-site by the ARCHITECT.

E. Operating and Maintenance Data: See Division 1 for the number of sets of data to be provided for submittal and additional requirements. Provide a minimum of four (4) copies. The following data shall be provided to the ARCHITECT for approval 30 days prior to the request for Substantial Completion inspection. Except for the valve directory and nameplate directory, the data shall be provided complete at one time. Partial or separate data will be returned for completion. The valve directory and nameplate directory may be provided for approval previous to the other data. The first section of the O&M manual shall be as listed in the following subparagraphs in order presented hereunder. All of the following subparagraphs sections shall be furnished with permanent plastic see through covers. See requirements under 1.4.C for additional submittal and formatting requirements.

1. Cover and Index sheets as in 1.4.C. above.
2. Description of systems and operating instructions: The Contractor shall prepare a brief type written description of all new and modified systems, explaining how the systems

operate and indicating the proper settings of controls and switches. The instructions are to include all information required for the proper settings of controls and switches. The instructions are to include all information required for the proper operation of the systems. Technical knowledge on controls or adjustments requiring specialized technicians should not be included in the instructions.

3. Nameplate directory: List of all new boilers, HRV's, fans, coils, water heaters, expansion tanks, thermostatic mixing valves, pumps, and other equipment nameplates, giving manufacturer's nameplate data, nameplate designation, location of equipment, area served, switch location, and normal position of the switch. Motor data must include the horsepower, voltage, full load amperage, phase, etc. See Section 230553 - Mechanical Identification.
4. Manufacturers' literature: Manufacturers' instructions for operation and maintenance of all mechanical equipment and specialties, including replacement parts lists, capacity curves or charts, equipment data sheets, manufacturers' literature on the equipment, and as-built wiring diagrams and control drawings, all suitable for side binding to 8-1/2 x 11 inch size. All data not applicable to the job is to be crossed out or deleted. Manuals turned in for review with non-applicable data not crossed out shall be returned to the Contractor.
5. Maintenance instructions: Typewritten instructions for the maintenance of the systems, listing each service required on all of the mechanical equipment, including inspections, lubrication, cleaning, checking, and all other operations required. The list is to include all types of bearings installed on the equipment and the type of lubricant required.
6. Maintenance schedule: List of each item of mechanical equipment requiring inspection, lubrication, cleaning, or service including the type of bearings and type of lubricating means for each piece of equipment. Each item of equipment is to be listed separately with the service required. List to include the times during the year when such inspection and maintenance shall be performed. The specific maintenance required shall be referenced back to the maintenance instructions.
7. Valve directory: Indicating valve number, size, location, function, and normal position for each numbered valve. The directory shall be provided and approved before installation of the valve tags. A sample arrangement will be furnished upon request. Two copies required for the preliminary list. See Section 230553 - Mechanical Identification.

F. Guide Documents: Sample operating and maintenance instructions and maintenance schedule may be obtained from the ARCHITECT upon request, to assist in properly setting up the data.

G. Instructions To Personnel and Training: The mechanical Subcontractor shall instruct operating personnel in the operation and maintenance of the systems before accepting the responsibility of operation and maintenance of the systems. Each training session shall be signed off by Project Manager.

H. Qualification Data: For sheet metal installers. For pipe fitters.

I. Submit prior to Substantial Completion Inspection and Final Inspection a detailed list of equipment and systems that will not be completed for the completion date. Include status and information of deficiencies from all previous inspection reports.

J. Submit prior to Re-inspections of Substantial Completion Inspections, if applicable, and the Final Inspection a marked copy of the previous Engineers Inspection Reports detailing all items

that have been completed and all items that have not been completed with reasons thereof. Re-inspection or Final Inspection will not occur until receipt of this list.

1.5 COOPERATIVE WORK

A. The Work hereunder shall be coordinated between various mechanical Sections and with the Work specified under other divisions or contracts toward rapid completion of the entire Project. If any cooperative Work must be altered due to lack of proper supervision hereunder, or failure to make proper provisions in time, then the Work hereunder shall include all expense of such changes as are necessary to be made in the Work under other divisions and contracts, and such changes shall be directly supervised by the ARCHITECT and shall be made to the satisfaction of the ARCHITECT.

B. In general pitched piping and ductwork shall take preference in location within the Project area. Coordination of all drain valves, duct access doors, and other equipment requiring access and maintenance procedures is required with all building components during construction for maximum accessibility and proper location as intended. Piping mains, piping branches, and sprinkler piping, as well as 2nd floor ducts will need to be installed in the joist space. Coordinate closely with all other Contractors.

1.6 QUALITY ASSURANCE

A. Perform Work in conformance with all applicable codes, regulations, local ordinances, contract documents, and generally accepted good practice. If discrepancies exist between Specifications and Contract Drawings then the solution that provides the Owner with the highest quality of product or installation shall be deemed as intended by the Contract Documents.

B. All sheet metal workers shall have a minimum documented sheet metal fabrication and installation experience in commercial or industrial facilities of three years or be enrolled in an Alaska Department of Labor approved Sheet Metal Apprentice program. The ratio of on-site workers shall not exceed 3 apprentices or sheet metal workers for every one foreman. A foreman is defined as a sheet metal worker with minimum three years experience as detailed above or is an approved Journeyman.

C. All Plumbers and Pipe Fitters shall have a minimum documented installation experience in commercial or industrial facilities of three years or be enrolled in an Alaska Department of Labor approved Plumbers and Pipe Fitters Apprentice program. The ratio of on-site workers shall not exceed 2 apprentices or pipe fitters for every one Journeyman.

1.7 FIELD MEASUREMENTS

A. See Division 01 for specific requirements.

B. Verifications: All measurements shall be verified at the site and prior to fabrications of equipment and systems. The existing conditions shall be fully observed before beginning the Work hereunder, and the Work hereunder executed in full coordination with the existing conditions observed. All hazardous material including asbestos materials that are discovered

during the course of construction shall be immediately brought to the attention of the ARCHITECT for action. All Work performed with hazardous materials not approved by the Owner shall be at the full responsibility of the contractor and not the Owner.

C. Changes: Variations apparently necessary due to existing conditions shall be made only on approval in writing by the ARCHITECT.

1.8 WARRANTY

A. See Division 01 for specific requirements regarding: Product warranties and product Bonds.

B. The contractor shall provide continuous and generally trouble-free operation of the mechanical systems for the time period listed in Division 01 or for one year after Substantial Completion whichever time period is longer. The operation and maintenance of systems other than incidental operations such as room thermostat settings or changing of air filters, shall be the sole responsibility of the contractor and shall be addressed by the contractor immediately if deficiencies are present. Leaking of valves, flanges, or air vents shall be addressed immediately by the contractor during the warranty period. Control settings, noise problems, and other deficiencies resulting in unsatisfactory environmental conditions shall be addressed immediately.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230510

SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pressure gages and pressure gage taps.

B. Thermometers and thermometer wells.

C. Test Ports.

1.2 RELATED REQUIREMENTS

A. Section 23 0926 - Building Automation System and Controls.

B. Section 23 2113 - Hydronic Piping.

1.3 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; The American Society of Mechanical Engineers; 2005.

B. ASTM E1 - Standard Specification for ASTM Thermometers; 2007.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2007.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

1. Manufacturer’s data indicating use, operating range, total range, accuracy, and location for manufactured components.
2. Submit product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes.
3. Submit schedule indicating manufacturer, model number, size, location, rated capacity, load served, and features for each specialty.
4. Submit schedule of pressure gage and thermometers detailing service and scale.

C. Project Record Documents: Record actual locations of components and instrumentation.

D. Operation and Maintenance Data.

E. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. Extra Pressure Gages and Thermometers: One of each type and size.

1.5 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PRESSURE GAGES

A. Manufacturers:

1. Dwyer Instruments, Inc
2. Moeller Instrument Co., Inc
3. Omega Engineering, Inc

B. Pressure Gages: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.

1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi and KPa.

2.2 PRESSURE GAGE TAPPINGS

A. Gage Cock: Tee or lever handle, brass for maximum 150 psi.

2.3 STEM TYPE THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc
2. Omega Engineering, Inc
3. Weksler Glass Thermometer Corp

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.

1. Size: 9 inch scale.
2. Window: Clear Lexan.
3. Stem: 3/4 inch NPT brass.
4. Accuracy: 2 percent, per ASTM E77.
5. Calibration: Degrees F.

2.4 SOLAR POWERED THERMOMETERS

A. Manufacturers:

1. Weiss
2. Weksler
3. FNW brand not acceptable.

B. Thermometer: Adjustable angle, digital solar powered thermometer, with positive locking device.

1. Stem: Brass, 3/4 inch NPT, 3-1/2 inch long.
2. Accuracy: 2 percent.
3. Calibration: Both degrees F and degrees C.

2.5 THERMOMETER SUPPORTS

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

2.6 TEST PLUGS

A. Test Plug: 1/4 inch NPT or 1/2 inch NPT brass self sealing fitting and screw type sealing cap for receiving 1/8 inch outside diameter pressure or temperature probe with Nordel core for temperatures up to 350 degrees F.

B. Test Kit: Carrying case, internally padded and fitted containing one 2-1/2 inch (60 mm) diameter pressure gages, one gage adapters with 1/8 inch (3 mm) probes, two 1 inch (25 mm) dial thermometers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide two pressure gages per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gage.

C. Install pressure gages with pulsation dampers. Provide gage cock to isolate each gage. Extend nipples to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Install thermometer sockets adjacent to controls systems thermostat, transmitter, or sensor sockets.

F. Provide instruments with scale ranges selected according to service with largest appropriate scale.

G. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

H. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

I. Locate test plugs adjacent to pressure gages and pressure gage taps.

END OF SECTION 230519

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe Markers.

1.2 REFERENCE STANDARDS

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

B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2001 (Reapproved 2007).

1.3 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

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

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

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

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Manufacturers:

1. Kolbi Pipe Marker Co
2. Seton Identification Products.

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

1. Letter Color: White.
2. Letter Height: 1/4 inch.
3. Background Color: Black.
4. Plastic: Conform to ASTM D709.

2.2 TAGS

A. Manufacturers:

1. Advanced Graphic Engraving
2. Brady Corporation
3. Kolbi Pipe Marker Co
4. Seton Identification Products

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

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

2.3 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation
2. Kolbi Pipe Marker Co
3. MIFAB, Inc
4. Seton Identification Products

B. Comply with ASME A13.1.

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

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

PART 3 - EXECUTION

3.1 PREPARATION

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

B. Symbols, numbers, and all mechanical identification shall match and be in accordance with Contract Documents.

3.2 INSTALLATION

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

B. Install tags with corrosion resistant chain.

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

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

E. Identify heat recovery units, fans, pumps, boilers, water heaters, coils, heat transfer equipment, heat exchangers, tanks, backflow preventers, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

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

J. Identify piping, concealed or exposed, with plastic pipe markers or plastic tape pipe markers.

1. Plastic pipe markers are to be used on uninsulated piping only.
2. Identify service, flow direction, and pressure.
3. Install in clear view and align with axis of piping.
4. Locate identification not to exceed 15 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
5. Install identifying devices after completion of coverings and painting.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic systems.

C. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council; 2002.

B. ASHRAE Std 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 1988, with 1997 Errata.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau; 2005, Seventh Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association; 2002.

1.3 SUMMARY

A. Scope of Work: Adjust and balance all building air systems. Adjust and balance all building hydronic systems. Air volumes are located on the drawings. Flow rates for all hydronic systems are shown on the schedules.

1. Ventilation and Exhaust Systems:

a. HRV-1System.
b. HRV-2 System.

2. Hot Water Recirculation Systems.

3. Hydronic Heating systems.

a. Radiant Floor Heating System.
b. Heating Coil Heating Systems

4. Coordination during Controls Start-up and Testing.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.

D. Progress Reports.

E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. TAB report to include actual procedures used as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for ARCHITECT and for inclusion in operating and maintenance manuals.
3. Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
6. Units of Measure: Report data in both I-P (inch-pound) units.
7. Include the following on the title page of each report:

a. Name of Testing, Adjusting, and Balancing Agency.
b. Address of Testing, Adjusting, and Balancing Agency.
c. Telephone number of Testing, Adjusting, and Balancing Agency.
d. Project name.
e. Project location.
f. Project ARCHITECT.
g. Project Engineer.
h. Project CONTRACTOR.
i. Project altitude.
j. Report date.

F. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC MN-1, AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
5. Maintain at least one copy of the standard to be used at project site at all times.

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
2. Having minimum of three years documented experience.
3. Certified by one of the following:

    a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
    b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
    c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute.
    d. Professional mechanical engineer with documented TAB experience within the last five years.

E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Filters have been replaced immediately prior to adjustment of air system.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place.
15. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 ADJUSTMENT TOLERANCES

A. HRV Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

D. Duct traverses at the supply fan outlets and at the exhaust fan inlets shall be compared to total grille and diffuser airflows for each fan unit to determine the percentage duct leakage. Coordinate with Sheet Metal contractor.

3.4 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:

1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. Mark on the drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.

E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

G. Adjust diffuser and grille blades for proper air diffusion throughout. Adjust horizontal to vertical projection cones for proper air diffusion for round diffusers.

H. Duct traverses at the supply fan outlets and at the exhaust fan inlets shall be compared to total grille and diffuser airflows for each fan unit to determine the percentage duct leakage.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

J. Where modulating dampers are provided, take measurements and balance at extreme conditions.

K. Measure building static pressure.

L. HRV, EF and SF Adjustment: Perform in the following sequence.

1. Achieve the design flow rates for all outlets.

a. HRV, SF, and EF: Adjust the sheave so that design cfm is achieved.

1) Balancing dampers in the longest run wide open.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Pumps

1. Adjust to design GPM.
2. Measure pressure difference across pump.

3.7 SCOPE

A. Test, adjust, and balance the following:

1. HVAC and Domestic Water Pumps
2. Heating Coils
3. Radiant Floor Heating System.
4. HRV Units
5. Air Filters
6. Air Inlets and Outlets

3.8 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer
2. Model/Frame
3. HP/BHP
4. Phase, voltage, amperage; nameplate, actual, no load
5. RPM
6. Service factor
7. Starter size, rating, heater elements
8. Sheave Make/Size/Bore

B. V-Belt Drives:

1. Identification/location
2. Required driven RPM
3. Driven sheave, diameter and RPM
4. Belt, size and quantity
5. Motor sheave diameter and RPM
6. Center to center distance, maximum, minimum, and actual

C. Pumps:

1. Identification/number
2. Manufacturer
3. Size/model
4. Impeller
5. Service
6. Design flow rate, pressure drop, BHP
7. Actual flow rate, pressure drop, BHP
8. Discharge pressure
9. Suction pressure
10. Total operating head pressure
11. Shut off, discharge and suction pressures
12. Shut off, total head pressure

D. Heating Coils:

1. Identification/number
2. Location
3. Service
4. Manufacturer
5. Air flow, design and actual
6. Water flow, design and actual
7. Water pressure drop, design and actual
8. Entering water temperature, design and actual
9. Leaving water temperature, design and actual
10. Entering air temperature, design and actual
11. Leaving air temperature, design and actual
12. Air pressure drop, design and actual

E. Air Moving Equipment:

1. Location
2. Manufacturer and Model
3. Serial number
4. Arrangement/Class/Discharge
5. Air flow, specified and actual
6. Exhaust air flow, specified and actual
7. Outside air flow, specified and actual
8. Total static pressure (total external), specified and actual
9. Inlet pressure
10. Discharge pressure
11. Sheave Make/Size/Bore
12. Number of Belts/Make/Size
13. Fan RPM

F. Return Air/Outside Air:

1. Identification/location
2. Design air flow
3. Actual air flow
4. Design return air flow
5. Actual return air flow
6. Design outside air flow
7. Actual outside air flow
8. Return air temperature
9. Outside air temperature
10. Exhaust air temperature
11. Heat Exchanger discharge temperatures

G. Duct Traverses:

1. System zone/branch
2. Duct size
3. Area
4. Design velocity
5. Design air flow
6. Test velocity
7. Test air flow
8. Duct static pressure
9. Air temperature
10. Air correction factor

H. Air Distribution Tests:

1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

B. Insulation jackets.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 – Interior Painting

B. Section 23 0553 - Identification for HVAC Piping and Equipment.

1.3 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

B. ASTM C553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2008.

C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2010.

D. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 1985 (Reapproved 2007).

E. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2011.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2010.

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

I. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

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

1.5 QUALITY ASSURANCE

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

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum 3 years of experience and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.2 GLASS FIBER, FLEXIBLE

A. Manufacturer:

1. Knauf Insulation.
2. Johns Manville Corporation.
3. Owens Corning Corp.
4. CertainTeed Corporation.

B. Insulation: ASTM C553; flexible, noncombustible blanket.

1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 1200 degrees F.
3. Maximum Water Vapor Sorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

2.3 GLASS FIBER, RIGID

A. Manufacturer:

1. Knauf Insulation.
2. Johns Manville Corporation.
3. Owens Corning Corp.
4. CertainTeed Corporation.

B. Insulation: ASTM C612; rigid or semi-rigid, noncombustible board.

1. 'K' value: 0.24 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum service temperature: 450 degrees F.
3. Maximum Water Vapor Sorption: 5.0 percent.
4. Maximum Density: 8.0 lb/cu ft.

C. Vapor Barrier Jacket:

1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Insulated ducts conveying air below ambient temperature:

1. Provide insulation with vapor barrier jackets.
2. Finish with tape and vapor barrier jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

D. Insulated ducts conveying air above ambient temperature:

1. Provide with or without standard vapor barrier jacket.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

E. Insulate outdoor and exhaust air ductwork between automatic damper at HRV and louver. Do not insulate supply or return ductwork exposed in finished spaces.

F. Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

G. Exhaust and Outdoor Air Ducts Exposed in Rental, Repair, and Upper Lobby areas: Finish with canvas jacket for finish painting.

3.3 SCHEDULES

A. Duct System Insulation:

1. Louvers and Dampers Connected to Louvers: Rigid Mineral Fiber Duct Board Insulation: 2 inches thick.
2. Ducts Connected to Louvers and plenums located where exposed in Rental, Repair, and Upper Lobby areas: Rigid Mineral Fiber Duct Board Insulation, 2 inches thick. Finish with canvas jacket for finish painting.

    a. Exhaust Air: Insulate duct from edge of louver to the exhaust air damper.
    b. Outside Air: Insulate duct from edge of louver to fan inlet connection.

3. Ducts Connected to Louvers and plenums located concealed above ceiling or in Mechanical Room: Mineral Fiber Blanket Insulation 1-1/2 inches thick.

    a. Exhaust Air: Insulate duct from edge of louver to the exhaust air damper. Insulate to fan if there is not an exhaust air damper.
    b. Outside Air: Insulate duct from edge of louver to fan inlet connection.

4. Outside air intake and exhaust air plenums: Rigid Mineral Fiber Duct Board Insulation, 2 inches thick. Insulate unused portions of louvers.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 – Interior Painting

B. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2010.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007.

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007.

D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.

E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2008.

F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2007e1.

G. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008.

H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.

I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2010.

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

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

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

1.5 QUALITY ASSURANCE

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

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84, NFPA 255, or UL 723.

2.2 GLASS FIBER

A. Manufacturers:

1. Knauf Insulation
2. Johns Manville Corporation
3. Owens Corning Corp
4. CertainTeed Corporation

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.

1. 'K' value: ASTM C177, 0.24 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

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

E. Vapor Barrier Lap Adhesive:

1. Water based insulation adhesive, UL classified. Compatible with insulation.

2.3 JACKETS

A. PVC Plastic.

1. Manufacturers:

a. Johns Manville Corporation
b. Proto/Knauf
c. Speedline

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

a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.

3. Covering Adhesive Mastic:

a. Compatible with insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

E. For hot piping conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

F. Glass fiber insulated pipes conveying fluids above ambient temperature:

1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

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

H. Pipe Exposed in Mech/Elec 110 (less than 5 feet above finished floor): Finish with PVC jacket and fitting covers.

I. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

J. Fill joints, cracks, seams, and depressions with cement to form smooth surface.

K. Finish insulation at supports, protrusions, and interruptions.

L. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

M. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

N. Factory Insulated Equipment: Do not insulate.

O. Inserts and Shields:

1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

3.3 SCHEDULE

A. Piping Systems:

1. Heating Water Supply and Return: Mineral fiber pipe insulation:

a. Pipe Size Range: Up to and including 1-1/2" pipe diameter; thickness of 1 inch.
b. Pipe Size Range: 2” to 2-1/2” pipe diameter, thickness of 1-1/2 inch.
c. Pipe Size Range: 3 inch and up pipe diameter, thickness of 1-1/2-inch.

END OF SECTION 230719

SECTION 230926 - BUILDING AUTOMATION SYSTEM AND AUTOMATIC CONTROLS

PART 1 - GENERAL

1.1 OVERVIEW

A. Furnish all labor materials, equipment, and service necessary for installation of the HVAC control system for the Eaglecrest Ski Area. Work includes installation of a Direct Digital Controls (DDC) control system with a totally native BACNet based system, including an operators workstation. All building controllers, application controllers, and all input/output devices shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135-2008, BACNet. All workstations and controllers, including unitary controllers, shall be native BACNet devices.

1.2 QUALITY ASSURANCE

A. The control Subcontractor shall maintain an office in Juneau or Anchorage with repair parts and maintenance personnel to ensure prompt response to an emergency call during the warranty period. The contractor shall maintain a complete sales, engineering, installation, and service organization.

B. All WORK described in this section shall be installed, wired, circuit tested and calibrated by factory trained electricians and mechanics qualified for this WORK. The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying that installation experience. Installation shall not be subcontracted. Supervision, calibration and checkout of the system shall be by personnel with documented experience with specified manufacturer.

C. All materials and equipment used shall be standard components, of regular manufacture for this application. All systems and components shall have been thoroughly tested and proven in actual use.

D. The automatic control system shall be installed by trained, qualified personnel and commissioned by factory-trained technicians.

E. Perform work in accordance with NFPA 70.

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

1.3 SYSTEM DESCRIPTION

A. Scope of WORK:

1. This specification describes the primary products and performance of the automatic control system.
2. The work includes working with the adjustment contractor and mechanical contractor.
3. The work also includes connection to an uninterruptible power system (UPS) battery back-up system for system controllers. UPS for distributed controllers such as for dampers and valve actuators are not required. Coordinate with Electrical.
4. The control system shall be designed such that each mechanical system will be able to operate under stand-alone control. In the event of a network failure, or the loss of any other controller, the control system shall continue to operate under independent control.
5. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

6. Provide supervisory specialists and technicians at the job site to assist in all phases of system installation, startup, balancing, inspection.
7. Provide a comprehensive operator and technician training program as described herein.
8. Provide as-built documentation, operator's terminal software, diagrams, and all other associated project operational documentation including technical manuals, on approved media, the sum total of which accurately represents the final system.

1.4 COORDINATION

A. Equipment: Control Subcontractor shall supply control equipment for installation by equipment suppliers and mechanical Subcontractor where required. This includes all control equipment installed in piping systems such as thermostat wells and automatic valves. Control Subcontractor shall also coordinate locations of control equipment, including, but not limited to, thermostats, and valve actuators, thermostat bulbs and averaging elements.

B. During the adjustment of the mechanical systems, air and water, the BAS Subcontractor shall provide a trained technician on-site to help the adjuster with their balancing procedures including any software required to interface with the control sequences. Responsibility for coordination of the times is included under the automatic controls.

C. Control Contractor shall be available throughout entire substantial completion inspection process. Control Contractor shall make adjustments and programming changes as needed during inspection.

1.5 ACCEPTABLE MANUFACTURERS

A. Alerton

B. Delta Controls

C. Siebe Environmental Controls (INVENSYS).

D. Siemens

1.6 SUBMITTALS

A. Submittal of the entire control system design shall be provided. Submittal shall consist of shop drawings, a complete list of equipment and materials, manufacturer's catalog data sheets, and installation instructions. Terminal identification for all control wiring shall be shown on the shop drawings. Prior to installing the automatic control systems, submit the following for review and approval:

B. Shop Drawings: Control system installation drawings showing the equipment controlled, the locations of field devices, field wiring, layout drawings, riser diagrams, sequence of operation, and bill of materials, in addition to the following:

1. Electrical drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
2. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
3. List connected data points, including connected control unit and input device. List all input/output object listings and an alarm point summary listing.
4. Indicate system graphics indicating monitored systems, data (connected and calculated)

point addresses, and operator notations. Provide demonstration diskette containing graphics.

5. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
6. Indicate description and sequence of operation of operating, user, and application software.
7. Bill of materials for all control equipment and components. Provide valve and damper schedules.
8. Drawings shall detail all control panels, control devices, and all other field devices on building floor plans.
9. Drawings shall be submitted in the following standard sizes: 11” x 17” (ANSI B).

C. Product data/specification sheets for control system components and field devices.

D. Manufacturer's Instructions: Provide and indicate manufacturer's installation instructions for installation, maintenance, and operation of all manufactured components.

E. Project Management: The vendor shall provide a detailed project design and installation schedule with time markings and details for hardware items and software development phases at the beginning of the project and updated as required. Schedule shall show all phases of the project. Schedule shall show all the target dates for transmission of project information and documents and shall indicate timing and dates for system installation, debugging, and commissioning.

F. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.

1. Revise shop drawings to reflect actual installation and operating sequences.
2. Include submittals data in final "Record Documents" form.
3. Upon completion of the work, provide a complete set of drawings on disk media. Drawings shall be provided as AutoCAD compatible files.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be submitted for review and approved before the final inspection and Owner training.

B. The operation and maintenance manuals shall include the following information:

1. A user's guide to operate the building management system. The guide shall include the following: log on procedure; viewing system information; viewing and acknowledging alarms; changing a setpoint; printing a trend or report; overriding a point.
2. Manufacturer's data for all control components and maintenance information for all control components requiring periodic maintenance.
3. Complete system “As-Built” control drawings. Complete software “As-Built” diagrams. As-built control drawings and sequences shall be re-submitted as necessary for changes made during commissioning process.

1.8 WARRANTY

A. A warranty period of one year shall commence upon acceptance of the systems by the OWNER. The warranty shall consist of providing parts and labor as required to repair or replace parts of the control system that prove to be faulty due to defective materials or improper installation practices or troubleshooting control sequences that are not operating as specified. Included is reprogramming of the system software to include changes in the point descriptions as requested by the Owner. This warranty excludes normal routine maintenance.

1.9 MAINTENANCE SERVICE

A. Provide service and maintenance of energy management and control systems for one year from Substantial Completion.

B. Provide two complete inspections per year, one in each season, of approximately 4 hours duration, to inspect, calibrate, and adjust controls as required, and submit written reports.

C. Provide complete service of systems, including call backs.

D. Operator workstation software, project software, database, and firmware updates shall be provided to the Owner and installed at no additional charge during the warranty period. Written authorization by Owner must, however, be granted prior to the installation of such changes.

1.10 ACCEPTANCE TESTING

A. Point Verification:

1. All control points shall be tested and included in point-to-point testing report provided to Engineer prior to inspection. To verify end-to-end operation of the system, the Subcontractor shall provide a hard copy of an All Points Summary Listing to the Owner of each part or system and verify that each point has been successfully tested. Successful testing report must be received prior to being placed in warranty by the Owner. For CHS systems, the Subcontractor shall additionally provide a print screen of the process display showing real time dynamic point information for all points on the subsystem(s) to be accepted.

B. Sequence Verification:

1. The Contractor shall notify the Owner of systems which perform all specified sequences. The Contractor shall provide a report to the Engineer detailing all sequences have been testing and determined to be operating properly prior to inspection. The ARCHITECT shall verify all sequences of operation and place the system into warranty acceptance test.

C. Prepare and start logic control system under provisions of this section.

D. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

1. Control system functional tests shall be successfully completed minimum 1week prior to substantial completion inspection.
2. Control Contractor shall be available on-site during balancing and during substantial completion inspection.
3. Control system point-to-point check-out and functional tests shall be successfully

completed minimum 1 week prior to substantial completion inspection. Provide point-to-point test summary to Engineer.

1.11 TRAINING

A. After substantial completion and prior to final completion of the installation, Eaglecrest Maintenance personnel and Staff shall be instructed on site in the sequence of operation and maintenance of the system hardware and software by the Subcontractor's qualified representative. A minimum 6 hours of training is to be provided. Coordinate with owner to determine the nature of training to be provided.

B. Subcontractor is to provide a training schedule for review and approval. Schedule shall be coordinated with and approved by the Owner.

C. Provide application engineer to instruct owner in operation of systems and equipment.

PART 2 - PRODUCTS

2.1 BUILDING AUTOMATION SYSTEM (BAS) COMMUNICATIONS

A. The distributed stand-alone DDC controller trunk communications shall consist of a multi-drop RS-485 bus architecture. The distributed DDC controllers shall provide communication transient protection. BACNet communication protocol required.

B. A high-speed Network Interface Module (NIM) shall be provided to support either Ethernet or Echelon communication. (BAS LAN) The NIM shall support a variety of cabling types. Minimum connectivity shall be provided for 10 Base 2 (ThinNet RG-58 A/U Coaxial cabling with BNC connectors) or 10BaseT (Twisted - Pair RJ-45 UTP cabling).

C. Portable operator's terminal: (1) Required.

1. Configuration: Provide Laptop work station.
2. PC Processor 1.8 GHz dual-core, or 3.0 GHz single processor.
3. 80 GB hard drive.
4. Minimum memory: 2GB RAM.
5. Cache memory: 512 Mbytes.
6. High-performance graphics adapter.
7. Keyboard: Low profile, detachable, having Qwerty layout plus 10 key numeric pad.
8. CD/DVD writer. Minimum of two USB ports.
9. Mouse: Software supported mouse with support software including self building menus and display of system operations and functions.
10. Minimum of a 17 inch diagonal flat screen monitor.
11. Communication: 56K modem, wireless network card, and future PCMCIA slot for a network card for hard connection.
12. Printer.
13. Operating system: Windows 8.
14. The contractor shall coordinate with Owner to connect the computer to the networks and to implement on the Owners networks prior to Substantial Completion.
15. Provide with DDC operational software and diagnostic software for field troubleshooting equipment, trending, and editing software.
16. Computer shall be provided and usable for interface with BAS system and shall have all necessary software and graphics capabilities loaded and operational.

D. Standard BACNet object types accessed by the workstation shall include as a minimum: Analog Value, Analog Input, Analog Output, Binary Value, Binary Input, Binary Output, Calendar, Device, Event Enrollment, File, Notification Class, Program and Schedule object types. All proprietary object types, if used in the system, shall be thoroughly documented and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.

E. Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network. The Operator Workstation shall comply with Annex J of the BACNet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACNet devices on the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs). Workstation shall support Foreign Device Registration to allow temporary workstation connection to IP network.

2.2 FACILITY MANAGEMENT SYSTEM HOST STATION SOFTWARE (CHS)

A. Graphics shall be provided for the Host computer workstation. The software shall provide the following functions and features:

1. Run in a Microsoft Windows operating environment.
2. Provide color graphics of controlled systems, facility wide access and coordination of global control strategies, and centralized documentation.
3. Provide for assigned password names and codes to limit the access into particular applications and functions of the system. Allow discrete menus into the system for each user.
4. Provide dynamic graphics with “system penetration” method of obtaining system information. Provide dynamic graphic screens of mechanical equipment and DDC controlled systems. Maximum of 128 dynamic points displayed on one screen.
5. Provide display and modification of individual dynamic system points from within any specific dynamic graphic display.
6. Provide help window displays for each point displayed on the screen. User editable information specific to the point and its' relationship to the system currently displayed.
7. Provide centralized scheduling and modification of the time clock functions.
8. Provide alarm management and system exception annunciation with real time trending and reports.
9. CONTRACTOR shall provide a 2 year subscription service for any and all software upgrades that are available from the manufacturer following the final acceptance of the BAS system. Service shall include installation of the software on-site and all necessary equipment to upgrade the system. Copies of the software shall be provided to the OWNER and the Operating and Maintenance manuals shall be updated appropriately.

B. Dynamic Graphics:

1. Upon entering the graphics program floor plans shall be shown with all terminal equipment locations, ALL room temperatures, and any alarm features at the actual physical locations and not in a tabulated format. The floor plan layout shall be shown accurately and as shown on the contract documents with the actual room numbers listed. Mechanical equipment systems shall have their own screens with all control points, adjustable set points, and alarms shown.
2. The user will be able to zoom in to the building from the site plan and then zoom in to a particular area for closer inspection and then further zoom in on this area and so on until the detailed color graphic display of a desired portion of the facility is represented. The

operator shall be able in this manner to "penetrate" to any desired system information without being required to enter any commands via the keyboard. A minimum of 70 dynamic points shall be displayable on any one screen.

3. As a minimum, a graphic screen shall be designed showing the entire facility, each major piece of mechanical equipment within each building, all of which will display the data for each area dynamically, and the control schematics shown on the drawings.
4. Equipment Diagrams: Provide a diagram of each piece of equipment similar to the schematic diagrams shown on the drawings. Display all monitored points, setpoints, control points, schedules, and alarms. Setpoints and schedules shall be adjustable from the equipment diagram. Provide a colored status indicator for the filters with green indicating green and red indicating dirty.

C. Systems Integration:

1. The CHS shall integrate the automation system being installed as a part of this contract with the current automation system now in use at this facility. Systems integration shall be defined as the following:

    a. All point data from the different systems shall be viewed and manipulated through one common format (see previous section "dynamic graphics" for definition of "viewed and manipulated"). Therefore, from the user's perspective, interaction with either of the two or more systems shall be identical in every way.
    b. Points from any of the different systems may be monitored concurrently on one graphic screen.
    c. Alarms shall be viewed and handled in a common format.
    d. Trended data shall be stored in a common database. This shall allow the data to be viewed or manipulated in common reports or charts.
    e. Panel database Upload and Download shall be supported directly by this CHS for each system being integrated and stored to the hard disk.

D. Centralized Scheduling and Modification:

1. Calendars shall be provided for displaying and modification of any of the Mechanical Systems Controller (MSDCs) time clock functions. The user shall be able to view an entire month's scheduling at a time. Holidays and Special functions shall be clearly marked on the calendar. Calendars shall be displayed by area served. A list of "served areas" shall be displayable at any time by clicking on a button on the calendar. The user shall only have to click on a "served area" to view its time clock schedule. A dynamic graphic shall be attached to each calendar allowing the user to view this "served area's" real time statistics, a link shall be provided on this same graphic screen to take the User back to the schedule.
2. Schedule changes may be made by clicking on a day or week and entering the new schedule. Changes shall be permanent or for "one time" or multiple occurrences of varying parameters. Global changes shall be allowed for similar or dissimilar schedules. There shall be no limit to the number of calendars allowed.

E. Alarm and System Exception Annunciation:

1. All alarms shall be displayed on the main alarm screen and be tied into the fire alarm sequence. Alarms shall be acknowledge by the operator in a manner equal to the existing alarm interface.

F. Trend Management and Reports:

1. The BAS system shall be provided with the ability to trend and produce reports with the new points installed under this project.
2. The CHS shall automatically perform time based periodic collection of real time point data and subsequently store it to the systems hard disk. There shall be two modes of operation; local collection shall allow the CHS to directly query the MSDCs for individual point samples; remote collection shall mean that the MSDCs collect and store trend data on individual points and then release the entire trend table(s) upon a request from the CHS. Manipulation and archiving of both types of data collection shall be treated commonly.
3. The report section of the CHS shall be the "gateway" to the CHS's database for all solicited and unsolicited data collected, and shall provide an easy means of reporting and information management.
4. The report generator shall be an integral part of the CHS, systems that use third party packages (such as Excel) for report manipulation shall not be acceptable.
5. Reports on historical trend data shall allow for daily, weekly, monthly and yearly reporting. These reports shall be completely flexible on the data items to be reported on. The user shall be able to select from a list of predefined reports or select data items on-the-fly. The selection of data items shall not be restricted by panel source. Reports may be up to 25 columns and infinite in length. Reports must be capable of reporting on data that has been collected at varying time intervals. Line interpolation shall be used when data samples are not present for a specific time placement, blank data rows for any time slot in the data columns will not be accepted. Report generator shall allow an operator to easily and quickly define the contents of a report as well as define a print time and date if so desired. Information contained in the reports shall be derived from alarm history, CHS or SDC generated exceptions, trend data and timed overrides.

G. Multi-tasking:

1. The CHS shall be capable of true multi-tasking capabilities. The User shall be able to use other non-related programs in the CHS while still running all CHS applications with no interruptions. This shall include the use of real time data in other applications. This CHS shall allow Spread Sheet programs to gather data from the MSDCs dynamically while running a dynamically updating Graphic screen. Up to 16 applications may collect data dynamically and simultaneously from the MSDCs. The CHS shall have the ability to allow the passing of data freely to MS Windows applications which incorporate the use of Dynamic Data Exchange.

2.3 MECHANICAL SYSTEMS CONTROLLERS (MSDCs)

A. General:

1. Controls shall be microprocessor based, Air Handler Digital Controllers (AHDC's). AHDC's shall be provided for Heat Recovery Ventilator, Boiler, and Pump control, and other applications as shown on the drawings. AHDC's shall be based on a minimum 16

bit microprocessor working from software program memory which is physically located in the AHDC. The application control program shall be resident within the same enclosure as the input/output circuitry which translates the sensor signals. All input/output signal conversion shall be performed through a minimum of a 10 bit A to D converter. All input points shall be universal in nature allowing their individual function definition to be assigned through the application software. All unused input points must be available as universally definable at the discretion of the owner. If the input points are not fully universal in nature, unused points must be equal in quantity between Analog Inputs and Digital Inputs.

2. The BAS Subcontractor shall provide and field install all AHDC's specified under this section.
3. All input/output signals shall be directly hardwired to the AHDC. Troubleshooting of input/output signals shall be easily executed with a volt-ohm meter (VOM). As a result of this intent, it is specified that power line carrier systems, or other systems which command multiple outputs over a single pair of wires, shall not be utilized.
4. AHDC's shall be in continuous direct communication with the network which forms the facility wide Building Automation System. The AHDCs shall communicate with the SDC at a baud rate of not less than 19,200 baud.

B. Non-Volatile Memory:

1. All control sequences programmed into the AHDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained. Power failures shall not cause the AHDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database. The AHDC shall allow for the creation of unique application control sequences. Systems that only allow selection of sequences from a library or table, are not acceptable.
2. All control sequences shall be fully programmable at the AHDC, allowing for the creation and editing of an application control sequence, while at the unit.

C. Service Port:

1. The AHDC shall be provided with an interface port for the HHOT. The interface port shall allow the HHOT to have full functionality as described in the HHOT section of this specification. From the interface port, the HHOT shall be able to directly access any AHDC, LIDC, UDC or VAVDC in the network.

D. Trending:

1. The AHDC shall provide an input/output point trending utility that is capable of accumulating 48 analog point samples and 10 digital point samples, per input/output point. Each sample shall be taken on a user defined interval, ranging from 1 second to 255 hours per sample. The digital readings shall be on a change of state occurrence for the digital points. All samples shall be recorded with the engineering units for the value, along with a time and date identifier for each sample taken. The samples shall be protected against loss due to power interruptions through a battery or capacitor backup method for a minimum of 30 days.
2. Systems unable to provide the above capability shall provide for the individual input/output point trending at the SDC. Specifics as to how each AHDC point will be trended, at the SDC, shall be provided in the submittal documents. Included in the explanation shall be the sample intervals, the memory allocation in the SDC and the number of AHDC's per SDC that can be expected.

E. Diagnostics:

1. The AHDC shall provide LED indication of transmit/receive communications performance, as well as for the proper/improper operation of the controller itself.

F. Controller Location:

1. To simplify controls and mechanical service troubleshooting, the AHDC shall be mounted adjacent to the air handling system. The AHDC shall be provided in a NEMA approved enclosure. The AHDC shall be constructed in a modular orientation such that service of the failed components can be done quickly and easily. The modular construction should limit the quantities of printed circuit boards to a maximum of two. All logic, control system, power supply and input/output circuitry shall be contained on a single plug-in circuit board. When required to replace a printed circuit board, it shall not be necessary to disconnect any field wiring. This shall allow all controls maintenance and troubleshooting to be made while at the air handling unit. The AHDC shall be directly wired to sensory devices, staging relays or modulating valves for heating and cooling.
2. For compatibility to the environment of the air handling unit, AHDC's shall have wide ambient ratings. AHDC's shall be rated for service from -40 Degree F (Degrees Fahrenheit) to 140 Degree F.
3. Subcontractor shall submit description of location of AHDC's on all mechanical and air handling equipment.

2.4 EQUIPMENT - GENERAL

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

2.5 CONTROL PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gages, pilot lights, push buttons and switches flush on cabinet panel face.

B. NEMA 250, general purpose utility enclosures with enameled finished face panel.

C. Provide common keying for all panels.

2.6 SENSING AND CONTROL OUTPUT REQUIREMENTS

A. Sensing: All sensing inputs shall be provided via industry standard signals. Temperature, humidity, differential pressure signals, and other signal inputs shall be one of the following types: 0-20 mA; 4-20 mA; 0-5 VDC; 0-12 VDC; 1000 ohm platinum (at O C, 2.62 ohms/ºC); 1000 ohm Balco (2.2 ohms/ºF); 10 k ohm Thermistor (at 25ºC/77ºF). All signal inputs shall be compatible with the controllers used and with the requirements for readout of variables in true scaled engineering units as specified.

B. Control Outputs:

1. The control panel shall internally provide test points for the circuits driving the equipment Subcontractor, for the purpose of troubleshooting the 120 VAC circuit to the Subcontractor. All such relays shall be of modular construction that can be easily and quickly replaced on an individual basis if the module were to be damaged.
2. Modulating outputs shall be industry standard 0-5 VDC, or 0-12 VDC with definable output spans to adapt to industry available control products. Milliamp outputs of 0-20 mA or 4-20 mA are also acceptable. Drive open/Drive closed type modulating outputs are acceptable for selected terminal unit control.

2.7 SENSORS

A. General:

1. Provide sensors with specified output type for remote sensing of temperature, humidity, pressure, and flow rate. Suitable for medium where used, system conditions, and ambient temperature.
2. Provide two wire temperature and humidity sensors.

B. Space Temperature:

1. Accessible adjustment (55-85F range) standard wall sensor shall use solid-state sensor and shall be packaged in aesthetically pleasing enclosure. Sensor shall contain a backlit LCD digital display. Minimum 0.1% accuracy. Removable covers. BAS monitoring and remote temperature override capability on ALL thermostats. Port for plug-in of Field Service Tool for field adjustments. Locking guards on all thermostats located in Lobbies, Hallways, Vestibules, and Public Restrooms.

C. Duct Air Temperature, Probe Type: For supply air, return air, and exhaust air.

1. With separable, perforated bulb guard. Thermistor or RTD with minimum 32-150 F range, accuracy of +/-0.4 F over full range, and maximum drift of 0.1F/year.

D. Duct Air Temperature, Averaging Type: For Heat Exchanger discharge due to bypass, and low limit temperature sensor.

1. Provide averaging bulb thermostats with element installed to cover twice the cross-section of the duct, typically a minimum of 20 feet. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range
2. RTD continuous sensing element with appropriate range, accuracy of +/- 0.75 F over full range, and maximum drift of 0.1 F/year.

E. Low Temperature Limit Switch: 4-wire, two SPDT switches, main contacts open on temperature below setpoint, pilot contacts close. Auto-reset unless otherwise indicated. Extended length capillary type element with any one foot at setpoint causing trip. Freeze protection low limit minimum range 0-60ºF. Suitable for ambient temperatures -40 to 140ºF.

F. Fluid Temperature:

1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint and adjustable throttling range. Thermistor or RTD with minimum 30-230 F range, accuracy of +/-1.0 F over full range, and maximum drift of 1F per year. Provide

appropriate thermal well for the pressure application to allow removal of the sensing element without draining the system. Wells filled with heat conductive compound.

G. Outside Air Temperature:

1. Platinum RTD with minimum -58-110 F range, Accuracy of +/-1.0 F over full range, and maximum drift of 1F per year. Hy-Cal RTS-5737-W or equal. Provide sunshield and weatherproof box for exterior location as required.

H. Fluid Pressure:

1. Semi-conductor strain gauge pressure transducer with range 150% of operating pressure and over pressure tolerance of 200% of range pressure, +/-2% accuracy over full range, and maximum drift of 1% full range per year. Kele PTX1E, Mamac PR262, or equal.
2. Provide with brass or stainless steel snubber and pigtail on steam applications.
3. Coordinate tap requirements with the mechanical contractor. Provide with gate or ball valve isolation.

I. Static Pressure Sensors:

1. Unidirectional Semi-conductor strain gauge pressure transducer with ranges not exceeding 150 percent of maximum expected input.
2. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F.
3. Accuracy: One percent of full scale with repeatability 0.3 percent.
4. Output: 0 - 5 vdc with power at 12 to 28 vdc.

J. Air Differential Pressure:

1. Semi-conductor strain gauge pressure transducer with range 150% of operating pressure and over pressure tolerance of 200% of range pressure, +/-2% accuracy over full range, and maximum drift of 1% full range per year.
2. Provide static pressure tips with integral compression fittings for reference tubing at duct penetrations.

K. Equipment Operation Sensors:

1. Status Inputs for Fans: Differential pressure switch with adjustable range of 0 to 5 inches wg.
2. Status Inputs for Electric Motors: Current sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
3. Current Sensing Switches: Current operated solid state switch with adjustable set-point from 1 to 135 amps. Power and status LED's, non-polarity sensitive.
4. Status Inputs for Pumps: Differential pressure switch piped across pump with adjustable pressure differential range of 8 to 60 psi.

L. Damper Position Indication: Potentiometer mounted in enclosure with adjustable crank arm assembly connected to damper to transmit 0 - 100 percent damper travel.

2.8 SWITCHES

A. Differential Pressure Switch - Liquid: Brass bellows operated single pole double throw switch. Where differential pressure is 10 PSI or less provide United Electric J21K Series or equal. Where differential pressure is greater than 10 PSI provide Penn P-74FA-5 or equal. Provide with gate or ball valve isolation.

B. Current Sensing Switches:

1. Current operated solid state switch, 0.5 to 200 amp amperage range. Mini solid-core or split-core for fixed loads. Veris H-800 series or equal.
2. Current operated solid state switch with adjustable set-point from 1 to 135 amps. Power and status LED's, non-polarity sensitive. For detecting belt loss and motor failure. Veris H-708 solid-core, H-908 split-core or equal.

2.9 CONTROL VALVES

A. Automatic Valves: For water or steam, as applicable, suitable for system conditions. 2-inch and smaller: Brass body, threaded, installed with union on each connection. 2-1/2 inch and larger: Iron body, flanged. Seats and discs or plugs of nonferrous metals. Modulating or positive acting as required. See Contract Documents for operation and capacity.

B. Positive-acting: Flat, single discs with renewable composition faces.

C. Modulating: Single or balanced, parabolic or V-notched inner valve plug. Steam valves single seat type for tight shutoff.

D. General: For hot water as applicable.

1. Non-terminal unit control valves (1/2” through 3”) sizes shall have cast bronze bodies with static pressure rating conforming to ANSI B16.15- 1971 250 PSIG rating. Maximum water pressure shall be 400 PSIG with 40 to 150ºF water, decreasing to 321 PSIG at the maximum water temperature of 281ºF.
2. Valves with flanged fittings (2.5” through 6”) sizes shall have cast iron bodies with static pressure rating conforming to ANSI B16.1-1975 125 PSIG rating Maximum water pressure shall be 200 PSIG with 40 to 150ºF water, decreasing to 165 PSIG at the maximum water temperature of 281ºF.
3. All valves shall have stainless-steel stems, brass or stainless-steel throttling plugs, bronze valve seats, and spring-loaded Teflon -cone packing. Two-way valve plugs for non-steam applications shall have composition disks.
4. All valves shall be fully modulating unless otherwise indicated. Control Subcontractor is responsible for the selection of the proper control valves for the project including sizing, flow characteristic, close-off rating, and actuator selection.
5. All two-way valves shall have contoured or characterized throttling plugs with linear (for steam applications) or equal- percentage flow characteristics.
6. All three-way and four-way valves shall have brass or stainless steel linear throttling plugs with stainless steel stems.

2.10 VALVE ACTUATORS

A. General:

1. Where exposed to outdoor air or air temperatures lower than 50ºF, provide completely weatherproof actuators with internal heaters to allow normal operation at -50ºF. The

valve actuator shall be capable of providing the minimum torque required for proper valve close off for the required application.

B. Modulating Electronic Actuators: Self contained, linear motorized actuator with approximately 3/4 inch stroke, 60 second full travel with transformer and SPDT contacts: 24 v DC, 6 watt maximum input.

C. Two-Position Electronic Actuators: Synchronous motor with enclosed gear train, dual return springs, valve position indicator; 2-10v DC, 4-20ma. Valves shall spring return to normal position for temperature protection.

2.11 DAMPER OPERATORS

A. General: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.

1. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
2. Provide one operator for maximum 36 sq ft damper section.
3. Electric damper actuators shall be direct shaft mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or setscrew type fasteners are not acceptable.
4. Where exposed to outdoor air or air temperatures lower than 50ºF, provide completely weatherproof actuators with internal heaters to allow normal operation at -50ºF.
5. With auxiliary end switch or sensor for monitoring damper position.

2.12 WIRING

A. Includes all control wiring to complete the system and provide control arrangements specified or shown on the drawings. Power or interlock wiring shall be run in separate conduits from sensor and communications wiring.

1. Low-voltage Control Wiring (12-24v): All control wiring shall be enclosed in conduit. Motor disconnect switch shall also disconnect control circuit. Indicating lights wired from the motor terminals or from the last controlling device to the motor to show actual operation. All low voltage control wiring 18 AWG minimum.
2. 110-volt and larger Control Wiring: 12 AWG minimum if directly operating a motor, and 14 AWG minimum if controlling relays and holding coils.

B. Control Power: Control Power will be provided under the Electrical Division for new panel locations. The power will be available in J-boxes located in the Mechanical Rooms. Provide the electrical connection between all automatic control equipment and the control power J-boxes.

2.13 GLOBAL DIGITAL CONTROLLER (GDC)

A. Provide a microprocessor based, direct digital controller to integrate and communicate with all microprocessor based controllers on the network. All communication interface programs shall be resident within the global controller. The following functions and features shall be provided:

B. Multi-tasking, 16-bit microprocessor operating from software program memory resident in the controller. 80186 Microprocessor with 12 MHZ clock frequency. Global controllers shall exist at the LAN level with the stand-alone digital controllers.

C. The GDC shall provide alarming, point trending, and energy report generation capabilities. Alarming points shall be uniquely definable, with multiple alarms assignable to a single point. The quantities of trended point values shall be limited only by total controller memory space. If necessary, a GDC may be dedicated fully to a trending task, allowing all controller memory to be available for the trend storage. Each unique trend report shall contain a minimum of 4 different points and minimum of 128 samples per point. Trending frequency for each report shall be operator definable from a sample once a second to a sample one every 24 hours. Trend reports shall be internally formatted by the GDC and shall be reportable directly to a serial printer, a VT-100 display terminal, or any other device capable of receiving a formatted ASCII data file.

D. All control sequences programmed into the GDC shall be stored in non-volatile memory, which is not dependent upon the presence of a battery to be retained. Power failures shall not cause the GDC memory to be lost, nor shall there be any need for batteries to be recharged or replaced to maintain the integrity of the controller database.

E. The GDC shall be provided with a battery-backed clock that is capable of maintaining the time of day and calendar for up to thirty days upon loss of power to the GDC without loss of setting. The battery for the time clock shall be field replaceable by the customer.

F. The GDC shall have a complete set of energy and facility management capabilities including maintenance time reminders, energy reports, and trend reports. The energy management functions shall include duty cycle, temperature compensated duty cycling, optimum start/stop, electric demand limiting, enthalpy changeover, and calendar scheduling.

G. The GDC shall have a keypad and display.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify conditions before starting work.

B. Verify that systems are ready to receive work.

C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

D. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of thermostats with plans and room details before installation. Locate 48 inches centerline above floor. Align with lighting switches.

C. Mount freeze protection thermostats using flanges and element holders.

D. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.

E. Provide separable sockets for liquids and flanges for air bulb elements.

F. Provide stainless steel thermowells suitable for respective application and for installation under other sections-sized to suit pipe diameter without restricting flow.

G. Provide locking guards and lock on thermostats in all public spaces. Provide keys to owner.

H. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures unless approved.

I. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

3.3 WIRING AND RACEWAYS

A. General:

1. All wiring/cabling shall be installed in conduit.
2. Provide wiring, conduits and raceway complying with the National Electrical Code, Division 26, 27, 28, State and Local Codes and Ordinances.
3. All thermostats/sensors shall be installed at 48-inch height.
4. Use EMT, metal duct, IMC, rigid conduit, surface metal raceways, or totally enclosed metal through with flexible metal tubing as required by Division 26.
5. Provide wire with copper stranded conductors. Provide color or number coded jackets.
6. Provide 20 gauge minimum foil-shielded cable rated 100 VDC at 80 C. for input/output wiring.
7. Provide communications network wiring meeting the gauge, impedance, capacitance, resistance and shielding requirements specified by the manufacturer of the connected devices.
8. Install conduit in a neat an orderly manner generally running piping along building lines.
9. Seal conduit penetrations at rated walls with fire-stopping installed in accordance with fire-stopping manufacturers UL listed installation requirements.
10. Wire all electrical controls and switches furnished under this section of the Specifications.
11. Support and conceal wiring in finished areas.

3.4 COORDINATION

A. Coordinate this WORK with the WORK of other trades, and make arrangements for the complete and proper accomplishment of all related WORK. Coordinate required control interlocks with HVAC manufacturers or local representatives as necessary.

B. Mechanical Subcontractor Responsibilities: Installs automatic valves and separable wells that are supplied by the Temperature Control Subcontractor.

3.5 TESTING AND ADJUSTING

A. Upon completion of the control installation, start up the system, perform necessary testing, and adjust the system to ensure proper operation.

B. Coordinate the final adjustments and “fine tuning” of control functions and devices so the mechanical systems and the control systems operate and respond as an integrated comfortable and energy efficient component of this facility.

C. See PART 1 for additional information.

3.6 WARRANTY ACCESS

A. The Owner shall grant to the Subcontractor, reasonable access to the BAS system during the warranty period. The owner shall provide, at no cost to the Subcontractor, a dedicated voice grade telephone extension for remote telecommunications during this period.

3.7 SEQUENCE OF OPERATIONS

A. ELECTRIC BOILER (B-1):

1. Electric boiler shall operate according to its own internal staging and sequencing control.
2. Remote/Local Control: When in remote position, BAS shall enable boiler to operate according to boiler's internal staging and sequencing control. Boiler operation shall be disabled when in remote position when outdoor air shutdown control (above adjustable 60F) shuts down boiler and circulation pumps P-1A and P-1B. Pumps P-1A and P-1B shall be operating when boiler is enabled. When in Local position, boiler shall operate according to its own internal staging and sequencing control.
3. Boiler Temperature Setpoint: Boiler internal staging to maintain adjustable 140F heating supply outlet temperature. Set Electric High Limit controller with manual reset at 160F.
4. Flow Sensor shall not allow boiler to operate without flow.
5. Provide sensors for BAS monitoring of building heating supply and heating return temperatures as shown on M601 Control Drawing.

B. BUILDING HEATING CIRCULATION PUMPS (P-1A AND P-1B): Magnetic starter with three position switch, located on the wall where shown. In AUTO position, lead pump to operate continuously unless shutoff due to high outdoor air temperature control (OSA above adjustable 60F). Same temperature shutoff setpoint for pumps shall also disable electric boiler when pumps are not operating. Pumps to operate in lead/backup operation with pumps switching lead/backup designation once per week. If Lead Pump fails to operate after a delay of one minute, Backup Pump switches to Lead designation and an alarm sent to BAS. When the magnetic starter is in the HAND position, pump to operate continuously.

1. Electric boiler will not operate unless the building circulation pumps (P-1A or P-1B) are operating through flow switch.
2. DDC Display: Indicate boiler heating water temperatures, lead/backup pump designation, pump operating status, and alarms.

C. RADIANT HEATING SYSTEM AND RADIANT PUMPS (P-2A and P-2B):

1. Zones: Room setpoints (initially set at adjustable 67F) shall be set 2 degrees above HRV discharge temperature setpoint so that radiant heat circulates continuously.
2. Magnetic starter with three position switch located on wall where shown. In the AUTO position, lead pump shall circulate continuously unless all radiant zone valves are closed. Pumps to operate in lead/backup operation with pumps switching lead/backup designation once per week. If Lead Pump fails to operate after a delay of one minute, Backup Pump switches to Lead designation and an alarm sent to BAS. When the magnetic starter is in the HAND position, pump to operate continuously.
3. Radiant Temperature: 4-way automatic Valve (AV-9) shall modulate to maintain minimum temperature heating water required to maintain zone temperatures and maintain constant circulation. Modulating reset schedule as follows:

OSA at 15F and below	Radiant Supply Temp at 120F
OSA at 55F and above	Radiant Supply Temp at 80F.

4. Zone Valves (AV-1 through AV-8): Zone automatic valves shall operate to maintain room temperature setpoint.
5. DDC Display: Indicate radiant heating water temperature setpoint, actual radiant heating water supply and return temperatures, room setpoints and room temperatures, pump operating status, and alarms.

D. GENERAL FAN UNIT NOTES: The following controls apply to the various ventilation systems outlined in this section, as indicated within each fan system description or listed below as typical for all fan units. Indicate all schedules, setpoints, temperatures, damper and valve positions, operating commands and status, and alarms on Graphics.

1. Filter Alarm: Differential pressure sensor across filter to send filter alarm to BAS whenever the differential pressure exceeds an adjustable 0.50 inches water column for pre-filters. Analog input signal with set point adjustable at the BAS. Alarm is to be sent to the BAS for confirmation. Indicate filter pressure, setpoint, and any alarms on Graphics.
2. Low-limit control: Averaging bulb thermostat at the discharge of the heating coil to stop the fan below an adjustable 40°F upon a time delay of 45 seconds. Outdoor and Exhaust dampers repositioned to full closed position and automatic valve positioned to full open heating. Fan automatically reset on temperature rise above set point. Alarm is to be sent to the BAS for confirmation. Indicate temperatures and any alarms on Graphics.
3. Fan operation status (Supply and Exhaust Fans): Current sensor to send fan operation signal to BAS when in operation. Alarm is to be sent to the BAS for confirmation when fan does not operate when commanded on. Indicate status and any alarms on Graphics.
4. HRV coil minimum flow: When OSA drops below 32F, HRV coil minimum flow rate shall be set at an adjustable 10% open when fan unit is off to reduce chance of freeze-up.

E. HEAT RECOVERY VENTILATORS (HRV-1 AND HRV-2): Magnetic Starter with a Hand-Off-Auto switch on the cover. In the AUTO position, the supply fan and exhaust fan operates according to the Occupied/Unoccupied schedule of the BAS and safety functions such as the low-limit thermostat. In the Hand position, the fan operates at the command of the low-limit thermostat. Display alarms and status on Graphics.

1. Schedule of Operation:

   a. Normal Occupied Schedule: Initially set schedule to operate HRV unit (HRV-1 and HRV-2) from 7:00 am until 5:00 pm Sunday through Saturday. Each day set up to have own individually adjustable schedule.
   b. Unoccupied Mode: HRV shall remain OFF in Unoccupied.
   c. Night Setback Mode: There shall be no Night Setback mode.

2. During the Occupied schedule, Outside air damper (OAD) and Exhaust air damper (EAD) to open during HRV operation.

3. Supply air temperature: Duct immersion thermostat controller, set at an adjustable 65F, to modulate heating coil 3-way automatic valve to maintain coil discharge air temperature at setpoint. Normally open automatic valve shall open on failure of control power. 24 volt control power.

4. Heat Exchanger:

    a. Frost Control with averaging bulb exhaust air sensor to modulate face and bypass dampers to bypass air around heat exchanger to maintain minimum frost control exhaust air temperature setting, initially set at 37°F.
    b. During Summer mode, OSA to bypass heat exchanger when OSA is above 60F.

5. Additional Controls: Each HRV shall have filter alarm, low-limit control, fan operation status, and minimum AV flow controls as described in General Fan Notes above. Indicate all schedules, setpoints, temperatures, damper and valve positions, operating commands and status, and alarms on Graphics.

F. DOMESTIC HOT WATER HEATING SYSTEM:

1. Electric Domestic Hot Water Heater (DWH-1):

    a. Factory installed immersion sensor shall control electric elements as needed to maintain water heater setpoint.

        1) DWH-1 setpoint: Initially set at 140F.

2. Hot Water Recirculating Pump (HWRP): Manual starter installed where shown. In the ON position, pump shall operate whenever immersion thermostat in the recirculating hot water piping, set at 95F, calls for heat. Display status on graphics.

G. HEATING PLANT SCHEMATIC: In addition to individual equipment control schematics on graphics, an overall Heating Plant Control Schematic shall be included on graphics to provide a quick overview of heating plant system operation. Provide all equipment and points on overall heating plant schematic as shown on drawings.

H. ADDITIONAL SYSTEMS AND MONITORING POINTS: See Control Drawings, M600 series drawings, for additional points required.

END OF SECTION 230926

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe and pipe fittings for:

1. Heating water piping system.
2. Radiant piping system including manifolds, flexible tubing, and installation.
3. Equipment drains and overflows.
4. Pipe hangers and supports.

B. Valves:

1. Gate valves.
2. Ball valves.
3. Check valves.
4. Flowsetters

1.2 RELATED REQUIREMENTS

A. Section 08 3113 - Access Doors.

B. Section 09 9123 – Interior Paint.

C. Section 22 0553 - Identification for Plumbing Piping and Equipment.

D. Section 22 0719 - Plumbing Piping Insulation.

E. Section 23 0553 - Identification for HVAC Piping and Equipment.

F. Section 23 0719 - HVAC Piping Insulation.

G. Section 23 2114 - Hydronic Specialties.

H. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.3 REFERENCE STANDARDS

A. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2010.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005) (ANSI B16.18).

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

D. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

E. ASTM B32 - Standard Specification for Solder Metal; 2008.

F. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.

G. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2005.

H. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2004 and errata.

I. AWWA C606 - Standard Specification for Grooved and Shouldered Joints; American Water Works Association; 2006.

J. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

K. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2010.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

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

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

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

E. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

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

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Valve Repacking Kits: One for each type and size of valve.

1.5 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with minimum three years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
3. Provide pipe hangers and supports in accordance with ASME B31.9 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated and as follows:

1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
2. For throttling, bypass, or manual flow control services, use globe or ball valves.
3. For shut-off and to isolate parts of systems or vertical risers, use gate or ball valves.

2.2 HEATING WATER PIPING, ABOVE GROUND

A. Copper Tube: ASTM B 88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
2. Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
3. Mechanical press fit joint with gasket equivalent to PROPRESS acceptable. Press joint fittings are not acceptable at heating coil piping assembly.

2.3 RADIANT HEATING PIPING

A. Aboveground in Mechanical 304 - Copper Tube: ASTM B 88, Type L annealed.

1. Fittings: ASME B16.22, wrought copper.
2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.

B. Description: High density cross linked polyethylene tubing manufactured using the PEX-a (Engel/Peroxide) method and with an oxygen diffusion barrier. 5/8 inch diameter for 1st floor and ½ inch diameter for 2nd floor.

1. Operating Pressure: 125 psig at maximum 180 degrees F.
2. Fittings: Brass flared compression.
3. Joints: Fittings adapt to copper tubing or copper tube fittings, threaded pipe and fittings, and copper compression fittings.

C. Manifolds: Stainless Steel. Supply and return manifold to be fabricated and to have isolating valves and adjusting fittings for each zone. All manifolds with automatic air vents and drain valves. Manifolds sized with number of circuits shown on M301, M302, and M502 drawings. Manifolds located in metal box enclosure with accessible front, coordinate size with location intended.

D. Zone Control: Supply and return manifolds, each with number of circuits as shown on Mechanical drawings, with the ability to control each zone with low voltage control valve, controlled by a room temperature sensor. Each circuit to have a shut-off valve in the supply and a combination shut-off/adjustment valve in the return. All manifolds to have an automatic air vent and drain valve. Each circuit shall be adjusted to flow rate. Radiant heating temperature regulated by 4-way mixing valve with the radiant supply temperature on a reset schedule based on outdoor air and actual rooms temperatures. On call for heat from radiant zone thermostat, lead pump P-2 activated, and individual zone automatic valve to open. System shall be designed to use the lowest temperature possible to maintain room temperature and provide constant circulation to radiant floor. Control shall be through DDC system. Coordinate requirements with Control Contractor.

E. Spare parts: Provide Owner with two zone automatic valves, one thermostat, and one 4-way mixing valve.

2.4 EQUIPMENT DRAINS AND OVERFLOWS

A. Copper Tube: ASTM B 306, Type DWV, drawn.

1. Fittings: ASME B123, cast bronze, or ASME B 129 wrought copper.
2. Joints: Solder, lead free, ASTM B 32, grade 50B.

2.5 PIPE HANGERS AND SUPPORTS

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

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron, adjustable swivel, split ring.

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

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

E. Wall Support for Pipe Sizes to 3 Inches: Insulated clamp.

F. Vertical Support: Steel riser clamp.

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

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

I. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded. Cadmium or zinc plated.

2.6 UNIONS, FLANGES, AND COUPLINGS

A. Unions for Pipe 2 Inches and Under:

1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 Inches:

1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.

C. Dielectric Connections: Union or waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, end types to match pipe joint types used.

D. Dielectric Connections: Union thermoplastic-lined steel construction, water impervious isolation barrier, end types to match pipe joint types used. IAMPO/UPC Listed.

2.7 GATE VALVES

A. Manufacturers:

1. Tyco Flow Control
2. Conbraco Industries
3. Nibco, Inc
4. Milwaukee Valve Company

B. Up To and Including 2 Inches:

1. Bronze body, bronze trim, hand wheel, inside screw, solid wedge disc, threaded ends. 1 inch and smaller valves may have soldered ends. 15% or less zinc content.
2. Conforms to ASTMB584 C84400.

C. Over 2 Inches:

1. Iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends.

2.8 GLOBE OR ANGLE VALVES

A. Manufacturers:

1. Tyco Flow Control
2. Conbraco Industries
3. Nibco, Inc
4. Milwaukee Valve Company

B. Up To and Including 2 Inches:

1. MSS SP-80, Class 125, Bronze body, bronze trim, screwed bonnet, rising stem and handwheel, inside screw with backseating stem, renewable composition disc and bronze seat, solder ends.

C. Over 2 Inches:

1. MSS SP-85, Class 125, iron body, bronze trim, bolted bonnet, rising stem, handwheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.9 BALL VALVES

A. Manufacturers:

1. Tyco Flow Control
2. Conbraco Industries
3. Nibco, Inc
4. Milwaukee Valve Company

B. Up To and Including 3 Inches:

1. Bronze two piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, blow out proof stem, lever handle, threaded ends. 1 inch and smaller may have soldered ends. 15% or less zinc content.
2. Conforms to ASTMB584 C84400.

2.10 SWING CHECK VALVES

A. Manufacturers:

1. Hammond Valve.
2. Nibco, Inc.
3. Milwaukee Valve Company.

B. Up To and Including 2 Inches:

1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, threaded ends. 1 inch and smaller may have soldered ends.

C. Over 2-1/2 Inches and larger:

1. Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.11 SPRING LOADED CHECK VALVES

A. Manufacturers:

1. Hammond Valve.
2. Crane Co.
3. Milwaukee Valve Company.

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

C. Up to and including 2 inches: Class 125, bronze body. Stainless steel stem and 316 Stainless

steel spring with rubber seat, threaded ends. 1" diameter and smaller valves may have soldered ends.

2.12 WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Amtrol Inc.
2. Cla-Val Co;.
3. Watts Regulator Company.

B. Up to 2 Inches:

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

C. Over 2 Inches:

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

2.13 FLOWSETTERS

A. Manufacturers:

1. Armstrong International, Inc.
2. ITT Bell & Gossett.
3. Myson, Inc.

B. Angle or straight pattern, rising stem, inside screw globe valve for 125 psi working pressure, with bronze body and integral union for screwed connections, renewable composition disc, plastic wheel handle for shut-off service, and lockshield key cap and set screw memory bonnet for balancing service.

C. Spare: Provide minimum of two spare caps and one set of probes suitable to test the valve

PART 3 - EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. Refer to Section 23 2500 for additional requirements.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating piping to ASME B31.9 requirements.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interfere with use of space. Piping to be installed in the joist space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls and floors.

G. Slope piping and arrange to drain at low points.

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

I. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
4. Place hangers within 12 inches of each horizontal elbow.
5. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.
9. Prime coat exposed steel hangers and supports. Refer to Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
10. All hangers are to be installed on the outside of the insulated piping.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.

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

access doors with Section 08 3113.

L. Use eccentric reducers to maintain top of pipe level.

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

N. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. Refer to Section 09 9123.

O. Install valves with stems upright, not inverted.

P. Branch piping connected to sides of mains. Connections off of top or bottom not permitted. When approved by the Engineer, branch piping may be connected to side of mains at a 45 degree angle when limited by space.

Q. Where piping penetrates wall, run insulation through penetration.

R. Piping Tests: All heating piping tested hydrostatically at 125 psi for minimum of four hours. System shall remain tight for test period without leaks, displacement, or straining. Equipment, gages, and thermometer wells rated for a lesser pressure suitably protected during tests. Leaks developed during tests shall be corrected without caulking and test restarted until a perfectly tight system is obtained. Enclosed piping tested before concealing. Test performed in presence of Owner.

S. Radiant Piping Coordination: Contractor is to coordinate and review piping installation requirements with General Contractor. Install piping as required by manufacturer and Engineer.

T. Radiant Piping Tests: Prior to concrete pour pressure test piping to 80 psi for 12 hours prior to pour. If not leaks are found then concrete pour may commence upon approval of Owner's Representative. Maintain pressure test on entire system during the 24 hours after the pour. Maintain a minimum temperature of 50F during 5-7 days curing process. Coordinate with General Contractor.

U. Radiant System Start-up and Training: Provide start-up of radiant system. After system has been operating satisfactory for minimum one week provide 2 hours of training to Owner with all applicable manuals and installation literature. Provide copies of all literature, wiring diagrams, and parts list for Operations and maintenance Manuals.

V. Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

W. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus. Flanged gasket material shall meet or exceed temperature and pressure rating of system.

X. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems.

Y. Use gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

Z. Use globe or ball valves for throttling, bypass, or manual flow control services.

AA. Use spring loaded check valves on discharge of pumps.

AB. Use 3/4 inch gate valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

AC. Install the radiant tubing as shown on drawings M301 and M302 and M502 piping diagram:

1. Tubing minimum on center distance as shown on radiant M301 and M302 drawings.
2. Maximum fluid temperature, difference: 120F, 20F delta.
3. Loops are to start at coldest areas, such as exterior walls and doors. See M301 and M302 for layout.
4. Install thermostats located where shown, at 4’-0” AFF to top of thermostats. All controls wiring is to be concealed and protected.
5. Fluid: water.
6. Maximum loop length: 350 feet. Approximate circuit loop lengths are shown on M301 and M302. Contractor to verify.

3.3 SCHEDULES

A. Hanger Spacing for Copper Tubing or Steel Pipe.

1. 1/2 inch and 1-1/4 inch: Maximum span, 6 feet; minimum rod size, 3/8 inch.
2. 1-1/2 inch and 2 inch: Maximum span, 10 feet; minimum rod size, 3/8 inch.
3. 2-1/2 inch through 3 inch: Maximum span, 10 feet; minimum rod size, 1/2 inch.

END OF SECTION 232113

SECTION 232114 - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Relief valves.

1.2 RELATED REQUIREMENTS

A. Section 22 1006 - Plumbing Piping Specialties: Backflow Preventers.

B. Section 23 2113 - Hydronic Piping.

C. Section 23 2500 - HVAC Water Treatment

1.3 REFERENCE STANDARDS

A. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.

C. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.

D. Project Record Documents: Record actual locations of flow controls.

E. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

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

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 - PRODUCTS

2.1 EXPANSION TANKS (ET)

A. Manufacturers:

1. Amtrol.
2. Taco.

B. ET-1 (Hydronic Heating Water): Replaceable Bladder type: Welded steel, tested and stamped in accordance with ASME SEC 8-D; rated for working pressure of 125 psig, with replaceable bladder. Steel stand support. Seismic bracing.

C. Accessories: Pressure gage and air-charging fitting.

D. Size: See Schedules on Sheet M001.

2.2 AUTOMATIC AIR VENTS

A. Manufacturers:

1. Spirotherm Spirotop

B. Brass body, solid non-metallic float, brass vented head threaded for connection of drain. Viton seal and o-ring. 150 psig working pressure. Automatic air vent suitable for system operating temperature and pressure; with isolating valve.

2.3 MANUAL AIR VENT

A. Manufacturers:

1. Hoffman Model 500.
2. Bell & Gossett Model 17SR.
3. Taco Model 417.
4. Substitutions: Not Permitted.

B. Manual Air Vent; Washer Type: Brass with hydroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.4 AIR SEPARATORS (AS-1)

A. Manufacturers:

1. Spirotherm - Spirovent Senior VSR FA

B. Air Separators:

1. Steel construction for 150 psig maximum operating pressure. ASME Section VIII, Division 1. Integrated brass venting mechanism on top. Threaded blowdown connection port at bottom.
2. Flanged.
3. Air eliminator: Copper bundle designed to suppress turbulence and provide high efficiency. Shall be capable of removing 100% of free and entrained air, and 99.6% of the dissolved air.

2.5 STRAINERS

A. Manufacturers:

1. Hoffman.
2. Spiray/Sarco
3. Mueller.

B. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 3 inch:

1. Flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.6 RELIEF VALVES

A. Manufacturers:

1. Armstrong International.
2. ITT Bell & Gossett.
3. Conbraco Industries.
4. Watts

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labeled.

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain and hose connection on strainer blow down connection.

G. Provide spring loaded check valve on discharge side of centrifugal pumps.

H. Provide relief valves on pressure tanks, low pressure side of reducing valves, and expansion tanks.

J. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

K. Pipe relief valve outlet to nearest floor drain.

3.2 MAINTENANCE

A. Clean all strainers immediately after pump start-up. Provide written verification to ARCHITECT.

END OF SECTION 232114

SECTION 232123 - HYDRONIC PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. In-line circulators.

B. Cartridge Circulators.

1.2 RELATED REQUIREMENTS

A. Section 22 0719 - Plumbing Piping Insulation.

B. Section 22 0716 - Plumbing Equipment Insulation.

C. Section 23 0716 - HVAC Equipment Insulation.

D. Section 23 0719 - HVAC Piping Insulation.

E. Section 23 2113 - Hydronic Piping.

F. Section 23 2114 - Hydronic Specialties.

G. Section 26 2726 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008.

B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 778 - Standard for Motor-Operated Water Pumps; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

E. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Provide one set of mechanical seals and coupling for each pump.
3. Provide one set of replaceable coupling and bearing assemblies or replaceable bearing cartridge for each pump.
4. Provide one spare pump for each of the following: HWRP, P-1, and P-2.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. ITT Bell & Gossett

B. Grundfos

C. No Substitutions

2.2 HVAC PUMPS - GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Minimum Quality Standard: UL 778.

C. Products Requiring Electrical Connection: Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.

2.3 SYSTEM LUBRICATED CIRCULATORS (HWRP)

A. Type: Horizontal shaft, single stage, direct connected with wet rotor motor for in-line mounting, for 140 psi maximum working pressure, 230 degrees F maximum water temperature. All bronze for domestic hot water recirculation.

B. Casing: Bronze with flanged pump connections.

C. Impeller, Shaft, Rotor: Stainless Steel.

D. Bearings: Metal Impregnated carbon (graphite) and ceramic.

E. Motor: Impedance protected, multiple speed, with external speed selector.

F. Performance:

1. See Schedule on Sheet M001

G. Electrical Characteristics:

1. See Schedule on Sheet M001
2. Refer to Section 26 2726.

2.4 IN-LINE CIRCULATORS (P-1A, P-1B, P-2A, P-2B)

A. Type: Horizontal shaft, single stage, direct connected, with resiliently mounted motor for in-line mounting, oil lubricated, for 175 psi maximum working pressure.

B. Casing: Cast iron, with flanged pump connections.

C. Impeller: Dynamically balanced cast bronze, keyed to shaft. Trimmed as required.

D. Bearings: Permanently-lubricated ball bearings.

E. Shaft: Alloy steel with bronze sleeve, integral thrust collar.

F. Seal: Carbon rotating against a stationary ceramic seat, 275 degrees F maximum continuous operating temperature.

G. Drive: Flexible coupling.

H. Performance:

1. See Schedule on Sheet M001.

I. Electrical Characteristics:

1. Refer to Section 26 2726.
2. See Schedule on Sheet M001.

2.5 MOTORS:

A. Manufacturers:

1. Baldor
2. General Electric
3. Reliance

B. Constructed and rated in accordance with current NEMA standards. The frame size, enclosures, and all appurtenances shall be suited to the application. 1.15 Service factor. Class F insulation.

1. Single phase motors: NEMA Design N for fractional horsepower
2. Three phase motors: NEMA Design B.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings.

D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat spring type check valve and shut-off valve on pump discharge.

E. Provide air cock and drain connection on horizontal pump casings.

F. Provide drains for bases and seals.

3.2 FIELD QUALITY CONTROL

A. Lubricate pumps before start-up.

B. Motors: Ensure proper alignment and rotation.

C. Verify power requirements on-site with Control Contractor and Electrical Contractor.

3.3 COORDINATION

A. Coordinate this Work with the Work of other trades, and make arrangements for the complete and proper accomplishment of all related Work. Coordinate required controls with Control Contractor.

3.4 TESTING AND ADJUSTING

A. Upon completion of the installation, start-up the system, perform necessary testing and adjust the system to ensure proper operation.

END OF SECTION 232123

SECTION 232500 - HVAC WATER TREATMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cleaning of piping systems.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 23 2114 - Hydronic Specialties.

C. Section 26 2726 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience. Company shall have local representatives with water analysis laboratories and full time service personnel.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of experience and approved by manufacturer.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

B. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 CHEMICAL TREATMENT

A. TriSodium Phosphate (TSP) based product specially formulated for new system start-ups. Designed as a pre-cleaner for anti-freeze applications. Removes greases, oil, rust, scale, flux, pipe joint compound and other residues of manufacture and assembly.

B. Provide volume required for cleaning interior hydronic heating piping system prior to start-up of service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Systems shall be operational, filled, started, and vented prior to cleaning.

B. Place terminal control valves in open position during cleaning.

C. Verify that electric power is available and of the correct characteristics.

3.2 CLEANING SEQUENCE

A. Hot Water Heating Systems:

1. Apply heat while circulating, slowly raising temperature to 140 degrees F and maintain for 12 hours minimum. Maximum temperature circulated through radiant system shall be 120F.
2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
3. Circulate for 6 hours at design temperatures, then drain.
4. Refill with clean water and repeat until system cleaner is removed.
5. Provide field report describing treatment.

B. Use neutralizer agents on recommendation of TSP system cleaner supplier and approval of ARCHITECT.

C. Remove, clean, and replace strainer screens.

D. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

END OF SECTION 232500

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Casing and plenums.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 – Interior Paint.

B. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.

C. Section 23 0713 - Duct Insulation: External insulation.

D. Section 23 3300 - Air Duct Accessories.

E. Section 23 3700 - Air Outlets and Inlets.

1.3 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2010.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010b.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.

F. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials.

C. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.5 QUALITY ASSURANCE

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

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

1.6 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.7 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 - PRODUCTS

2.1 DUCT ASSEMBLIES

A. All Ducts: Galvanized steel, unless otherwise indicated.

B. HRV Supply and Return/Exhaust: 2 inch w.g. pressure class, galvanized steel.

2.2 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating. Minimum of 24 gage.

B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.

1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
2. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
3. For Use With Flexible Ducts: UL labeled.

D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or

continuously threaded. Rod shall be cleaned and suitable for painting.

2.3 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

E. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

G. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

H. Fittings shall be spot welded two gages heavier than indicated in SMACNA Standard. Prime coat welded joints. All round ductwork shall be spiral type. Utilize manufactured duct fittings for all branch take-offs unless indicated otherwise.

I. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

J. Provide standard 45-degree lateral wye takeoffs unless otherwise indicated where 90-degree conical tee connections may be used.

K. Pleated 90 degree round elbows may be used only on duct 6-inch diameter and under. Use segmented 5 piece elbows on 90 degree elbows 8 inches and over. 90 degree adjustable elbows are not acceptable unless approved on a case by case basis by the ARCHITECT.

L. Flanged closures must be SMACNA “J” rated with minimum 1-3/8 inch flange. Flange shall be gasketed. Corners bolted. Metal cleat for application around perimeter of transverse joint.

M. Transverse joints: Ductmate proprietary duct connections will be accepted. Ductwork constructed using these systems will refer to manufacturers guidelines for sheet gage, intermediate reinforcement size and spacing, and joint reinforcement. TDF shall be constructed in accordance with SMACNA – HVAC Duct Construction Standards Manuals T-24 flange.

Basis for evaluating a substitution shall be Ductmate Joining System, all steel construction. Ductmate system shall utilize minimum 20 gage steel companion angles, 12 gage steel corner pieces, and an integral polymer mastic seal. Acceptable joining systems: Ductmate 35, Nexus, Accuduct, or TDF. TDC is not acceptable.

N. Longintudinal seams and fitting: Pittsburgh lock or snap lock shall be used on all longitudinal seams. Use Pittsburgh only on fittings, snap lock is not acceptable.

2.4 PLENUMS

A. Fabricate plenums in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

B. Support plenums with channel framing and secure to structure as shown on details.

C. Reinforce access door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

2.5 INSULATED FLEXIBLE DUCTS

A. Manufacturers:

1. Thermaflex
2. Thermoid
3. Wiremold

B. Two ply vinyl film supported by helical wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.

1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
2. Maximum Velocity: 4000 fpm.
3. Temperature Range: -10 degrees F to 160 degrees F.

2.6 DUCT, CASING AND PLENUM SEALANTS

A. Sealant: UL listed vinylacrylic or copolymer based duct sealer. Similar to Durodyne DDS-181, Uni-mastic 181.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Check daily or more frequently that sealing of ducts is intact.

D. Flexible Ducts: Connect to metal ducts with draw bands.

E. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

H. Use double nuts and lock washers on threaded rod supports. Exposed duct (outside of the mechanical room) hung from threaded rod supports, not strapping.

I. Connect terminal units to supply ducts with three feet maximum length of flexible duct. Do not use flexible duct to change direction.

J. At exterior wall louvers, seal duct to louver frame and install blank-out panels.

K. Connect flexible ducts to metal ducts with adhesive and draw bands.

L. Duct and Plenum Sealing:

1. Plenums: Seal plenum longitudinal and latitudinal joints with sealant. Apply sealant in accordance with manufacturer’s recommendations. Inspect seams with ductwork pressurized and reapply as required for an airtight application.
2. Seal all longitudinal and latitudinal joints of metal ducts with two coats of sealant. Apply sealant in accordance with manufacturer’s recommendations. Apply second coat of sealant after first coat has completely cured. Inspect seams with ductwork pressurized and reapply as required for an airtight application.
3. Exhaust Fan inlet and outlet ducts: Apply two coats of sealant to all seams.

M. Duct traverses at the supply fan outlets and at the exhaust fan inlets shall be compared to total grille and diffuser airflows for each fan unit to determine the percentage duct leakage. If the duct leakage is determined to be over 10% of the specified volume, the CONTRACTOR shall reseal all ductwork to the satisfaction of the ARCHITECT.

N. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Check daily or more frequently that sealing of ducts is intact.

O. Prepare ductwork for finish painting.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide Pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

3.4 CLEANING

A. If supply, exhaust, or return air ductwork is found to be dirty during construction due to inadequately capped/sealed ductwork or operating fans without filters, the CONTRACTOR shall clean all affected duct systems with high power vacuum machines to the satisfaction of the ARCHITECT. Return air plenums not sealed off during construction shall be cleaned by the CONTRACTOR to the satisfaction of the OWNER. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. All construction debris is to be removed by CONTRACTOR prior to cleaning.

B. Clean exterior of ductwork and prepare ductwork for finish painting.

END OF SECTION 233100

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct access doors.

B. Duct test holes.

C. Flexible duct connections.

D. Volume control dampers.

E. Automatic Dampers

F. Duct Thermometers

1.2 RELATED REQUIREMENTS

A. Section 09 9123 – Interior Paint.

C. Section 23 0713 - Duct Insulation: External insulation.

C. Section 26 2717 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association; 2009.

B. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

C. UL 555 - Standard for Fire Dampers; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

C. Project Record Drawings: Record actual locations of access doors and test holes.

D. Maintenance Materials: Furnish the following for OWNER's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

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

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 - PRODUCTS

2.1 DUCT ACCESS DOORS

A. Manufacturers:

1. Air Balance
2. Durodyne
3. Ventlock
4. Ruskin Company

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Submittal is required.

C. Fabrication: Rigid and close fitting of reinforced galvanized steel with closed cell neoprene sponge rubber sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1 inch thick insulation with sheet metal cover.

1. Less Than 12 inches square, secure with sash locks.
2. Up to 18 inches Square: Provide two small hinges or one continuous hinge and one compression latch.
3. Up to 24 x 48 inches: Three large hinges or one continuous hinge and two compression latches with outside and inside handles.
4. Sash Lock: Similar to Ventlock Model 90.
5. Compression Latch: Similar to Ventlock Model 140, 202, or 310.
6. Hinge: Small hinges to be zinc plated steel, minimum 2 x 1-1/2 inches wide or 1-1/2 inch wide piano hinge. Large hinges to be zinc plated steel, minimum 3 x 2 inches wide or 2 inch wide piano hinge. Similar to Ventlock Model 150, 157 or 167, 250.
7. Access panels with sheet metal screw fasteners are not acceptable.

2.2 AUTOMATIC DAMPERS

A. Manufacturers:

1. Ruskin Model CD60
2. Air Balance.
3. Johnson Control.

B. Dampers: 14 gage galvanized steel air foil shaped dampers with vinyl bulb or neoprene edging and flexible metal compression edge seals in 16 gage galvanized steel hat channel frame. Bearings shall be corrosion resistant, permanently lubricated, stainless steel sleeve type. Axles shall be plated steel type positively locked in damper blade. Damper blades positioned across short air opening dimension. Parallel blades for positive acting & opposed blade for modulating dampers.

C. Low leakage type with maximum 2 percent leakage at 4 inch wg differential pressure when sized for 2000 fpm face velocity.

D. Coordinate with HRV Manufacturer for provision of automatic dampers.

2.3 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.4 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Carlisle HVAC
2. Elgen Manufacturing
3. DuroDyne.

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

C. Flexible Duct Connections: Fabric crimped into metal edging strip.

1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.

a. Net Fabric Width: Approximately 2 inches wide.

2.5 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Ventlock
2. Nailor Industries Inc
3. Ruskin Company
4. Durodyne
5. Rossi

B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. For stainless steel duct manual dampers constructed of stainless steel material and rods painted two coats of rust preventive paint or constructed of stainless steel material.

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.

1. Fabricate for duct sizes up to 6 x 30 inch.
2. Blade: 24 gage, minimum.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.

1. Blade: 18 gage, minimum.

E. End Bearings: Except in round ductwork 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Provide closed end bearings on all ducts having a pressure classification over 2 inches wg; Ventlock Model 607 or 609. Similar Durodyne or Young

F. Regulators:

1. Provide self-locking, indicating regulators with heavy steel stamped handle on single and multi-blade dampers.
2. On insulated ducts mount regulators on standoff mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches provide regulator at both ends.
4. Ventlock Model 641. Similar Durodyne or Young.
5. For concealed damper locations use concealed damper regulator type for installation in ceilings. Ventlock Model 666. Similar Durodyne or Young.
6. Regulators with wing nuts are not acceptable.

2.6 DIAL THERMOMETERS

A. Manufacturers:

1. Dwyer Instruments, Inc
2. Omega Engineering, Inc
3. Weksler Glass Thermometer Corp

B. Thermometer (Supply/Return/Exhaust Air): ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.

1. Size: 4-1/2 inch diameter dial.
2. Lens: Clear Lexan.
3. Accuracy: 1 percent.
4. Calibration: Degrees F.

C. Thermometers (Heat Exchanger Discharge Air): ASTM E1; Stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens; Brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens.

1. Size: 4-1/2 inch diameter dial.
2. Lens: Clear Lexan.
3. Length of Capillary: Minimum 5 feet.
4. Accuracy: 2 percent.
5. Calibration: Degrees F.

2.7 THERMOMETER SUPPORTS

A. Flange: 3 inch outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify ducts and equipment installations are ready for accessories.

3.2 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 3100 for duct construction and pressure class.

B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access, 18x18 size for shoulder access, and as indicated. Review locations prior to fabrication.

C. Provide duct test holes where indicated and required for testing and balancing purposes.

D. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

E. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

G. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

H. Install thermometers in air duct systems on flanges.

I. Install thermometers adjacent to controls systems thermostat, transmitter, or sensor sockets.

J. Locate duct mounted thermometers minimum 5 feet downstream of mixing dampers, coils, or other devices causing air turbulence. Otherwise use averaging bulb type.

K. Coil and conceal excess capillary on remote element instruments.

L. Provide instruments with scale ranges selected according to service with largest appropriate scale.

M. Install gages and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

N. Adjust gages and thermometers to final angle, clean windows and lenses, and calibrate to zero.

END OF SECTION 233300

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Grilles.

C. Louvers.

1.2 RELATED REQUIREMENTS

A. Section 09 9123 - Painting and Coating: Painting of ducts visible behind outlets and inlets.

1.3 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2007.

B. ASHRAE Std 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006.

C. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

B. Test and rate louver performance in accordance with AMCA 500-L.

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

PART 2 - PRODUCTS

2.1 CEILING SUPPLY GRILLE (SG-1)

A. Manufacturers:

1. Titus 300FL

2. Krueger
3. Price

B. Type: Rectangular, double deflection with individually adjustable horizontal bars in face and vertical bars behind. ¾-inch spacing.

C. Frame: 1-1/4 inch border, surface mount. Countersunk screw mounting. With sponge rubber gaskets where installed on gypboard.

D. Fabrication: Aluminum. Baked Enamel Finish. White.

2.2 CEILING SUPPLY DIFFUSERS (SG-2)

A. Manufacturers:

1. Titus TDCA-AA
2. Krueger
3. Price

B. Type: Square 24x24 inch module size for lay-in type. Louver size as shown on plans. Round neck with size as shown on drawings.

C. Diffusers: Movable vanes, accessible from face to adjust discharge from horizontal to vertical. Core for discharge pattern of four-way corner blow. Diffusers are four-way blow unless otherwise shown on schedule.

D. Frame: 24"x24" Lay-in type border for all T-bar ceilings.

E. Fabrication: Aluminum with white baked enamel finish.

2.3 EXHAUST GRILLES (EG-1)

A. Manufacturers:

1. Titus 350FL
2. Krueger
3. Price

B. Type: Ceiling and wall return/exhaust grille. Face: Blades with 3/4 inch spacing, 35 degree deflection, blades parallel to long dimension.

C. Frame: 1-1/4 inch margin with countersunk screw mounting. With sponge rubber gaskets under flanges.

D. Fabrication: Aluminum. White baked enamel finish.

2.4 LOUVER (LV-1 and LV-2)

A. Manufacturers:

1. Ruskin ELF6375DXH
2. Greenheck

B. Type: Extruded aluminum, 0.125 inch nominal thickness. 6 inch deep with fixed blades on 37 degree slope, heavy channel frame, bird screen with 1/2 inch square mesh. Blades 5-inches on center. High performance louver with drainable blade.

C. Performance:

1. Free area intake Velocity at beginning point of water penetration: 1000 ft/min.
2. Maximum pressure drop at intake velocity: 0.04 inches w.g. at 500fpm
3. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

D. Fabrication: Extruded 6063T5 aluminum welded construction

E. Finish: 70% Kynar Finish for 20 year warranty. Color and gloss to be selected by the ARCHITECT.

F. Sizes for air louvers are shown on plans.

G. Mounting: Provide extended sill.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify inlet/outlet locations.

B. Verify ceiling and wall systems are ready for installation.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on branch duct to diffusers and grilles whether shown or not.

E. Paint ductwork visible behind air outlets and inlets matte black.

F. Modify ceiling and ceiling lay-in panels as required for diffuser installation.

G. Install all flashing required for complete water type installation. Test louver installation for water tightness.

END OF SECTION 233700

SECTION 235213 - ELECTRIC BOILERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boiler.

B. Boiler Controls.

C. Water Connections.

D. Electrical Hook-up.

1.2 RELATED REQUIREMENTS

A. Section 232114 - Hydronic Specialties.

B. Section 262726 – Wiring Devices

C. Section 230926 – Sequence of Operations

1.3 REFERENCE STANDARDS

A. ASME (BPV IV) - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; The American Society of Mechanical Engineers; 2007.

B. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.

C. HI BTS-2000 - Testing Standard, Method to Determine Heating Efficiency of Commercial Space Heating Boilers; The Hydronics Institute of AHRI; 2007.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.

E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 834 - Heating, Water Supply, and Power Boilers - Electric; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide literature indicating general assembly components, controls, safety controls, wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Shop Drawings: Indicate assembly, weights, heater configuration, and electrical characteristics and connection requirements. Provide specific wiring diagram for this project.

D. Manufacturer's Instructions: Indicate rigging, installation, and start-up procedures.

E. Manufacturer's Field Reports: Indicate conditions observed after start-up, including control settings.

F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, as-built wiring diagram, and maintenance and repair data.

G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner’s name and registered with manufacturer.

1.5 QUALITY ASSURANCE

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

1.6 REGULATORY REQUIREMENTS

A. Conform to ASME (BPV IV) and ASME (BPV VIII, 1) for boiler construction.

B. Conform to NFPA 70 for internal wiring of factory wired equipment.

C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. in UL (EAUED) as suitable for the purpose specified and indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect units before, during, and after installation from damage to casing by leaving factory shipping packaging in place until immediately prior to final acceptance.

1.8 START-UP

A. Start-Up: Factory technician start-up of electric boiler. Factory technician shall provide start-up of Electric boiler.

1.9 MAINTENANCE SERVICE

A. Provide service and maintenance of boilers, burners, trim, and controls for one year from Date of Substantial Completion.

1.10 WARRANTY

A. See Division 1 - Closeout Submittals, for additional warranty requirements.

B. Provide 18 month warranty to include coverage for boiler package.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Precision PCW1-075 480 volt (Design Manufacturer)

B. Cleaver Brooks

C. Teledyne Laars

2.2 MANUFACTURED UNITS

A. Description: Electric hot water boiler, compact, completely packaged, factory assembled, ready for operation except for external connections of piping and electrical connections.

2.3 FABRICATION

A. Assembly: Heavy Duty welded steel shell with heater support nipples or flanges and inspection hand hole. Provide necessary fittings to accept gages, safety and operating controls; flanged inlet and outlet connections; inlet diffuser; and lifting lugs, conforming to ASME (BPV IV) requirements, and tested for maximum working pressure of 150 psig.

B. Heating Elements: Threaded or flanged, incoloy or stainless steel sheathed, with maximum density of 75 watts per square inch, suitable for operation at 150 psig. Attach each element to tube sheet by mechanical assembly permitting single elements to be replaced without replacing entire tube bundle. 5 elements minimum.

C. Enclose in heavy duty 16 gauge steel enclosure with factory applied baked enamel, insulated with 4 inch thick and 3/4 lb. density fiberglass insulation.

2.4 TRIM

A. ASME rated pressure relief valve set at 45 psi.

B. Assemble with pressure gage, thermometer in brass separable well, automatic air vent, and drain valve.

C. Probe type low water cut-off with manual reset to automatically prevent operation when water falls below safe level.

D. Inlet flow switch to automatically prevent operation on low flow through boiler.

E. Temperature gauge.

F. Flanged Connections.

2.5 CONTROLS

A. Provide pre-wired, factory assembled electric controls enclosed in NEMA 250, Type 1 cabinet, factory mounted integral with unit.

B. Controls shall include:

1. Non-fused disconnect switch with door interlock.
2. Splitter arrangement and fused magnetic contactors for each element.
3. Ability for adjustable time delay 1-60 minutes for stage sequencing.
4. Fused control circuit transformer with control circuit on/off switch.
5. Proportioning step controller. Solid-state sequencer.
6. Inlet flow switch.
7. Low water cut-off.
8. Remote bulb operating thermostat complete with brass separable well.
9. Two remote bulb high limit thermostats (1 auto reset, 1 manual reset) complete with brass separable well.
10. Pilot lights for each step of control.
12. Manual limit toggle switches for each stage.
13. On/Off switch with pilot light.
14. Local/Remote switch.
15. Building Automation System terminal connection for remote enable.
16. Red common alarm light. Dry contacts for common alarm

C. Electric Boiler Performance:

1. Performance rating shall be in accordance with HI- Testing and Rating Standard for Cast Iron and Steel Heating Boilers.
2. Rating:

a. Heating Capacity: 256,000 BTU/Hr or nominal 75 kW.
b. Numbers of Steps: 5 steps at 15 KW each.

D. Electrical Characteristics and Components:

1. Disconnect Switch: Factory mount in control panel. Disconnect for door. Safety interlock.
2. Design and Fabrication: Balanced 3-phase, 3 wire, delta load at 480 volts, 3-phase, 60 Hz.
3. UL listed Control Panel.
4. Single point power connection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and in accordance with National Electrical Code

B. Install boiler on reinforced concrete housekeeping base, minimum 3 inches high and 6 inches larger on each side than boiler base.

C. Provide piping connections and accessories as indicated.

D. Pipe relief valves to nearest floor drain.

E. Provide for connection to electrical service. Refer to Division 26.

3.2 START-UP AND COMMISSIONING

A. Start-Up: Factory technician start-up and testing of electric boiler. Provide start-up report.

3.3 TRAINING

A. Train operating personnel in operation and maintenance of units. Factory technician shall provide minimum 2 hours training to Owner’s representatives.

B. Provide the services of manufacturer's field representative to conduct training.

3.4 MAINTENANCE

A. Provide service and maintenance of boilers, trim, and controls for one year from Date of Substantial Completion.

END OF SECTION 235213

SECTION 237313 – HEAT RECOVERY UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Heat recovery units.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping: Equipment drains.

B. Section 23 0719 - HVAC Piping Insulation.

C. Section 23 3300 - Air Duct Accessories: Flexible duct connections.

D. Section 26 2726 – Wiring Devices: Electrical characteristics and wiring connections.

E. Section 230926 – Sequence of Operations

1.3 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; American Bearing Manufacturers Association, Inc.; 1990 (Reapproved 2008).

B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; American Bearing Manufacturers Association, Inc.; 1990 (Reapproved 1999).

C. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc.; 2010.

D. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 2007 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; Air Movement and Control Association International, Inc.; 2008.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 2006.

G. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2007.

H. AHRI 410 - Standard for Forced-Circulation Air-Cooling and Air-Heating Coils; Air-Conditioning, Heating, and Refrigeration Institute; 2001 (R2005) .

I. AHRI 430 - Standard for Central-Station Air-Handling Units; Air-Conditioning, Heating, and

Refrigeration Institute; 2009.

J. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2009, Revision 1 - 2010.

K. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

M. UL (EAUED) - Electrical Appliance and Utilization Equipment Directory; Underwriters Laboratories Inc.; current edition.

N. UL 900 - Standard for Air Filter Units; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. See Section 01 3300 - Administrative Requirements, for submittal procedures.

B. Product Data:

1. Published Literature: Indicate dimensions, weights, capacities, ratings, gages and finishes of materials, and electrical characteristics and connection requirements.
2. Filters: Data for filter media, filter performance data, filter assembly, and filter frames.
3. Fans: Performance and fan curves with specified operating point clearly plotted, power, RPM.
4. Sound Power Level Data: Fan outlet and casing radiation at rated capacity.
5. Electrical Requirements: Power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

C. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

D. Manufacturer's Instructions: Include installation instructions.

E. Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

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

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Fan Belts: One set for each fan.
3. Extra Filters: Four complete spare sets for each filter section.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

B. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

C. Do not operate units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. XeteX IAQ-2500-BP-HW (Design Manufacturer)

B. Heatex

C. Innovent

D. Substitutions: See Section 012500 - Substitutions Procedures requirements.

2.2 HEAT RECOVERY UNIT (HRV-1, HRV-2)

A. Exhaust Side Configuration:

1. Return air inlet.
2. Return air filter section: 2-inch flat filter. MERV 8.
3. Heat Exchanger.
4. Exhaust Fan.
5. Exhaust Automatic Damper.
6. See Drawings for arrangement.

B. Supply Side Configuration:

1. Outdoor air inlet with automatic outdoor air damper.
2. Filter Section: 2-inch flat filter. MERV 8.
3. Face and bypass damper.
4. Heat Exchanger

5. Heating Coil.
6. Supply Fan.
7. See Drawings for arrangement.

C. Performance Base: 1100 ft Altitude.

D. Fabrication: Conform to AMCA 99 and ARI 430.

E. Performance: See Schedules.

F. Size of cabinet/casing:

1. HRV Maximum Dimensions: 28” height plus 3” base, 108” length, 48” width. See Plans for arrangement.
2. See Plans for complete requirements and required clearances.

G. Casing

1. Welded steel base frame.
2. Outside Casing: Galvanized Steel: 18 gauge.
3. Inside Casing: Galvanized Steel: Solid, 22 gauge.
4. Base Floor: Galvanized Steel: 16 gauge. 1-inch insulation.
5. Wall Insulation: 2-inch thick.
6. Access Doors: Galvanized steel insulated sandwich construction with galvanized steel interior, for flush mounting, with hinges, gasket, handle latch and handle assemblies.
7. Drain Pans: Welded 304 stainless steel drain pans.
8. Lifting Lugs.
9. Designed to be hung from structure.

H. Fan Connections: Flexible connections.

I. Fans

1. Wheel and inlet

a. Supply Fan: Centrifugal Fan, steel, DWDI. Forward Curved.
b. Return Fan: Centrifugal Fan, steel, DWDI. Forward Curved.

2. Performance Ratings: Conform to AMCA 210 and label with AMCA Certified Rating Seal.
3. Sound Ratings: AMCA 301, tested to AMCA 300 and label with AMCA Certified Sound Rating Seal.
4. Bearings: Self-aligning, grease lubricated, ball or roller bearings with lubrication fittings.
5. Mounting: Locate fan and motor internally on welded steel base. Factory mount motor on slide rails. Provide access to motor, drive, and bearings through access doors. Mount base on vibration isolators.
6. Fan Performance: See Fan Schedule for additional information. Sea level pressure.

a. Filter Static Pressures: Use 0.40" w.g. in calculating internal static pressures for MERV 8, 2-inch filters.

b. HRV-1 SF: Max 1800 fan rpm. 2 hp motor minimum. 208 volt, three phase.
c. HRV-1 RF: Max 1600 fan rpm. 1.5 hp motor minimum. 208 volt, three phase.
d. HRV-2 SF: Max 1725 fan rpm. 2 hp motor minimum. 208 volt, three phase.
e. HRV-2 RF: Max 1625 fan rpm. 1.5 hp motor minimum. 208 volt, three phase.

J. Bearings and Drives

1. Bearings: Heavy duty type pillow block type, self-aligning, grease-lubricated ball bearings.
2. Shafts: Solid, hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
3. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, bored to fit shafts, and keyed. Variable and adjustable pitch sheaves selected so required rpm is obtained with sheaves set at mid-position.

K. Heating Coil Sections

1. Casing with access to both sides of coils.
2. Tubes: 5/8-inch OD seamless copper expanded into fins, brazed joints.
3. Fins: Aluminum. Maximum 12 fins per inch.
4. Casing: Die formed channel frame of galvanized steel.
5. Water.
6. Hot Water Heating Coil capacity: ARI Certified and rated in Accordance with ARI 410.

a. HRV-1 Heating Coil HC: 1350 cfm @ 28F to 65F air temperature rise @ 20F water temperature drop. 115F EWT. 540 fpm maximum face velocity. 0.25"wg maximum air pressure drop. 3ft head maximum water pressure drop. 2 rows. Water.
b. HRV-2 Heating Coil HC: 1600 cfm @ 30F to 65F air temperature rise @ 20F water temperature drop. 115F EWT. 610 fpm maximum face velocity. 0.27"wg maximum air pressure drop. 5ft head maximum water pressure drop. 2 rows. Water.

L. Heat Exchanger

1. Description: Crossflow aluminum plate air-to-air type. No moving parts or secondary heat transfer surfaces.
2. Construction: Aluminum plates
3. Drain Pan: 304 Stainless steel.
4. Drains provided on both supply and exhaust sides.
5. Capacities and pressure drops: See Below. Total static pressure listed is approximate and may vary with manufacturer. Coordinate motor size differences with electrical contractor and specific requirements therein.
6. Performance.

a. HRV-1

1) 1350 CFM Supply Air, 1180 CFM Exhaust Air.
2) Energy Recovered – 58 MBH
3) Sensible Effectiveness – 68%

4) Entering Outdoor Air: 0F db, -2.7F wb, 24.6% RH
5) Entering Exhaust Air: 65F db, 51.9F wb, 39.9% RH
6) Leaving Supply Air: 38.2F db, 25.7F wb.
7) Leaving Exhaust Air: 35F db, 35F db.
8) Maximum air pressure drop: Supply - 0.78 in WG. Exhaust – 0.63 in WG.
9) Maximum face velocity: Supply – 390 fpm; Exhaust – 380 fpm.

b. HRV-2

1) 1600 CFM Supply Air, 1550 CFM Exhaust Air.
2) Energy Recovered – 69 MBH
3) Sensible Effectiveness – 66.7%
4) Entering Outdoor Air: 0F db, -2.7F wb, 24.6% RH
5) Entering Exhaust Air: 65F db, 51.9F wb, 39.9% RH
6) Leaving Supply Air: 42F db, 27.3F wb.
7) Leaving Exhaust Air: 29.7F db, 29.7F db.
8) Maximum air pressure drop: Supply - 0.77 in WG. Exhaust – 0.79 in WG.
9) Maximum face velocity: Supply – 385 fpm; Exhaust – 425 fpm.

M. Filter Box: Section with filter guides, access doors from both sides, for side loading with gaskets and blank-off plates. Provide blank-off plates to prevent air bypassing filters.

1. Filter Media:

a. Filter Section: UL 900 listed, Class II MERV 8. Maximum velocity of 525 fpm per square foot of filter. Flat 2 inches deep disposable slide in panel filters. MERV 8.

2. Filter Gauges: 3-1/2 inch diameter diaphragm actuated dial in metal case, with static pressure tips.

N. Dampers

1. Outdoor Air Damper on inlet (OAD): Factory mount. Aluminum blades, with vinyl bulb edging and edge seals, galvanized steel frame, and axles in self-lubricating nylon bearings. Two position.
2. Exhaust Air Damper on outlet (EAD): Factory mount. Aluminum blades, with vinyl bulb edging and edge seals, galvanized steel frame, and axles in self-lubricating nylon bearings. Two position.
3. Face and Bypass Damper for Heat Exchanger (HX): Damper and modulating actuator arranged to match heat exchanger face. Factory mount in casing with access doors, of aluminum blades, with vinyl bulb edging and edge seals, galvanized steel frame, and axles in self-lubricating nylon bearings. Modulating Control.

O. Sound Level Requirements.

1. Maximum bare fan at design flow rate: AMCA Standard No. 300 Sound Power Levels dB.

Fan	Octave Band	125	250	500	1000
SF-1	Outlet	55	63	70	78
RF-1	Inlet	58	61	62	66
SF-2	Outlet	55	66	70	78
RF-2	Inlet	60	65	63	66

P. Electrical Characteristics and Components

1. See Fan Schedules.
2. Motors must meet CEE Premium Efficiency Criteria. See MOTORS Below.

2.3 MOTORS

A. Manufacturers:

1. Baldor
2. General Electric
3. Reliance

B. Constructed and rated in accordance with current NEMA standards. The frame size, enclosures, and all appurtenances shall be suited to the application. 1.15 Service factor. Class F insulation.

1. Three phase motors: NEMA Design B. 208 Volt, 3 phase.

C. Electrical Requirements: At a minimum, motors must meet the following premium efficiency criteria as defined by (CEE) Consortium for Energy Efficiency for motors 1 hp and above.

HP	EFFICIENCY (1200 RPM)	EFFICIENCY (1800 RPM)
1	82.5	85.5
1.5	86.5	86.5
2	87.5	86.5

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Hang from structure with seismically restrained vibration isolation similar to Mason 30. Size for specific weights.

D. Install flexible duct connections between fan inlet and discharge ductwork and HRV. Ensure that metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

E. Install assembled unit on vibration isolators. Install isolated fans with resilient mountings and flexible electrical leads. Install restraining snubbers as indicated. Adjust snubbers to prevent tension in flexible connectors when fan is operating.

F. Provide sheaves required for final air balance.

G. Make connections to coils with unions or flanges.

H. Motors: Ensure proper alignment and rotation.

I. Hydronic Coils:

1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
2. Provide shut-off valve on supply line and shut-off valve and lockshield balancing valve with memory stop and shut-off valve on return line.
3. Locate water supply at bottom of supply header and return water connection at top.
4. Provide float operated automatic air vents at high points complete with stop valve.
5. Ensure water coils are drainable and provide drain connection at low points.

END OF SECTION 237313

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 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 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 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

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; stranded.

B. Branch Circuits: Copper, stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.

B. Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Branch Circuits: Type THHN-2-THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

B. 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.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

3.4 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.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.7 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 079200 "Joint Sealants."

3.8 FIELD QUALITY CONTROL

A. 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 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. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

B. 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.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.
10. Siemens Power Transmission & Distribution, Inc.

2.2 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 UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-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.

2.4 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.

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.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel, 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors for unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor.

1. Bury at least 24 inches (600 mm) below grade.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors.
3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. 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.

B. 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.

C. 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.

3.4 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 Rods: Drive rods until tops are 2 inches (50 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 one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. 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.

D. 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.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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. Allied Tube & Conduit.
b. Cooper B-Line, Inc.
c. ERICO International Corporation.
d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Atkore International.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. 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 and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. 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. 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) Hilti, Inc.
        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless 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. 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) Cooper B-Line, Inc.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti, Inc.
        4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
        5) 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.

PART 3 - EXECUTION

3.1 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.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. 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).

C. 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 Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. 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.
4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
5. To Light Steel: Sheet metal screws.
6. 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.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "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.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 2 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 033000 "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.

3.5 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 099123 "Interior Painting" for cleaning and touchup 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.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 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.
5. Handholes and boxes for exterior underground cabling.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. 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.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. IMC: Comply with ANSI C80.6 and UL 1242.

D. EMT: Comply with ANSI C80.3 and UL 797.

E. FMC: Comply with UL 1; zinc-coated steel.

F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

G. 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: Setscrew or 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.

H. 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.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. 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.

B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

C. LFNC: Comply with UL 1660.

D. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

E. Fittings for LFNC: Comply with UL 514B.

F. 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).

G. Solvent cements and adhesive primers 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."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

B. 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.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. 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.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 and 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.

G. 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.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

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.

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. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC.
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. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Boxes and Enclosures: NEMA 250, Type 1.

C. Raceway Fittings: Compatible with raceways 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. EMT: Use setscrew or compression fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 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 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. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches (300 mm) of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches (300 mm) of enclosures to which attached.

H. Raceways 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 raceways to reinforcement at maximum 10-foot (3-m) intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways 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 RNC to GRC or IMC before rising above floor.

I. Stub-ups to Above Recessed Ceilings:

1. Use EMT 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. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

N. 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.

O. 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.

P. 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.

Q. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed 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.

R. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements.

S. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

T. Locate boxes so that cover or plate will not span different building finishes.

U. 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.

V. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 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 312002 "Trenching" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312002 "Trenching."
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 312002 "Trenching."
4. Install manufactured duct elbows for stub-up 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. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 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. 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.

3.5 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 079200 Joint Sealants."

3.6 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.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification of power and control cables.
2. Identification for conductors.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

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.

PART 2 - PRODUCTS

2.1 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 raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 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 Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 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 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.

2.4 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. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 10 by 14 inches (250 by 360 mm).

2.5 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.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. 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).

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. 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

3.1 INSTALLATION

A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Apply identification devices to surfaces that require finish after completing finish work.

C. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

D. 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.

3.2 IDENTIFICATION SCHEDULE

A. 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 Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

    a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    b. Colors for 208/120-V Circuits:

        1) Phase A: Black.
        2) Phase B: Red.
        3) Phase C: Blue.

    c. Colors for 480/277-V Circuits:

        1) Phase A: Brown.
        2) Phase B: Orange.
        3) 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.

B. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. 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.

D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel 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.

F. 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.

G. 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.

END OF SECTION 260553

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Photoelectric switches.
2. Indoor occupancy sensors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data

PART 2 - PRODUCTS

2.1 OUTDOOR PHOTOELECTRIC SWITCHES

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 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, 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.

2.2 INDOOR OCCUPANCY SENSORS

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. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Brands Lighting, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D.
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.

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.

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.

2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

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. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Brands Lighting, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D.
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:

1. 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).
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage.
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.

2.4 LIGHTING CONTACTORS

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. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP.
3. Eaton Corporation.
4. General Electric Company; GE Consumer & Industrial - Electrical Distribution; Total Lighting Control.
5. Square D.

B. Description: Electrically operated and electrically held, 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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.

B. 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.

C. 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.

D. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. 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.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 ACTION SUBMITTALS

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

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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.3 INFORMATIONAL SUBMITTALS

A. Panelboard schedules for installation in panelboards.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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 NEMA PB 1.

C. Comply with NFPA 70.

1.6 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

2.1 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.

2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Phase, Neutral, and Ground Buses: Tin-plated aluminum.

C. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus Configured Terminators: Mechanical type.

D. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 DISTRIBUTION PANELBOARDS

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. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. 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.

D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

F. Branch Overcurrent Protective Devices: Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

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. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE 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. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
2. Siemens Energy & Automation, Inc.
3. 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. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. 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. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

C. 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.

D. Install overcurrent protective devices and controllers not already factory installed.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

G. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating 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 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

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.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. 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.

END OF SECTION 262416

SECTION 262419 - MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes MCCs for use with ac circuits rated 600 V and less and having the following factory-installed components:

1. Incoming main lugs and OCPDs.
2. Full-voltage magnetic controllers.
3. Auxiliary devices.

1.2 DEFINITIONS

A. BAS: Building automation system.

B. CPT: Control power transformer.

C. LED: Light-emitting diode.

D. MCC: Motor-control center.

E. NC: Normally closed.

F. NO: Normally open.

G. OCPD: Overcurrent protective device.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of controller and each type of MCC.

B. Shop Drawings: For each MCC, manufacturer's approval drawings as defined in UL 845. In addition to requirements specified in UL 845, 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.
2. Nameplate legends.
3. Vertical and horizontal bus capacities.
4. Features, characteristics, ratings, and factory settings of each installed unit.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain MCCs and controllers of a single type 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 NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

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. ABB; Control Products.
2. General Electric Company; GE Industrial Systems.
3. Rockwell Automation, Inc.; Allen-Bradley Brand.
4. Siemens Energy & Automation, Inc.; Power Distribution.
5. Square D; a brand of Schneider Electric.

B. General Requirements for MCCs: Comply with NEMA ICS 18 and UL 845.

2.2 FUNCTIONAL FEATURES

A. Description: Modular arrangement of main units, controller units, control devices, auxiliary devices, and other items mounted in vertical sections of MCC.

B. Controller Units: Combination controller units.

1. Install units up to and including Size 3 on drawout mountings with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.
2. Equip units in Type B with pull-apart terminal strips for external control connections.

C. Future Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

D. Spare Units: Installed in compartments indicated "spare."

2.3 INCOMING MAINS

A. Main Lugs Only: Conductor connectors suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum.
2. Main and Neutral Lugs: Mechanical type.

B. 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. 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. 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.

2.4 COMBINATION CONTROLLERS

A. Full-Voltage Controllers:

1. General Requirements for Full-Voltage Enclosed Controllers: Comply with NEMA ICS 2, general purpose, Class A.
2. Magnetic Controllers: Full voltage, across the line, electrically held.

a. Configuration: Nonreversing.

B. Disconnecting Means and OCPDs:

1. Fusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
c. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.

C. Control Power:

1. 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.

2.5 ENCLOSURES

A. Enclosures: Freestanding steel cabinets unless otherwise indicated. NEMA 250, Type 1.

B. Enclosure Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

C. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.

D. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in MCC; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.

E. Wiring Spaces:

1. Vertical wireways in each vertical section for vertical wiring to each unit compartment; supports to hold wiring in place.
2. Horizontal wireways in bottom and top of each vertical section for horizontal wiring between vertical sections; supports to hold wiring in place.

2.6 AUXILIARY DEVICES

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: Covered types; maintained contact unless otherwise indicated.
b. Pilot Lights: LED types; push to test.

2.7 CHARACTERISTICS AND RATINGS

A. Control and Load 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.

B. Nominal System Voltage: 208 V, three phase, four wire.

C. Short-Circuit Current Rating: Fully rated; 10kA.

D. Main-Bus Continuous Rating: 100 A.

E. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy.

F. Neutral Buses: 50 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables.

G. Ground Bus: Minimum size required by UL 845, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit equipment grounding conductors. Front-Connected, Front-Accessible MCCs:

H. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Controllers: Install MCCs on 4-inch (100-mm) nominal thickness concrete base.

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. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible switch.

D. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

E. Comply with NECA 1.

3.2 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification of MCC, MCC components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label MCC and each cubicle with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.3 CONNECTIONS

A. Comply with requirements for installation of conduit in Section 260533 "Raceways and Boxes for Electrical Systems." Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. 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 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed controllers will be considered defective if they do not pass tests and inspections.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers.

END OF SECTION 262419

SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes equipment for electricity metering by utility company and electricity metering by Owner.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Dimensioned plans and sections or elevation layouts and wiring diagrams.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1.5 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.

PART 2 - PRODUCTS

2.1 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.

2.2 EQUIPMENT FOR ELECTRICITY METERING BY OWNER

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. Accuenergy.

B. General Requirements for Owner's Meters:

1. Comply with IEC 62053-22 and ANSI C12.20.
2. Sensors: Current-sensing type, with current or voltage output, selected for optimum range and accuracy for meters indicated for this application.

a. Type: Split core.

3. Model: Acuvim IIE with Ethernet communication module.

PART 3 - EXECUTION

3.1 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.

3.2 FIELD QUALITY CONTROL

A. Perform tests and inspections.

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.

END OF SECTION 262713

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 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.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 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.

2.2 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.

2.3 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-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.

2.5 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, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Cooper.
b. Hubbell.
c. Leviton.
d. Pass & Seymour.

C. Key-Operated Switches, 120/277 V, 20 A:

1. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.6 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: Smooth, high-impact thermoplastic.
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.

2.7 FINISHES

A. Device Color:

1. Ivory

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 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.

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. 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.

F. 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.

3.2 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.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Exit signs.
3. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.

1.3 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 NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
b. UV stabilized.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.95 or higher.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

1. Ballast Manufacturer Certification: Indicated by label.

D. Ballasts for Low-Temperature Environments: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

2.4 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
5. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.5 EXIT SIGNS

A. General Requirements for Exit Signs: 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: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500K, and average rated life 20,000 hours unless otherwise indicated.

2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Comply with NFPA 70 for minimum fixture supports.

3.2 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

END OF SECTION 265100

SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks.
4. Grounding.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 BACKBOARDS

A. Backboards: Plywood, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm). Comply with requirements for plywood backing panels specified in Section 061000 "Rough Carpentry."

2.2 EQUIPMENT FRAMES

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. 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: 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, aluminum 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. 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.

2.3 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: Unit continues to supply power if protection is lost.
7. Rocker-type on-off switch, illuminated when in on position.

2.4 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-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.

2.5 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

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers.

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.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 FIRESTOPPING

A. Comply with requirements in Section 079200 "Joint Sealants."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.3 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.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

B. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cable.
3. 62.5/125-micrometer, optical fiber cabling.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Cabling identification products.

1.2 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.

1.3 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.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.
3. Wiring diagrams to show typical wiring schematics including the following:

    a. Cross-connects.
    b. Patch panels.

4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

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. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. 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.

B. Cable Trays:

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. 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 electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inches (0.012 mm) thick.

a. Ladder Cable Trays: Nominally 12 inches wide, and a rung spacing of 8 inches.

C. Conduit and Boxes: Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems."

2.2 BACKBOARDS

A. Backboards: Plywood, 3/4 by 48 by 96 inches (19 by 1220 by 2440 mm).

2.3 UTP CABLE

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. Belden CDT Inc.; Electronics Division.
2. Berk-Tek; a Nexans company.
3. CommScope, Inc.
4. Draka USA.
5. Genesis Cable Products; Honeywell International, Inc.
6. KRONE Incorporated.
7. Mohawk; a division of Belden CDT.
8. Nordex/CDT; a subsidiary of Cable Design Technologies.
9. Superior Essex Inc.
10. SYSTIMAX Solutions; a CommScope Inc. brand.
11. 3M.
12. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. Description: 100-ohm, 50-pair UTP, formed into binder groups covered with a gray 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:

2.4 UTP CABLE HARDWARE

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 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.

2.5 OPTICAL FIBER CABLE

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. 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. 3M.

B. Description: Multimode, 62,5/125-micrometer, 6-fiber, tight buffer, optical fiber cable.

1. Comply with ICEA S-87-640 for mechanical properties.
2. Comply with TIA/EIA-586-B.3 for performance properties.
3. 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. Gneral Purpose, Nonconductive: Type OFN or OFNG.

C. Jacket:

1. Jacket Color: Orange.
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.

D. OPTICAL FIBER CABLE HARDWARE

E. 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. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Sytems.
5. Dynacom Corporation.

6. Hubbell Premise Wiring.
7. Siemon Co.

F. 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.

G. Cable Connecting Hardware:

1. Quick-connect, simplex and duplex, Type ST connectors. Insertion loss not more than 0.75 dB.

2.6 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.7 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.

2.8 SOURCE QUALITY CONTROL

A. Factory test cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Cable will be considered defective if it does not pass tests and inspections.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 INSTALLATION OF PATHWAYS

A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

B. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for installation of conduits.

C. Install manufactured conduit sweeps and long-radius elbows whenever possible.

D. 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. Extend conduits 3 inches (76 mm) above finished floor.
3. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch (2440-mm) dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 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. 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. Terminate cable on connecting hardware that is rack mounted.

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

F. Group connecting hardware for cables into separate logical fields.

G. 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).

3.4 FIRESTOPPING

A. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 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.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. 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.

C. 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, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect UTP 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 requirement 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 backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
2) 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.

B. 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.

C. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

D. Prepare test and inspection reports.

END OF SECTION 271300

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Cable connecting hardware, patch panels, and cross-connects.
3. Telecommunications outlet/connectors.
4. Cabling system identification products.

B. Related Requirements:

1. Section 271300 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.

1.2 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.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 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. 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. Grounding: Comply with J-STD-607-A.

2.2 UTP CABLE

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. 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: 100-ohm, four-pair UTP, binder groups 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:

2.3 UTP CABLE HARDWARE

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. 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, plus spares and blank positions adequate to suit specified expansion criteria.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: By Onwer.

2.4 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. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.5 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.6 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 260553 "Identification for Electrical Systems."

2.7 SOURCE QUALITY CONTROL

A. Factory test UTP cables on reels according to TIA/EIA-568-B.1.

B. Factory test UTP cables according to TIA/EIA-568-B.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Install cables in pathways except within consoles, cabinets, desks, and counters.

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.

3.2 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 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. Install 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. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. 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).

3.3 FIRESTOPPING

A. Comply with requirements in Section 079200 "Joint Sealants."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. 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.

C. 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.

D. 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. 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.

3. 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.

E. 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.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect UTP 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. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:

1) Wire map.
2) Length (physical vs. electrical, and length requirements).
3) Insertion loss.
4) Near-end crosstalk (NEXT) loss.
5) Power sum near-end crosstalk (PSNEXT) loss.
6) Equal-level far-end crosstalk (ELFEXT).
7) Power sum equal-level far-end crosstalk (PSELFEXT).

8) Return loss.
9) Propagation delay.
10) Delay skew.

6. 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.

B. 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.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 271500

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Addressable interface device.
7. Digital alarm communicator transmitter.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

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.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment.
d. Riser diagram.
e. Record copy of site-specific software.
f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator 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.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Automatic sprinkler system water flow.
5. Fire standpipe system.
6. Dry system pressure flow switch.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Recall elevators to primary or alternate recall floors.
5. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Loss of communication with any panel on the network.

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 communication with any addressable sensor, input module, relay, control module, or remote annunciator.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.

2. Identify specific device initiating the event at fire-alarm control unit.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.3 FIRE-ALARM CONTROL UNIT

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. Notifier.
2. Siemens Industry, Inc.; Fire Safety Division.
3. SimplexGrinnell LP.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. 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, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:

   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.

2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.

G. 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.

H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

I. 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 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.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.

1. Single-action mechanism, 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.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
3. 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.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
6. Remote Control: Unless otherwise indicated, detectors shall be digital-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 of combination smoke- and heat-detection units 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 characteristic of combination smoke- and heat-detection units 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. Multiple levels of detection sensitivity for each sensor.
d. Sensitivity levels based on time of day.

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. Ionization Smoke Detector:

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.).

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, 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. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464.

C. Visible Notification Appliances: Xenon strobe lights complying 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. Mounting: Wall mounted unless otherwise indicated.
2. Flashing shall be in a temporal pattern, synchronized with other units.
3. Strobe Leads: Factory connected to screw terminals.
4. Mounting Faceplate: Factory finished, red.

2.8 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two 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 either 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.
5. Loss of power.
6. Low battery.
7. Abnormal test signal.
8. 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.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.

3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.

E. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

F. 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. Install all devices at the same height unless otherwise indicated.

G. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

H. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 PATHWAYS

A. Pathways shall be installed in EMT.

3.3 CONNECTIONS

A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) 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 elevator recall system and components.
2. Supervisory connections at valve supervisory switches.
3. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 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.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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" chapter.
b. Comply with the "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 the "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 visible appliances for the public operating mode according to manufacturer's written instructions.
5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

B. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

C. Fire-alarm system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

SECTION 312000 - EROSION CONTROL

PART 1 - GENERAL

1.01 THE REQUIREMENT

A. The CONTRACTOR shall provide for erosion control during construction in accordance with the requirements of the Alaska Department of Environmental Conservation (ADEC). All discharge of pollutants and sedimentation from on-site drainage shall be caught on-site.

B. Erosion Control includes preparation and maintenance of a Storm Water Pollution Prevention Plan (SWPPP), control of erosion, sedimentation and discharge of pollutants, in accordance with the ADEC Construction General Permit (CGP).

C. The WORK under this section includes providing all labor, materials, tools and equipment necessary to construct and maintain temporary erosion control works; including but not limited to, wattles, silt fences, silt containment booms, settling ponds, check dams, ditches, etc.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall be suitable for the intended use and perform effectively to control silt and surface erosion. All materials shall remain the property of the CONTRACTOR.

PART 3 - EXECUTION

3.01 GENERAL

A. The CONTRACTOR is responsible to prepare, submit and maintain a SWPPP, as required by the CGP that is in accordance with their construction methodologies and sequences.

1) For projects disturbing greater than 1 Acre, this requirement shall include submission of a Notice of Intent (NOI) to ADEC prior to beginning of WORK. Copies of the NOI and SWPPP shall also be submitted to the OWNER's Representative within 5 days of submittal to ADEC.

2) For projects disturbing less than 1 acre, the SWPPP shall be submitted to the OWNER's Representative prior to the beginning of WORK; submittal to ADEC or an NOI are not required.

B. WORK at the Project site will not be permitted until the above documents are submitted to the OWNER's Representative and acceptance of this plan has been obtained from the governing agency or agencies (if required by the CGP).

C. The CONTRACTOR shall install temporary erosion control structures and devices as required by their SWPPP, prepared in accordance with the ADEC CGP. They shall be maintained in effective operating condition at all times. Prior to completion of work, the CONTRACTOR shall clean and remove all silt and debris from the settling pond and check dams.

D. Temporary erosion control structures shall remain in place until the project is completed and replaced by permanent erosion control WORK, protected by final stabilization or until the OWNER's Representative approves their removal.

E. The CONTRACTOR shall be responsible for meeting the requirements of all permits (including permits naming the OWNER, or other parties); therefore, shall be responsible for the quality of the run-off water from the Project site and for any fines and/or penalties resulting from the construction operation.

F. The CONTRACTOR shall submit NOT (Notice of Termination) at completion of the WORK and removal of all SWPPP items.

END OF SECTION 312000

SECTION 312001 - EXCAVATION AND EMBANKMENT

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for excavation and embankment construction to the lines, grades and cross sections indicated in the Drawings or as directed by the OWNER's Representative.

1.03 SUBMITTALS

A. Select Borrow – sample for gradation analysis.

B. Shot Rock Borrow – samples for gradation and/or visual analysis.

PART 2 – PRODUCTS

2.01 EXCAVATION

A. All excavation shall be unclassified excavation, and shall consist of excavation of all materials, of whatever character, encountered in the WORK. Excavated soils that meet the requirements for Embankment may only be used on the project with approval from the OWNER's Representative.

2.02 EMBANKMENT

A. Material for embankment construction shall consist of non-frost-susceptible earth, sand, gravel, fractured rock or combination thereof containing no muck, peat, frozen materials, roots, sod or other deleterious materials, and shall be compactable to the density required by the Specifications.

2.03 SELECTED EMBANKMENT

A. Selected Embankment shall meet all the requirements for Embankment Material, and in addition, shall have a plasticity index not greater than 6 as determined by AASHTO T 90 and shall contain no more than 6% by weight of material passing the 200 mesh sieve. The percentage of material passing the 200 mesh sieve shall be determined using only the material which passes a 3-inch sieve.

2.04 BORROW

A. Borrow shall meet the requirements for Embankment above.

2.05 SELECTED BORROW

A. Selected Borrow shall meet the requirements for Selected Embankment above.

2.06 SHOT ROCK BORROW

A. Shot Rock Borrow shall conform to the following gradation:

SIEVE DESIGNATION	PERCENT PASSING BY WEIGHT
6 Inch	100
4 Inch	85 - 100
3 Inch	10 - 50
No. 200*	0 - 3

**Gradation shall be determined on that portion passing the 3-inch screen*

B. At least 50% by weight of the particles retained on the 3/8-inch sieve shall have at least two fractured faces as determined by ATM T-4.

C. Elongation Specification
The length of the crushed stone backfill shall not be more than twice the designated screed diameters.

D. Sodium Sulfate Loss
Aggregate shall pass the percent sodium sulfate loss per AASHTO T 104 with 9% maximum.

E. Shot Rock Borrow for this Project shall have a maximum Nordic Abrasion value of 22. Test procedure for Nordic Abrasion is Alaska Test Method 312. This is available at the CBJ Engineering Department or the State of Alaska Department of Transportation and Public Facilities Southeast Region Materials Laboratory.

F. Shot Rock Borrow shall consist of 6-Inch minus shot rock and shall contain no muck, frozen material, roots, sod or deleterious matter. Shot rock borrow material shall be obtained from a local rock quarry. Shot Rock Borrow material shall not consist of predominantly all one size, or an open graded mix, but rather a uniform grading of shot rock material smaller than 6-inch in size. Shot Rock Borrow shall be free of schist that cleaves along preferred foliation planes. Shot Rock Borrow shall be free of platy mineral grains. Metamorphic shot rock shall be free of slaty cleavage.

2.07 2-INCH MINUS SHOT ROCK

A. 2-Inch Minus Shot Rock shall contain no mulch, frozen material, roots, sod or other deleterious matter.

B. The shot rock shall have a plasticity index not greater than 6, as determined by AASHTO T-90. It shall consist of not more than 3% by weight of particles that pass the NO. 200 sieve, as determined by ATM T-7.

C. At least 50% by weight of the particles retained on the 3/8-inch sieve shall have at least two fractured faces as determined by ATM T-4.

D. At least 70% by weight of particles shall be retained on the 1-inch sieve.

E. Elongation Specifications:
The length of the crushed stone backfill shall not be more than twice the designated screen dimensions.

F. Sodium Sulfate Loss:
Aggregate shall pass the percent sodium sulfate loss per AASHTO T 104 with 9% maximum.

G. LA Abrasion:
Percent of wear per AASHTO T 96 shall be 45% maximum.

H. 2-Inch Shot Rock for this Project shall have a maximum Nordic Abrasion value of 22. Test procedure for Nordic Abrasion is Alaska Test Method 312. This is available at the CBJ Engineering Department and State of Alaska Department of Transportation and State of Alaska Department of Transportation and Public Facilities Southeast Region Materials Laboratory.

PART 3 – EXECUTION

3.01 EXCAVATION

A. Excavations shall be reasonably smooth and uniform to the lines, grades and cross sections shown in the Drawings or as directed by the OWNER's Representative. Excavations shall be conducted to ensure that material outside of excavation limits remains undisturbed.

B. Excavations shall be protected from erosion and maintained to drain freely at all times.

C. When excavation to the limits indicated on the Drawings encounters unsuitable underlying material, the OWNER's Representative may require the CONTRACTOR to remove the unsuitable material and backfill with approved material. The CONTRACTOR shall take the necessary cross section measurements before backfill is placed in order to measure the amount of unsuitable material removed.

D. Excavated soils that do not meet the requirements for embankment material and surplus suitable excavation shall be disposed of by the CONTRACTOR at a location and in a manner approved by the OWNER's Representative. No material may be wasted without the prior approval of the OWNER's Representative.

E. The CONTRACTOR is responsible for securing a waste disposal site if none is indicated on the Drawings. The CONTRACTOR shall obtain the written permission of the landowner for use of all disposal sites, and shall either obtain any required permits or assure that they have been obtained by others. If required by the OWNER's Representative, the CONTRACTOR shall furnish the permit numbers of all required

permits for the disposal sites. The costs of securing such sites shall be borne by the CONTRACTOR.

F. Temporary storage of useable or suitable excavation is the responsibility of the CONTRACTOR, and no additional payment will be made.

G. The CONTRACTOR shall conduct all operations to prevent contaminating useable excavation with unsuitable material.

H. The CONTRACTOR shall provide added care when excavating adjacent to existing roadways, sidewalks, curbs and underground utilities. Damage caused to existing roadways, sidewalks, curbs and underground utilities by the CONTRACTOR shall be repaired at the CONTRACTOR's expense.

I. After excavation to the subcut limit is complete and prior to backfilling with Shot Rock Borrow, the bottom of the subcut shall be proof rolled with an excavator or backhoe-mounted vibrating compactor until a firm base for the backfill material is obtained.

3.02 EMBANKMENT

A. Embankments shall be constructed to a reasonably smooth and uniform shape conforming to the lines, grades and cross sections indicated on the Drawings or as directed by the OWNER's Representative.

B. Embankment construction includes, but is not limited to; placing and compacting selected borrow adjacent to building foundation walls and footings, access ramps, sidewalks, curbs and underground structures. Only approved materials shall be used in the construction of embankments and backfills. Embankment material will be approved for gradation following placement, but prior to compaction.

C. Embankment shall not be placed on frozen ground.

D. Red top grading hubs shall be set to top of select borrow for this project in all areas where additional select borrow has been placed and compacted to ensure proper elevations have been obtained. They shall be set by the CONTRACTOR at breaks in the grade and on even grade intervals not to exceed 50 feet, with additional stakes at vertical curves.

E. When embankment is to be placed on both sides of a concrete wall or box-type structure, operations shall be so conduced that the embankment is always at approximately the same elevation on both sides of the structure.

F. The finish subgrade surface (bottom of base course level) shall not vary more than 0.05-foot when tested using a ten foot straightedge, applied parallel with and at right angles to the centerline of the roadway or parking area to receive base course grading D-1 material, nor vary more than 0.05-foot from the established grade.

G. If continued hauling over a completed or partially completed embankment causes loss of stability as evidenced by pumping or rutting, or other damage, the CONTRACTOR shall repair the damaged embankment at its own expense and adjust its hauling equipment and procedures so as to avoid further damage.

3.03 EMBANKMENTS CONSTRUCTED WITH MOISTURE DENSITY CONTROL

A. Except for embankments constructed predominantly of rock fragments or boulders, all embankments shall be constructed with moisture density control. Embankments shall be placed in horizontal layers not to exceed 12-inches in depth, loose measurement, for the full width of the embankment, except as required for traffic, and shall be compacted before the next layer is placed. A smaller depth will be required if the compaction equipment is considered by the OWNER's Representative to be insufficient to obtain the required densities. Embankments shall be compacted at the approximate optimum moisture content to not less than 95% of the maximum density as determined by AASHTO T 180 D or Alaska Test Method T-12. Embankment materials may require drying or moistening to bring the moisture content near to optimum. In-place field densities will be determined by Alaska Test Method T-3 or T-11. Sufficient time shall be allowed between placement of layers to allow for field density tests.

3.04 EMBANKMENTS CONSTRUCTED FROM ROCK FRAGMENTS

A. When embankment material consists predominantly of rock fragments or boulders too large to be contained in the lift thickness specified without crushing or further fracturing, such material may be placed in lifts not exceeding in thickness the approximate average size of the larger rocks, or 18 inches, whichever is less.

B. This material shall not be dumped in final position but shall be deposited on the fill and distributed by blading or dozing so that voids, packets and bridging will be reduced to a minimum. Intervening spaces and interstices shall be filled with smaller stones and earth to form a dense, well compacted embankment. Hauling equipment shall be uniformly routed over the entire width of the embankment, and compaction equipment shall be utilized if necessary to assure that a well-compacted embankment is obtained.

C. Compaction shall be obtained by routing construction equipment and/or rollers uniformly over the entire surface of each layer before the next layer is placed.

D. Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until compaction has been completed and approved by the OWNER's on-site representative.

E. All shot rock borrow surfaces shall be rolled full width with a minimum of eight passes of a vibratory grid roller (minimum centrifugal force shall be 50,000 lb) prior to placement of subsequent layer of material. A vibratory grid roller will be required for this project.

3.05 DITCH GRADING

A. Ditch Grading shall include all excavation, backfill, compaction, grading and other WORK necessary to construct drainage ditches, armor rock lined ditches and parking lot sideslopes outside the subcut limits shown or described on the Drawings, in these Specifications, or as directed by the OWNER's Representative.

B. All areas beyond the construction limits that are disturbed during construction shall be graded to a smooth, uniform grade, with drainage ditches or swales free of humps or low areas that cause standing water in excess of 1-inch deep.

C. Ditch Grading shall produce a uniform transition from the ditch swale to the existing undisturbed areas. All slopes shall be 3:1 or flatter, unless shown on the Drawings or otherwise approved by the OWNER's Representative.

3.06 SELECT BORROW

A. Select Borrow material shall be placed and compacted over the existing select borrow surface as necessary to meet the embankment tolerances specified in Part 3.2, Embankment. All pot holes, wash boarding and contaminated select borrow material shall be re-graded to meet these tolerances. Select Borrow shall be compacted to 95% of the maximum dry density unit weight as determined by AASHTO T-180D test method.

3.07 INDIVIDUAL MINING PLAN

A. If the CONTRACTOR decides to use material from the City/State Lemon Creek Borrow Pit, or CBJ Stabler's Point Rock Quarry, the CONTRACTOR shall provide an Individual Mining Plan that conforms to CBJ requirements.

B. The Individual Mining Plan shall be developed using survey information provided by the OWNER, or the CONTRACTOR may provide an independent survey with two-foot contours of the City/State Lemon Creek Borrow Pit, or CBJ Stabler's Point rock quarry. The survey shall provide sufficient survey information to calculate quantities and show drainage features and property boundaries. If the CONTRACTOR uses the OWNER furnished survey information, the Individual Mining Plan shall be done in a Windows-based AutoCAD format, utilizing the current AutoCAD release in use by the OWNER.

END OF SECTION 312001

SECTION 312002 - TRENCHING

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for the excavation and backfill required for installation of pipelines, manholes, vaults, diversion structures, and other appurtenances; and for ground surface restoration, including pavement.

PART 2 - MATERIALS

2.01 TRENCH EXCAVATION

A. Trench excavation shall consist of all material, of whatever nature, excepting liquids, excavated from trenches.

2.02 BEDDING

A. Bedding, Class A, shall be aggregate conforming to the following gradation:

Sieve Designation	Percent Passing by Weight
1-1/2"	100
No. 4	0-35
No. 200	0-8

B. Bedding, Class B, shall be three inch minus material, free of muck, frozen material, lumps, organic material, trash, lumber or other debris, with no more than eight percent passing the No. 200 screen.

2.03 BACKFILL

A. Backfill is defined as material placed above the level of bedding material. Backfill material consists of native material excavated from the trench that is determined by the OWNER'S Representative to be suitable as backfill. Backfill material used under asphalt or concrete pavement, as shown on the Drawings, shall be non-frost-susceptible, granular material that is free of rocks larger than six inches, mulch, frozen material, lumps, organic material, trash, lumber, or other debris. All backfill material available from trench excavation shall be utilized prior to the use of the imported backfill.

2.04 IMPORTED BACKFILL

A. Imported backfill shall be granular material, free draining, free of mulch, frozen material, lumps, or organic material and shall conform to the following gradation:

Sieve Designation	Percent Passing by Weight
3 Inch	100
No. 4 *	20-70
No. 200 *	0-6

*Gradation shall be determined on that portion passing the three inch screen.

2.05 AGGREGATE BASE

A. Aggregate base shall conform to Grading D-1 of Section 312003 - Base Course.

PART 3 - EXCECUTION

3.01 EXCAVATION

A. Excavation for trenches shall conform to the lines and grades shown on the Drawings and to the limits depicted in the Drawings. The CONTRACTOR shall also do any WORK necessary to prevent surface water from entering the trench.

B. Excavation of any and all material more than six inches below the invert of the pipe as shown on the Drawings shall be done only when ordered in writing by the OWNER's Representative. The material so excavated will be handled in the manner described below:

1) All excavated material suitable for use as backfill shall be piled in an orderly manner separately from unsuitable material, at a sufficient distance from the edge of the trench to prevent material from sloughing or sliding back into the trench. When the trench is in a traveled roadway the OWNER's Representative may require removal and temporary storage of excavated material elsewhere.

2) Materials unsuitable for use as backfill shall be hauled to a CONTRACTOR furnished disposal site off of the Project, unless otherwise directed in writing by the OWNER's Representative. The CONTRACTOR is responsible for securing waste disposal sites if none is indicated on the Drawings. The CONTRACTOR shall obtain the written permission of the landowner for use of all disposal sites, and shall either obtain any required permits or assure that they have been obtained by others. If requested by the OWNER's Representative, the CONTRACTOR shall furnish the permit numbers of all required permits for the disposal sites. The cost of securing such sites shall be borne by the CONTRACTOR.

3) If the CONTRACTOR fails to comply with the provisions of any city ordinance or permit pertaining to waste disposal or disposal sites, the OWNER shall have the right, after giving 30 days written notice, to bring the disposal sites into compliance and collect the cost of the WORK from the CONTRACTOR, either directly or by withholding monies otherwise due under the Contract.

C. The CONTRACTOR shall protect and preserve all existing pavement, throughout the entire project. No tracked equipment may be operated on any pavement without first

protecting the pavement with pavement pads approved by the OWNER's Representative. All pavement which is damaged in any manner by the CONTRACTOR's operations shall be restored to original or better condition at the CONTRACTOR's expense. Repair WORK to state highways shall be in all ways satisfactory to the Alaska Department of Transportation and Public Facilities.

D. Where required to prevent caving of the trench, or by any safety law or regulation such as OSHA, the CONTRACTOR shall furnish and install bracing and/or sheeting to protect the excavation. This bracing and/or sheeting shall be removed as trench backfill progresses.

E. Excavations for manholes and similar structures shall be large enough to provide proper working room. Any over depth excavation shall be backfilled with concrete or other approved material at the CONTRACTOR's expense.

F. The CONTRACTOR shall provide temporary support of existing structures, as necessary, to protect the structures from settlement or other disturbances caused by construction activities. All structures disturbed by the CONTRACTOR's activities shall be returned to original or better condition.

3.02 BEDDING

A. Bedding shall be placed in conformance with the lines and grades shown on the Drawings. Before placing any bedding material, the bottom of the trench shall be hand raked ahead of the pipe laying operation to remove stones and lumps which will interfere with smooth and complete bedding of the pipe. The specified bedding material shall then be placed in layers the full width of the trench, each layer not exceeding eight inches in thickness loose measure, and compacted to 95% of maximum density as determined by AASHTO T 180 D, until the elevation of the plan grade for the pipe invert is attained. The pipe bed shall then be fine-graded by hand and compacted as above. Bell holes shall be hand dug at the location of joints and shall be of sufficient size to allow proper making of the joint and to prevent the collar or bell of the pipe from bearing on the bottom of the trench.

B. After the pipe has been laid and approved for covering, the specified bedding material shall be placed evenly on both sides of the pipe for the full width of the trench. Approval for covering does not imply final acceptance of the pipe, or relieve the CONTRACTOR in any way of responsibility to complete the Project in conformance with the Drawings and Specifications. Bedding material shall be placed in layers. The thickness, loose measure, of the first layer shall be either one-half the outside diameter of the pipe plus two inches or eight inches, whichever is least. This layer shall be compacted as specified above to provide solid support to the underside of the pipe.

C. The bedding material shall be placed and compacted in layers not more than eight inches in thickness, loose measure, up to a plane 12-inches above the top of the pipe.

D. The initial density test at any location will be paid for by the OWNER. If the initial test shows that the material compaction is not as specified, the CONTRACTOR shall modify the compaction methods used, as approved by the OWNER's Representative, and have the material re-tested until the tests show that the compaction method meets with the

Specification requirements. If the CONTRACTOR's compaction methods are not consistent and/or do not meet the requirements of these Specifications, the OWNER reserves the right to undertake additional compaction tests as necessary to determine the extent of substandard compaction, and to charge the CONTRACTOR for all such tests.

3.03 BACKFILL

A. The trench shall be backfilled above the bedding material, as shown in the Drawings, with approved material saved from trench excavation. If there is not sufficient approved material from the excavation, the backfilling of the trench shall be completed utilizing imported backfill. The backfill and/or imported backfill shall be compacted to 95% of optimum density within paved and parking, as shown on the Drawings, and 90% elsewhere, as determined by AASHTO T 180 D. Lifts shall not exceed 12-inches in depth for loose material. After backfilling of the trench is completed, any excess material from trench excavation shall be disposed of by the CONTRACTOR.

B. Where trenches cross roadways, streets or driveways, etc., backfilling shall be done immediately following excavation and laying of the pipe. All crossings shall be backfilled, compacted, and open to traffic at the end of each working period.

C. At least 24 hours prior to commencing backfilling operations, the CONTRACTOR shall notify the OWNER’s Representative of the proposed method of compaction. No method will be approved until the CONTRACTOR has demonstrated, under actual field conditions, that such method will produce the degree of compaction required.

D. The initial density test at any location will be paid for by the OWNER. If the initial test shows that the material compaction is not as specified, the CONTRACTOR shall modify the compaction methods used, as approved by the OWNER’s Representative, and have the material re-tested until the tests show that the compaction meets the Specification requirements. If the CONTRACTOR's compaction methods are not consistent and/or do not meet the requirements of these Specifications, the OWNER reserves the right to undertake additional compaction tests as necessary to determine the extent of substandard compaction, and to charge the CONTRACTOR for all such tests.

3.04 AGGREGATE BASE

A. Aggregate base shall be placed in layers not exceeding six inches compacted depth, extending the full width of the trench and compacted to 95% of maximum density as determined by AASHTO T 180 D. The thickness of the top layer shall be such that, after compaction, the surface shall be at the elevation shown in the Drawings. Care shall be taken to ensure proper compaction near the sides of the trench, and to avoid segregation.

3.05 ASPHALT CONCRETE PAVEMENT

A. Pavement to be removed shall be neatly saw cut full depth along straight lines. Only such pavement shall be removed as is necessary to excavate for the appurtenances, but the pavement shall be cut a sufficient distance outside the excavation to prevent damage to adjacent pavement by lifting or tearing of the mat. All removed pavement shall be disposed of at the asphalt disposal stockpile in the CBJ/State Lemon Creek Gravel Pit.

B. After trench backfilling is complete, the edges of existing pavement shall be neatly saw cut vertically as shown in the Drawings. All loose, cracked or undermined sections of existing pavement shall be removed.

END OF SECTION 312002

SECTION 312003 - BASE COURSE

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and placing one or more layers of aggregate base or leveling course on a prepared surface to the lines and grades shown on the Drawings.

1.03 SUBMITTALS

A. Base course grading D-1 gradation and modified proctor from independent laboratory from current construction season.

PART 2 - PRODUCTS

2.01 MATERIAL

A. Aggregate base course shall consist of crushed gravel or crushed stone, conforming to the quality requirements of AASHTO M 147. The aggregate shall be free from lumps, balls of clay, or other objectionable matter, and shall be durable and sound.

B. The base course shall be sampled according to "WAQTC FOP for AASHTO T2-Sampling Aggregates" as described in the *Alaska Test Methods Manual*, published by the Alaska Department of Transportation and Public Facilities.

C. Coarse aggregate (that material retained on a No. 4 sieve) shall be crushed stone and shall consist of sound, tough, durable rock of uniform quality. Rock shall be free of schist that cleaves along preferred foliation planes. Rock shall be free of platy mineral grains. Metamorphosed rock shall be free of slaty cleavage. All material shall be free of clay balls, vegetable matter or deleterious matters. Coarse aggregate shall not be coated with dirt or other finely divided matter. All aggregates shall be free of roots and wood. In addition, coarse aggregate shall meet the following requirements:

L.A. Wear, %, 25% maximum loss in accordance with AASHTO T 96.
Degradation Value, 45 minimum in accordance with ATM 313.
Sodium Sulfate Soundness Loss, %, 9 maximum in accordance with AASHTO T 104.

D. Base course material shall conform to the following gradations:

BASE COURSE GRADING D-1 GRADATION

(Percent passing by weight)

Sieve Size	D-1
1”	100
3/4"	70-100
3/8”	50-80
No. 4	35-50
No. 8	20-35
No. 40	8-20
No. 200	0-6

For grading D-1, at least 70% by weight of the particles retained on a No. 4 sieve shall have at least one fractured face as determined by Alaska Test Method T-4.

PART 3 - EXECUTION

3.01 GENERAL

A. Prior to placement of the base course, the underlying surface shall be prepared by dressing, shaping, wetting or drying, and compacting of the underlying material to a minimum density of 95% as determined by AASHTO T 180-D. Surfaces shall be cleaned of all foreign substances and debris.

B. Any ruts or soft yielding spots that may appear shall be corrected by loosening and removing unsatisfactory material and adding approved material as required, reshaping, and recompacting the affected areas to the lines and grades indicated on the Drawings. If required by the OWNER’s Representative the CONTRACTOR shall proof load questionable areas with a loaded truck or other piece of equipment approved by the OWNER’s Representative.

C. Base course material shall be deposited and spread in a uniform layer to the required grades, and to such loose depth that when compacted to the density required, the thickness will be as indicated on the Drawings. Portions of the layer which become segregated shall be removed and replaced with a satisfactory mixture, or shall be remixed to the required gradation.

D. The maximum compacted thickness of any one layer shall not exceed six inches, except the compacted depth of a single layer may be increased to eight inches if compaction equipment capable of delivering sufficient compactive energy, as determined by the OWNER’s Representative, is used. If the contract documents require the compacted depth to exceed six inches, the base shall be constructed in two or more layers of approximately equal thickness. Each layer shall be shaped and compacted before the succeeding layer is placed.

E. The base course shall be compacted to at least 95% of maximum density as determined by AASHTO T 180-D. In places not accessible to rolling equipment, the mixture shall be compacted with hand-tamping equipment.

F. Blading, rolling, and tamping shall continue until the surface is smooth and free from waves and irregularities. If at any time the mixture is excessively moistened, it shall be serrated by means of blade graders, harrows, or other approved equipment, until the moisture content is such that the surface can be recompacted and finished as above.

G. The grading operations shall be conducted in a manner that will remove any quarter crowns, or other humps in the cross section of the roadway. The cutting edges of the grading blade shall be replaced if they are found to be worn beyond the tolerances specified for the roadway surface. The finished surface shall not have humps or dips between blue-topped intervals along the roadway alignment that exceed the tolerances given in the following paragraph, H.

H. The finished surface of the base course, when testing using a ten foot straightedge shall not show any deviation in excess of 3/8-inch between two contact points. The finish surface shall not vary more than 1/2-inch from established grade. Additionally, the algebraic average of all deviations from established grade of the finish base course surface elevations taken at 50-foot intervals shall be less than 0.02 foot.

I. The initial density at any location will be paid for by the OWNER. If the initial test shows that the material compaction is not as specified, the CONTRACTOR shall modify the compaction methods used, as approved by the OWNER's Representative, and have the material retested until the tests show that the compaction meets the Specification requirements. All tests, after the initial test at any given location, shall be paid for by the CONTRACTOR.

END OF SECTION 312003

SECTION 312004 - FILTER MATERIAL

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. The WORK of this Section includes providing all labor, materials, tools and equipment necessary to complete construction of the filter material for the retaining wall drains, foundation drains and roof drains as shown on the Drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Filter material shall be gravel consisting of crushed or naturally occurring granular material. It shall be washed and free of clay particles and conforming to the following gradation.

SIEVE SIZE	PERCENT PASSING BY WEIGHT
2”	100
1-1/2"	95-100
3/4"	0-20
3/8”	0-5

B. Foundry sand and other material which may be cementious or not suitable for water percolation shall not be used.

PART 3 - EXECUTION

3.01 GENERAL

A. The filter material shall be placed to the lines, grades, and thickness shown on the Drawings and shall be placed on all sides of perforated pipes to form a wall drain.

3.02 PREPARATION OF THE SUBBASE

A. Subbase preparation shall consist of dressing, shaping, wetting, and compacting of the subbase to a minimum density of 95%.

B. Surfaces shall be cleaned of all foreign substances and debris. Any ruts or soft yielding spots that may appear in the subbase surface shall be corrected by loosening, removing and adding approved material, reshaping and re-compacting the affected areas to the line, grade, and to the specified density requirements.

3.03 PLACING

A. Filter material shall be deposited and spread in a uniform layer to the required contour and grades.

B. The filter material shall be completely encapsulated in geotextile, Type A filter cloth. See Section 323000.

C. Compacting the filter material is generally not required, however, the material shall be lightly tamped to ensure uniformity.

D. Care shall be taken to maintain the proper grade on the wall drain pipe while placing the filter material.

END OF SECTION 312004

SECTION 312316 - REMOVE AND DISPOSE OF CULVERT PIPE

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. The WORK under this Section includes providing all labor, tools and equipment necessary for removal and disposal of all existing culverts and headwalls within the Project limits designated for removal.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 GENERAL

A. All culvert pipe shown on the Drawings for removal shall be removed and backfilled with suitable material to match the adjacent ground surface. This WORK will include removal and disposal of existing culvert headwalls. Usable material from Project trench excavation shall be used as backfill. Pipe to be disposed shall be removed from the Project and disposed in a legal manner.

END OF SECTION 312316

SECTION 312317 - STORM AND SANITARY STRUCTURE REMOVAL

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. The WORK under this Section includes providing all labor, materials, tools, and equipment necessary for removal and disposal of existing storm manholes and catch basins and sanitary manhole structures.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 GENERAL

A. Storm and sanitary sewer structures designated on the Drawings to be removed, shall be removed and backfilled with suitable material to the excavation subcut limits. Structures to be disposed shall be removed from the Project and disposed in a legal manner.

END OF SECTION 312317

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes provisions for site dewatering during excavation operations for the Project. Dewatering consists of lowering and controlling groundwater levels and hydrostatic pressures to permit site and building excavation, base course placement and compaction. All equipment, materials and labor necessary shall be furnished by the CONTRACTOR to ensure dewatered conditions.

1.03 QUALITY ASSURANCE

A. Maintain adequate supervision and control to ensure that stability of excavated and constructed slopes are not adversely affected by water, erosion is controlled, and flooding of excavation does not occur.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 DEWATERING

A. Provide an adequate system to lower and control groundwater in order to permit excavation and placement of base course materials. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of storm drains, sewers, water main and other excavations.

B. Dispose of water removed from excavations in a manner to avoid endangering public health, property, and portions of WORK under construction or completed. Dispose of water in a manner to avoid inconvenience to others. Provide sumps, sedimentation tanks, and other flow control devices as required by governing authorities to maintain proper water quality.

C. The CONTRACTOR shall submit a dewatering plan to the OWNER’s Representative. Written approval shall be obtained prior to commencement of WORK.

D. The dewatering plan shall include, but should not be limited to, the following provisions:

1) Prevent surface or groundwater from flowing into or accumulating in excavations.

2) Prevent water from flowing in an uncontrolled fashion across the project site or to erode slopes or to undermine cut slopes.

3) Prevent water from being diverted onto adjacent properties.

4) Provide continual and effective drainage of excavations.

5) Provide and maintain temporary diversion ditches, dikes, and grading as necessary. Trench excavations shall not be used for this purpose.

6) Provide sumps, wellpoints, French drains, pumps, and other control measures necessary to keep excavations free of water.

7) Provide control measures prior to excavation to water level and maintain water level continuously below working level.

END OF SECTION 312319

SECTION 316000 - CONSTRUCTION SURVEYING

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary to perform all surveying and staking necessary for the completion of the Project in conformance with the Drawings and Specifications and standard surveying practices, including all calculations required to accomplish the WORK.

B. The WORK shall include the staking, referencing and all other actions as may be required to preserve and restore land monuments and property corners which are situated within the Project area, and to establish monuments as shown on the Drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. All surveying involving property lines or monuments shall be done by, or under the direction of, a Registered Land Surveyor licensed in the State of Alaska.

B. The OWNER will supply information relative to the approximate locations of monuments and corners, but final responsibility for locations, referencing, and restoration shall rest with the CONTRACTOR.

C. In the event the CONTRACTOR does not replace the survey monuments and property corners disturbed by the CONTRACTOR’s operations, the OWNER may, after first notifying the CONTRACTOR, replace the monuments in question. The cost of such replacements shall be deducted from payments to the CONTRACTOR.

D. The CONTRACTOR shall provide the OWNER with a copy of all surveyors' notes, if requested by the OWNER’s Representative, prior to each Pay Request payment.

E. The CONTRACTOR shall provide the OWNER with a copy of all surveyors' notes, prior to the request for final payment, and include the information on the record drawings.

F. The CONTRACTOR shall obtain all information necessary for as-built plan production, from actual measurements and observations made by its own personnel, including Subcontractors, and submit this information to the OWNER’s Representative.

G. The CONTRACTOR shall use competent, qualified personnel and suitable equipment for the layout work required and shall furnish all stakes, templates, straightedges and other devices necessary for establishing, checking and maintaining the required points, lines and grades.

H. The CONTRACTOR shall perform all staking necessary to delineate clearing and/or grubbing limits; all cross sections necessary for determination of excavation and embankment quantities, including intermediate and/or remeasure cross sections as may be required; all slope staking; all staking of culverts and drainage structures, including the necessary checking to establish the proper location and grade to best fit the conditions on site; the setting of such finishing stakes as may be required; the staking of right-of-way; the staking, referencing and other actions as may be required to preserve or restore land monuments and property corners; and all other staking necessary to complete the project.

I. Field notes shall be kept in standard bound notebooks in a clear, orderly and neat manner, consistent with standard surveying practices. The CONTRACTOR's field books shall be available for inspection by the OWNER's Representative at any time.

J. All field survey notes, including those which become source documentations from which quantities for payment are computed, shall be recorded by a notekeeper furnished by the CONTRACTOR. The notekeeper shall be thoroughly familiar with generally accepted standards of good survey notekeeping practice.

K. The OWNER's Representative may randomly spot-check the CONTRACTOR's surveys, staking and computations at the OWNER's Representative discretion. After the survey or staking has been completed, the CONTRACTOR shall provide the OWNER'S Representative with a minimum of 72-hour notice prior to performing any WORK, and shall furnish the appropriate data as required, to allow for such random spot-checking; however, the OWNER assumes no responsibility for the accuracy of the WORK.

END OF SECTION 316000

SECTION 321218 - REMOVE EXISTING ASPHALT SURFACING

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary to remove existing asphalt surfacing as shown on the Drawings, or as directed by the OWNER's Representative.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 GENERAL

A. Asphalt pavement to be removed shall be neatly saw cut full depth along straight lines, with a tolerance of 0.1 feet in 50 feet and 0.2 feet in 100 feet. Only such pavement shall be removed as is necessary to excavate for the appurtenances, but the pavement shall be cut a sufficient distance outside the excavation to prevent damage to adjacent pavement by lifting or tearing the mat.

B. The CONTRACTOR shall deliver the removed asphalt surfacing material to an approved asphalt disposal site. If the CBJ/State Lemon Creek Gravel Pit is used, the CONTRACTOR shall stack the material with a loader as required by the CBJ.

C. If the CONTRACTOR fails to comply with the provisions of any CBJ ordinance or permit pertaining to waste disposal or disposal sites; the OWNER shall have the right, after giving 30 days written notice, to bring the disposal sites into compliance and collect the cost of the WORK from the CONTRACTOR, either directly or by withholding monies otherwise due under the contract.

D. Use of grinding or milling equipment will be allowed to remove existing asphalt under the requirements of this section. Pavement grindings from this Project shall be disposed of at an approved asphalt disposal site. Grindings shall not be reused on the Project.

END OF SECTION 321218

SECTION 321313 - SITE CONCRETE

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing portland cement concrete for civil concrete structures in conformance with the Drawings and Specifications.

1.03 SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturer:
   1. Form-release agents.
   2. Joint filler for concrete sidewalk, curbs and site walls.
   3. Reinforcing steel shop drawings.
   4. Concrete mix design.

PART 2 - PRODUCTS

2.01 PORTLAND CEMENT

A. Portland cement shall conform to the requirements of AASHTO M 85.

B. Unless otherwise permitted by the OWNER's Representative, the product from only one mill and one brand and type of portland cement shall be used on the Project.

2.02 FINE AGGREGATE

A. Fine aggregate for portland cement concrete shall conform to the requirements of AASHTO M 6 with the following exceptions:

Delete section on deleterious substances and substitute the following:

The amount of deleterious substances shall not exceed the following limits:

Friable particles percent by weight ..... 5 max.
Coal and Lignite, percent by weight using a liquid of 1.95 specific gravity
(only material that is brownish-black shall be considered as coal or lignite)... 0.5 max.
Material passing the No. 200 sieve, percent by weight..... 3.0 max.

Delete paragraph 4.2 of AASHTO M 6.

2.03 COARSE AGGREGATE

A. Coarse aggregate for portland cement concrete shall conform to the requirements of AASHTO M 80, class A, with the following exceptions:

Delete section on deleterious substances and substitute the following:

The amount of deleterious substances shall not exceed the following limits:

Coal and Lignite, percent by weight (only material that is brownish-black or black shall be considered coal or lignite) ..... 1.0 max.
Material passing the No. 200 sieve ..... 1.0 max
Thin-elongated pieces, percent by weight. (Length greater than five (5) times average thickness) ..... 15 max.
Sticks and roots, percent by weight ..... 0.10 max.
Friable Particles, percent by weight ..... 0.25 max.
Maximum loss from AASHTO T 96 shall be 50 percent.
Maximum loss from AASHTO T-104 shall be 12 percent.

2.04 JOINT FILLERS

A. Joint filler, of the type designated in the contract, shall conform to the following:

1. Poured filler shall conform to AASHTO M 173 or AASHTO M 282 as specified.
2. Preformed fillers shall conform to AASHTO M 33 for bituminous type; AASHTO M 153 for sponge rubber (type I), cork (type II), and self-expanding cork (type III); AASHTO M 213 for nonextruding and resilient bituminous types and resilient bituminous types and AASHTO M 220 for pre-formed elastomeric types as specified.
3. AASHTO M 220 for preformed elastomeric types as specified. The filler shall be punched to admit the dowels where called for on the Drawings. Joint filler shall be furnished in a single piece for the depth and width required for the joint unless otherwise authorized by the OWNER's Representative. When more than one piece is authorized for a joint, the abutting ends shall be fastened securely, and held accurately to shape, by stapling or other positive fastening satisfactory to the OWNER's Representative.
4. Foam filler shall be expanded polystyrene filler having a compressive strength of not less than 10 psi.
5. Hot-poured sealants for concrete and asphaltic pavements shall conform to ASTM D 3405.
6. Hot-poured elastomeric type sealant for concrete pavements shall conform to ASTM D 3406.
7. Cold-poured silicone type sealant for concrete pavements shall conform to Federal Specification TT-S-1543, Class A. The sealant shall be a one part, low-modulus silicone rubber with an ultimate elongation of 1,200 percent.

2.05 CURING MATERIAL

A. Curing material shall conform to the following requirements as specified:

1. Burlap Cloth made from Jute Kenaf AASHTO M 182.
2. Sheet Material for Curing Concrete AASHTO M 171.
3. Liquid Membrane-Forming Compounds AASHTO M 148 for Curing Concrete, Type I.

B. The requirements specified in AASHTO M 148 covering "Liquid Membrane-Forming Compounds for Curing Concrete" are modified by adding the following:

1. Liquid membrane-forming compounds utilizing linseed oil shall not be used.

2.06 AIR ENTRAINING AGENTS

A. Air-entraining admixtures shall conform to the requirements of AASHTO M 154.

2.07 MIXING WATER

A. Unless otherwise permitted in writing by the OWNER'S Representative, all water shall be obtained from the CBJ potable water system.

2.08 REINFORCING STEEL

A. Reinforcing shall conform to AASHTO M 31, and be of grade 60 or the grade designated on the Drawings or in the Specifications. Welded wire fabric shall conform to AASHTO M 55. Epoxy coated reinforcing bars shall conform to AASHTO M 284.

2.09 SHIPPING AND STORAGE OF CEMENT

A. Cement may be shipped from pretested approved bins. The cement shall be well protected from rain and moisture. Any cement damaged by moisture or which fails to meet any of the specified requirements shall be rejected and removed from the WORK.

B. Cement stored by the CONTRACTOR for a period longer than 60-days in other than sealed bins or silos shall be retested before being used. Cement of different brands, types, or from different mills shall be stored separately.

2.10 COMPOSITION OF CONCRETE

A. All portland cement concrete shall be ready-mix, provided by an approved plant regularly engaged in the production of concrete, unless otherwise authorized in writing by the OWNER'S Representative. Ready-mix concrete shall conform to the requirements of AASHTO M 157.

B. The CONTRACTOR shall furnish the mix design to the OWNER's Representative for approval. The mix design shall be suitable for its intended use. Concrete shall be designed using an absolute volume analysis. The CONTRACTOR shall be responsible for having each mix design tested at a laboratory. Prior to the start of production of any mix design, the CONTRACTOR shall submit test results and certifications for all materials, detailed mix design data and results of laboratory tests to the OWNER's Representative for approval. Approval by the OWNER's Representative will be based on apparent conformity to these Specifications. It shall remain the CONTRACTOR's responsibility during production to produce concrete conforming to the mix design and the minimum acceptance criteria in the contract. When requested by the OWNER's Representative, the CONTRACTOR shall submit samples of all materials for verification testing. Production shall not commence until the mix design is approved by the OWNER's Representative.

C. Unless otherwise specified the design mix shall meet the following:

Minimum cement content	6 1/2 sacks (611 lb.) per C.Y.
Maximum water/cement ratio	5.75 gal/sack (0.51 #/#)
28-day compressive strength (fc)	as indicated on Drawings.
Slump	3" ± 1"
Entrained Air	3 to 6%
Coarse Aggregate	AASHTO M 43, Gradation No. 67

Cement factors are based on 94-pound sacks

D. The CONTRACTOR shall be responsible for producing and placing specification concrete with a cement content that is within a tolerance of two percent.

E. The use of superplasticizers in the concrete mix to improve the workability of mixes with low water cement ratios will require prior written approval by the OWNER's Representative

F. The CONTRACTOR may, subject to prior approval in writing, use alternative sizes of coarse aggregate as shown in Table 1 of AASHTO M 43. If the use of an alternative size of coarse aggregate produces concrete which exceeds the permissible water-cement ratio above, thereby requiring additional cement above that specified, no compensation will be made to the CONTRACTOR for the additional cement.

2.11 SAMPLING AND TESTING

A. Field tests of all materials will be made by the OWNER's Representative when deemed necessary, in accordance with the applicable Specifications. When the results of the field tests indicate the material does not conform to the requirements of the Specifications, the re-tests required by the OWNER's Representative shall be at the CONTRACTOR's expense.

B. Materials which fail to meet contract requirements, as indicated by laboratory tests, shall not be used in the WORK. The CONTRACTOR shall remove all defective materials from the site.

C. Types and sizes of concrete specimens shall be in accordance with ASTM C 31. Additional slump tests and/or test cylinders may be required at the discretion of the OWNER's Representative. Should the analysis of any test cylinder not meet the preceding requirements of Article 2.10 (Composition of Concrete) its representative concrete shall be removed and replaced at the CONTRACTOR's expense.

D. Three copies of all test reports shall be furnished to the OWNER's Representative.

2.12 COLD WEATHER CONCRETE

A. Concrete shall not be placed when the descending air temperature in the shade, away from artificial heat, falls below 40°F. Placement of concrete shall not resume before the ascending air temperature reaches 35°F, without specific written authorization. When the air temperature falls below 40°F, or is, in the opinion of the OWNER's Representative,

likely to do so within a 24-hour period after placing concrete, the CONTRACTOR shall have ready on the job materials and equipment required to heat mixing water and aggregate and to protect freshly placed concrete from freezing.

B. Concrete placed at air temperatures below 40°F shall have a temperature not less than 50°F or greater than 70°F when placed in the forms. These temperatures shall be obtained by heating the mixing water and/or aggregate. Mixing water shall not be heated to more than 160°F.

C. Binned aggregates containing ice or in a frozen condition will not be permitted nor will aggregates which have been heated directly by gas or oil flame or heated on sheet metal over an open fire. When aggregates are heated in bins, only steam-coil or water-coil heating will be permitted, except that other methods, when approved, may be used. If live steam is used to thaw frozen aggregate piles, drainage times comparable to those applicable for washed aggregates shall apply.

D. When the temperature of either the water or aggregate exceeds 100°F, they shall be mixed together so that the temperature of the mix does not exceed 80°F at the time the cement is added.

E. Any additives must have prior approval of the OWNER's Representative before being used.

F. The use of calcium chloride is prohibited.

G. When placing concrete in cold weather, the following precautions shall be taken in addition to the above requirements:

1. Heat shall be applied to forms and reinforcing steel before placing concrete as required to remove all frost, ice, and snow from all surfaces which will be in contact with fresh concrete.
2. When fresh concrete is to be placed in contact with hardened concrete, the surface of the previous pour shall be warmed to at least 35°F, thoroughly wet, and free water removed before fresh concrete is placed.
3. When Type I or II cement is used, freshly placed concrete shall be maintained at a temperature of not less than 70°F for three days or not less than 50°F for five days. When Type III cement is used, freshly placed concrete shall be maintained at a temperature of not less than 70°F for two days or not less than 50°F for three days.
4. The above requirements are not intended to apply during the normal summer construction season when air temperatures of 40°F or higher can reasonably be anticipated during the two-week period immediately following concrete placement, or until the concrete is no longer in danger from freezing.

H. When temperatures below 20°F are not expected during the curing period and, in the opinion of the OWNER's Representative, no other adverse conditions, such as high winds, are expected, concrete temperatures may be maintained in thick concrete sections by retention of heat of hydration by means of adequately insulated forms.

I. When, in the opinion of the OWNER's Representative, greater protection is required to maintain the specified temperature, the fresh concrete shall be completely enclosed and an adequate heat source provided. Such enclosure and heat source shall be so designed that evaporation of moisture from the concrete during curing is prevented. Precautions shall be taken to protect the structure from overheating and fire.

J. At the end of the required curing period protection may be removed, but in such a manner that the drop in temperature of any portion of the concrete will be gradual and not exceed 30°F in the first 24-hours.

K. For concrete placed within cofferdams and cured by flooding with water, the above conditions may be waived provided that the water in contact with the concrete is not permitted to freeze. De-watering shall not be carried out until the OWNER's Representative determines that the concrete has cured sufficiently to withstand freezing temperatures and hydrostatic pressure.

L. The CONTRACTOR shall be wholly responsible for the protection of the concrete during cold weather operations. Any concrete injured by frost action or overheating shall be removed and replaced at the CONTRACTOR's expense.

2.13 FORMS

A. Forms shall be so designed and constructed that they may be removed without injuring the concrete.

B. Unless otherwise specified, forms for exposed surfaces shall be made of plywood, hard-pressed fiberboard, sized and dressed tongue-and-groove lumber, or metal in which all bolt and rivet holes are countersunk, so that a plane, smooth surface of the desired contour is obtained. Rough lumber may be used for surfaces that will not be exposed in the finished structure. All lumber shall be free from knotholes, loose knots, cracks, splits, warps, or other defects affecting the strength or appearance of the finished structure. All forms shall be mortar tight, free of bulge and warp, and shall be cleaned thoroughly before reuse.

C. In designing forms and falsework, concrete shall be regarded as a liquid. In computing vertical loads a weight of 150-pounds per cubic foot shall be assumed. The lateral pressure for design of wall forms shall not be less than that given by the following formulas:

For walls with R less than or equal to 7-feet per hour:

$$P=150+\frac{9000R}{T}$$, but not more than 2000 p.s.f. or 150 h, whichever is less.

For walls with R greater than 7-feet per hour:

$$P=150+\frac{43,400}{T}+\frac{2800R}{T}$$, but not more than 2000 p.s.f. or 150 h, whichever is less.

Where:

P = lateral pressure for design of wall forms, p.s.f.
R = rate of placement, feet per hour
T = temperature of concrete in forms, °F
h = maximum height of fresh concrete in form, feet.

D. The above formulas apply to internally vibrated concrete placed at 10 feet per hour or less, without the use of retarding agents, and where depth of vibration is limited to four feet below the top of the concrete surface. The CONTRACTOR shall state the placement rate and minimum concrete temperature on the working drawings for concrete form WORK. Deflection of plywood, studs, and walers shall not exceed 1/360 of the span between supports.

E. Forms shall be so designed that placement and finishing of the concrete will not impose loads on the structure resulting in adverse deflections or distortions.

F. The forms shall be so designed that portions covering concrete that is required to be finished may be removed without disturbing other portions that are to be removed later. As far as practicable, form marks shall conform to the general lines of the structure.

G. When possible, forms shall be day-lighted at intervals not greater than 10 feet vertically, the openings being sufficient to permit free access to the forms for the purpose of inspecting, and working.

H. Metal ties or anchorages within the forms shall be so constructed as to permit their removal to a depth of at least one inch from the face without injury to the concrete. All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left will be of the smallest possible size.

I. All exposed edges 90° or sharper shall be chamfered 3/4-inch unless otherwise noted. Chamfering of forms for re-entrant angles shall be required only when specifically indicated on the Drawings.

J. Forms shall be inspected immediately prior to the placing of concrete. Dimensions shall be checked carefully and any bulging or warping shall be remedied and all debris and standing water within the forms shall be removed. Special attention shall be paid to ties and bracing and where forms appear to be braced insufficiently or built unsatisfactorily, either before or during placing of the concrete, the OWNER's Representative shall order the WORK stopped until the defects have been corrected.

K. Forms shall be constructed true to line and grade. Cleanout ports shall be provided at construction joints.

L. All forms shall be installed in accordance with approved fabrication and erection plans.

M. All porous forms shall be treated with non-staining form oil or saturated with water immediately before placing concrete.

N. Falsework shall be built to carry the loads without appreciable settlement. Falsework that cannot be founded on solid footings must be supported by ample falsework piling. Falsework shall be designed to sustain all imposed loads.

O. Detail drawings of the falsework shall be submitted for review, but such review shall not relieve the CONTRACTOR of any responsibility under the contract for the successful completion of the structure.

P. Forms and falsework shall not be removed without the consent of the OWNER's Representative. The OWNER's Representative's consent shall not relieve the CONTRACTOR of responsibility for the safety of the WORK. Blocks and bracing shall be removed at the time the forms are removed and in no case shall any portion of the wood forms be left in the concrete.

Q. To facilitate finishing, forms used on exposed vertical surfaces shall be removed in not less than 12, nor more than 48-hours, depending upon weather conditions.

PART 3 - EXECUTION

3.01 GENERAL

A. All concrete shall be placed before it has taken its initial set and, in any case, within 45 minutes after mixing. Concrete shall be placed in such a manner as to avoid segregation of coarse or fine portions of the mixture, and shall be spread in horizontal layers when practicable. Special care shall be exercised in the bottom of slabs and girders to assure the working of the concrete around nests of reinforcing steel, so as to eliminate rock pockets or air bubbles. Enough rods, spades, tampers and vibrators shall be provided to compact each batch before the succeeding one is dumped and to prevent the formation of joints between batches.

B. Extra vibrating shall be done along all faces to obtain smooth surfaces. Care shall be taken to prevent mortar from splattering on forms and reinforcing steel and from drying ahead of the final covering with concrete.

C. Concrete shall not be placed in slabs or other sections requiring finishing on the top surface when precipitation is occurring or when in the opinion of the OWNER's Representative precipitation is likely before completion of the finishing, unless the CONTRACTOR shall have ready on the job all materials and equipment necessary to protect the concrete and allow finishing operations to be completed.

D. Troughs, pipes, or short chutes used as aids in placing concrete shall be arranged and used in such a manner that the ingredients of the concrete do not become separated. Where steep slopes are required, troughs and chutes shall be equipped with baffle boards or shall be in short lengths that reverse the direction of movement. All chutes, troughs, and pipe shall be kept clean and free of hardened concrete by flushing thoroughly with water after each run. Water used for flushing shall be discharged clear of the concrete in place. Troughs and chutes shall be of steel or plastic or shall be lined with steel or plastic and shall extend as nearly as possible to the point of deposit. The use of aluminum for pipes, chutes or tremies is prohibited. When discharge must be intermittent, a hopper or other device for regulating the discharge shall be provided.

E. Dropping the concrete a distance of more than five (5) feet or depositing a large quantity at any point and running or working it along the forms will not be permitted. The placing of concrete shall be so regulated that the pressures caused by wet concrete shall not exceed those used in the design of the forms.

F. High frequency internal vibrators of either the pneumatic, electrical, or hydraulic type shall be used for compacting concrete in all structures. The number of vibrators used shall be ample to consolidate the fresh concrete within 15-minutes of placing in the forms. In all cases, the CONTRACTOR shall provide at least two concrete vibrators for each individual placement operation (one may be a standby), which shall conform to the requirements of these Specifications. Prior to the placement of any concrete, the CONTRACTOR shall demonstrate that the two vibrators are in good working order and repair and ready for use.

G. The vibrators shall be an approved type, with a minimum frequency of 5,000 cycles per minute and shall be capable of visibly affecting a properly designed mixture with a one inch slump for a distance of at least 18-inches from the vibrator.

H. Vibrators shall not be held against forms or reinforcing steel nor shall they be used for flowing the concrete or spreading it into place. Vibrators shall be so manipulated as to produce concrete that is free of voids, is of proper texture on exposed faces, and of maximum consolidation. Vibrators shall not be held so long in one place as to result in segregation of concrete or formation of laitance on the surface.

I. Concrete shall be placed continuously throughout each section of the structure or between indicated joints. If, in any emergency, it is necessary to stop placing concrete before a section is completed, bulkheads shall be placed as the OWNER’s Representative may direct and the resulting joint shall be treated as a construction joint.

J. The presence of areas of excessive honeycomb may be considered sufficient cause for rejection of a structure. Upon written notice that a given structure has been rejected, the rejected WORK shall be removed and rebuilt, in part or wholly as specified, at the CONTRACTOR's expense.

3.02 PUMPING CONCRETE

A. Concrete may be placed by pumping if the CONTRACTOR demonstrates that the pumping equipment to be used will effectively handle the particular class of concrete with the slump and air content specified and that it is so arranged that no vibrations result that might damage freshly placed concrete. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced.

B. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned. Slump tests shall be taken at the discharge end of the pipe.

3.03 EXPANSION JOINTS

A. Expansion joints shall be located and formed as required on the Drawings.

B. Open Joints. Open joints shall be placed in the location shown on the Drawings and shall be formed. The form shall be removed without chipping or breaking the corners of the concrete. Reinforcement shall not extend across an open joint, unless so specified on the Drawings.

C. Filled Joints. Unless otherwise shown on the Drawings, expansion joints shall be constructed with pre-molded expansion joint filler with a thickness equal to the width of the joint.

D. The joint filler shall be cut to the same shape and size as the adjoining surfaces. It shall be fixed firmly against the surface of the concrete already in place in such manner that it will not be displaced when concrete is deposited against it.

E. Immediately after the forms are removed, the expansion joints shall be inspected carefully. Any concrete or mortar that has sealed across the joint shall be removed.

F. Joint sealer for use in deck joints shall be of the type shown on the Drawings conforming to the requirements of Article 2.04 (Joint Filler) of this Section. The faces of all joints to be sealed shall be free of foreign matter, paint, curing compound, oils, greases, dirt, free water, and laitance.

G. Elastomeric Compression Seals. The joint seal shall be shaped as shown on the Drawings. It shall be installed by suitable hand or machine tools and thoroughly secured in place with a lubricant-adhesive recommended by the seal manufacturer. The lubricant-adhesive shall cover both sides of the seal over the full area in contact with the sides of the joint.

H. The seal shall be in one piece for the full width of the joint. Any joints at curbs shall be sealed adequately with additional adhesive.

I. The seal may be installed immediately after the curing period of the concrete. Temperature limitations of the lubricant-adhesive as guaranteed by the manufacturer shall be observed.

J. Strip Seals. Expansion joint strip seals shall be as shown on the Drawings, and composed of a steel extrusion and an extruded strip seal. The steel shall conform to ASTM A242 or A588. Strip seals shall be one piece for the length of the joint.

K. Installation of the expansion joints shall be in accordance with the manufacturer's recommendations, except that the joint opening shall be adjusted for the dimensions indicated on the Drawings.

3.04 PIPES, CONDUITS, AND DUCTS

A. Pipes, conduits, and ducts that are to be encased in concrete shall be installed in the forms by the CONTRACTOR before the concrete is placed. Unless otherwise indicated, they shall be standard, lightweight cast-iron water pipe or wrought iron. They shall be held rigidly so they will not be displaced during concrete placement.

3.05 FINISHING CONCRETE SURFACES

A. All concrete surfaces exposed in the completed WORK shall receive an Ordinary Finish, as described below, unless otherwise noted on the Drawings or in the special provisions.

3.06 ORDINARY FINISH

A. An Ordinary Finish is defined as the finish left on a surface after the removal of the forms, the filling of all holes left by form ties, and the repairing of all defects. The surface shall be true and even, free from stone pockets and depressions or projections. All surfaces that cannot be satisfactorily repaired shall be given a Rubbed Finish.

B. The concrete in caps and tops of walls shall be struck off with a straightedge and floated to true grade. The use of mortar topping for concrete surfaces shall in no case be permitted.

C. As soon as the forms are removed, metal devices that have been used for holding the forms in place, and which pass through the body of the concrete, shall be removed or cut back at least one inch beneath the surface of the concrete. Fins of mortar and all irregularities caused by form joints shall be removed.

D. All small holes, depressions, and voids that show upon the removal of forms shall be filled with cement mortar mixed in the same proportions as that used in the body of the WORK. In patching larger holes and honeycombs, all coarse or broken material shall be chipped away until a dense uniform surface of concrete exposing solid coarse aggregate is obtained. Feathered edges shall be cut away to form faces perpendicular to the surface. All surfaces of the cavity shall be saturated thoroughly with water, after which a thin layer of neat cement mortar shall be applied. The cavity shall then be filled with stiff mortar composed of one part portland cement to two parts sand, which shall be thoroughly tamped into place. The mortar shall be pre-shrunk by mixing it approximately 20 minutes before using. The length of time may be varied in accordance with brand of cement used, temperature, humidity, and other local conditions. The surface of this mortar shall be floated with a wooden float before initial set takes place and shall be neat in appearance. The patch shall be kept wet for a period of five days.

E. For patching large or deep areas, coarse aggregate shall be added to the patching material. All mortar for patching on surfaces which will be exposed to view in the completed structure shall be color matched to the concrete. Test patches for color matching shall be conducted on concrete that will be hidden from view in the completed WORK and shall be subject to approval.

3.07 RUBBED FINISH

A. When forms can be removed while the concrete is still green, the surface shall be pointed and wetted and then rubbed with a wooden float until all irregularities and form marks are removed and the surface is covered with a lather composed of cement and water. This lather shall be allowed to set for at least five days. The surface shall then be smoothed by being rubbed lightly with a fine carborundum stone. If permitted, a thin grout composed of one part cement and one part fine sand may be used in the rubbing.

B. If the concrete has hardened before being rubbed, a medium coarse carborundum stone shall be used to finish the surface. Such WORK shall not be done until at least four days after placing and it shall be done in the following manner:

1. A thin grout composed of one part cement and one part fine sand shall be spread over a small area of the surface. It shall be rubbed immediately with the stone until all form marks and irregularities are removed and the surface is covered with a lather. The surface shall then be finished as described above for green concrete.

C. The surface shall be smooth in texture and uniform in appearance. The building up of depressions will not be permitted.

D. If, through the use of first-class form materials and the exercise of special care, concrete surfaces are obtained that are satisfactory, the CONTRACTOR may be relieved entirely or in part from the requirements for a rubbed finish.

3.08 CURING CONCRETE

A. Water Curing:

1. All concrete surfaces shall be kept wet for at least seven (7) days after placement if Type I or II cement has been used or for three days if Type III cement has been used. Concrete shall be covered with wet burlap, cotton mats, or other materials meeting the requirements of AASHTO M 171 immediately after final finishing of the surface. These materials shall remain in place for the full curing period or they may be removed when the concrete has hardened sufficiently to prevent marring. The surface shall immediately be covered with sand, earth, straw, or similar materials.

2. In either case the materials shall be kept thoroughly wet for the entire curing period. All other surfaces, if not protected by forms, shall be kept thoroughly wet, either by sprinkling or by the use of wet burlap, cotton mats, or other suitable fabric, until the end of the curing period. If wood forms are allowed to remain in place during the curing period, they shall be kept moist at all times to prevent opening at joints.

B. Membrane Curing. Liquid membrane curing compound meeting the requirements of AASHTO M 148, Type I, may be permitted, subject to approval by the OWNER's Representative. Compounds utilizing linseed oil shall not be used. All finishing of concrete surfaces shall be performed to the satisfaction of the OWNER's Representative prior to applying the impervious membrane-curing compound. The concrete surfaces must be kept wet with water continuously until the membrane has been applied. The manufacturer's instructions shall be carefully followed in applying the membrane. In all cases, the membrane-curing compound must always be thoroughly mixed immediately before application. If the membrane becomes marred, worn, or in any way damaged, it must immediately be repaired by wetting the damaged area thoroughly and applying a new coat of the impervious membrane-curing compound. Membrane curing will not be

permitted for concrete slabs that are to be covered with waterproof membranes, for polymer modified concrete or at construction joints.

3.09 BACKFILLING

A. Unbalanced backfilling against concrete structures will not be permitted until the concrete has attained a compressive strength of not less than 80% of the ultimate strength (f'_c) shown on the Drawings.

B. The compressive strength shall be determined from informational test cylinders cured on the site under similar conditions of temperature and moisture as the concrete in the structure.

3.10 CLEANING UP

A. Upon completion of the structure and before final acceptance, the CONTRACTOR shall remove all falsework. Falsework piling shall be removed or cut off at least two feet below the finished ground line.

END OF SECTION 321313

SECTION 323000 - FILTER CLOTH

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. The WORK under this Section includes providing all labor, material, tools, and equipment necessary for furnishing and installing filter cloth in accordance with the Drawings.

1.03 SUBMITTALS

A. Filter cloth material certification and manufacturer's product information.

PART 2 - PRODUCTS

2.01 CLOTH

A. Filter cloth shall be composed of plastic yarn fabricated into a pervious sheet with distinct pores or openings.

B. The plastic yarn shall consist of a long-chain synthetic polymer composed of at least 85% by weight of propylene, ethylene, or vinylidene-chloride and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure. The cloth shall be calendared or otherwise finished so that the yarns will retain their relative position with respect to each other. The edges of the cloth shall be selvedged or otherwise finished to prevent the outer yarn from pulling away from the cloth.

C. Type A filter cloth, woven or non-woven, shall meet the following requirements:

Grab Tensile Strength (ASTM D 1682)	90 lbs. min.
Bursting Strength (ASTM D 751)	100 psi min.
Equivalent Opening Size (EOS)	40 minimum, 100 maximum

D. Type B filter cloth, woven or non-woven, shall meet the following requirements:

Grab Tensile Strength (ASTM D 1682)	200 lbs. min.
Bursting Strength (ASTM D 751)	500 psi min.

E. Type C filter cloth, woven or non-woven, shall meet the following requirements:

Grab Tensile Strength (ASTM D 1682)	200 lbs. min.
Grab Tensile Elongation (ASTM D 1682)	30% maximum
Bursting Strength (ASTM D 751)	290 psi min.
Trapezoid Tear Strength (ASTM D 1117)	50 lbs. min.
Puncture Strength (ASTM D 751)*	75 lbs. min.
Water Permeability (AASHTO M 288)**	0.001 cm/sec. min.

*Using 5/16" flat-tipped pod
**5 cm. Constant head

2.02 SEAMS

A. Seams, when required, shall be sewn with thread of material meeting the chemical requirements given above for plastic yarn. The sheets for filter cloth shall be sewn together at the factory or another approved location to form sections not less than two feet wide. Seams shall be tested in accordance with ASTM D 1682, using one inch square jaws and 12-inches per minute constant rate of traverse. The strengths shall be not less than 90-pounds in any principal direction.

2.03 ACCEPTANCE REQUIREMENTS

A. All brands of plastic filter cloth and all seams to be used will be accepted on the basis of a certification. The CONTRACTOR shall furnish the OWNER's Representative a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the cloth. The mill certificate or affidavit shall attest that the cloth meets the chemical, physical, and manufacturing requirements stated in this Section.

2.04 SHIPMENT AND STORAGE

A. During all periods of shipment and storage, the cloth shall be protected from direct sunlight, ultraviolet rays, temperatures greater than 140º F, mud, dirt, dust, and debris. To the extent possible, the cloth shall be wrapped in a heavy-duty protective covering.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Filter cloth shall be placed in the manner and at the locations shown on the Drawings or as directed by the OWNER's Representative. At the time of installation, cloth shall be rejected if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

B. The surface upon which the filter cloth is to be placed shall be free of projections or depressions, and rocks, roots, and other sharp objects which may cause the filter cloth to be punctured. The filter cloth shall be placed without stretching and shall lie smoothly in contact with the soil or wall surface. When overlapping of strips is necessary, the joints shall be overlapped a minimum of two feet. End overlaps shall be made in the direction of flow.

C. The cloth shall be protected at all times during construction from contamination or from damage during its installation or during placement of subsequent covering; contaminated or damaged cloth shall be replaced at the CONTRACTOR's expense, or if the OWNER's Representative permits, torn fabric may be patched. The aggregate material shall be cleaned from the fabric, and the torn area shall be overlain with fabric with a minimum three foot overlap around the edges of the torn area. Care shall be taken that the patch remains in place when material is placed over the affected area.

D. The WORK shall be scheduled so that not more than 30-days elapse between the placement of the cloth and the time it is covered with specified material.

E. Type-A filter cloth shall be utilized in all installations except under riprap or gabions, or for subgrade reinforcement.

F. Type-B filter cloth shall be utilized under riprap or gabions.

G. Type-C filter cloth shall be utilized for subgrade reinforcement.

H. Following placement of the fabric on the prepared surface, material of the type shown on the Drawings shall be back-dumped on the previously spread fabric or ground adjacent to the fabric and carefully pushed or spread onto the fabric by a dozer or other machinery. A minimum depth of one foot, or the depth shown on the Drawings, shall be maintained at all times between the fabric and the wheels or tracks of the construction equipment. At no time shall equipment operate on the unprotected fabric. The material shall be spread in the direction of the fabric overlap. Special care shall be taken to maintain a proper overlap and fabric continuity.

END OF SECTION 323000

SECTION 329200 - SEEDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for preparing the ground and furnishing and applying seed, fertilizer, lime and mulch as called for in the contract, all in reasonably close conformity with these specifications and at locations shown on the Drawings or established by the OWNER's Representative.

B. It is the intent of these Specifications that a living vegetative cover will be provided in the areas indicated on the Drawings.

C. Seed mix for this Project shall be Deschampsia caespetosa 'Nortran' or 'Norcoast', 40 lbs./acre; Annual Rye, 15 lbs/acre; Lupinus nootkatensis (**not poly),** 5 lbs/acre; Fireweed (if available) pre-seed, 6 oz/acre.

PART 2 - PRODUCTS

2.01 SEED

A. Seed shall be furnished separately or in mixture in standard sealed containers clearly labeled with: Seed name; lot number; net weight; percentages of purity and of germination and hard seed; and, percentage of maximum weed seed content. The CONTRACTOR shall furnish the OWNER's Representative duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by an industry certified laboratory for seed testing within six months of date of delivery. This statement shall include: Name and address of laboratory; date of test; lot number for each kind of seed; and results of tests as to name, percentages of purity and germination, and percentage of weed content, for each kind of seed furnished, and, in the case of a mixture, the proportions of each kind of seed.

2.02 FERTILIZER

A. Fertilizer shall be a standard commercial grade fertilizer, supplied separately or in mixtures, and shall conform to all State and Federal regulations. Fertilizer shall be 16-16-16 applied at the rate of 150 pounds per acre. The fertilizer shall contain slow release nitrogen in the form of inorganic chemicals amounting to at least 75% of the available nitrogen specified.

B. Fertilizer shall be furnished in new, clean, sealed, moisture-proof, and properly labeled containers, clearly labeled with the name, weight, and guaranteed analysis of the contents.

C. Fertilizer for use in a hydraulic sprayer shall be soluble or ground to a fineness that will permit complete suspension of all insoluble particles in the water or slurry.

2.03 LIME

A. Lime shall be agricultural ground limestone containing not less than 85% dolomite, with 95% passing through a 100-mesh screen, delivered to the site in original unopened containers labeled to show analysis.

B. Limestone for use in a hydraulic sprayer shall be soluble or ground to a fineness that will permit complete suspension of all insoluble particles in the water or slurry.

2.04 MULCH

A. Mulch shall be natural or cooked wood cellulose fiber which shall have the property of dispersing readily in water and shall have no toxic effect when combined with seed or other materials. The homogeneous slurry or mixture shall be capable of application with power spray equipment. A colored dye which is noninjurious to plant growth may be used when specified. Wood cellulose fiber shall be packaged in new, labeled containers, shall have an equilibrium air-dried moisture content of 12% plus or minus 3% at the time of manufacture, and shall have a pH range of 3.5 to 5.0.

PART 3 - EXECUTION

3.01 SOIL PREPARATION

A. After grading, and topsoiling, if required, has been completed in conformity with the lines and grades shown on the Drawings or staked by the OWNER's Representative, and before beginning seeding operations, the areas to be seeded shall be cultivated to provide a reasonably firm, but friable seedbed. Cultivation shall be carried to a depth of two inches, except on slopes steeper than 3:1, depth of cultivation may be reduced as directed by the OWNER's Representative. All cultivated areas shall be raked or cleared of stones two inches in diameter and larger and all weeds, plant growth, sticks, stumps, and other debris or irregularities which might interfere with the seeding operation, growth of grass, or subsequent maintenance of the grass covered areas, shall be removed.

3.02 SEEDING SEASONS

A. All seeding shall be completed after May 1 and prior to August 15th, or the contract deadline, whichever is sooner. Seeding other than the specified dates will be allowed only with prior written permission of the OWNER's Representative and will be at the CONTRACTOR's own risk.

B. No seeding shall be done during windy conditions or when climactic conditions or ground conditions would hinder placement or proper growth.

3.03 APPLICATION METHODS

A. Seed, fertilizer, ground limestone and mulch material shall be placed by one of the following methods.

B. Hydraulic Method

1. Seeding by hydraulic methods shall consist of furnishing a slurry made of seed, fertilizer, ground limestone, wood cellulose fiber mulch, and water, and applying the slurry under pressure to the designated area.
2. A slurry unit shall consist of a mixture of the following proportionate quantities of water, mulch fiber, seed, fertilizer and ground limestone:

Water	1,000 gallons
Mulch Fiber	200 pounds
Seed	35 pounds
Fertilizer	120 pounds
Ground Limestone	500 pounds

3. An adequate scale shall be provided by the CONTRACTOR to weigh the mix proportions.
4. The mixing and application shall be as follows:

    a. Fill the tank with water to 1/3 full and agitate at half speed.
    b. Add fertilizer, ground limestone if required, and 1/2 the required mulch fiber.
    c. Fill the tank to 2/3 full and agitate at full speed.
    d. Add the remaining mulch fiber.
    e. Agitate at full speed and add water until the tank is full, then add the seed.
    f. Begin slurry distribution after five minutes of agitation.

5. After fertilizer and seed are placed in the hydraulic seeder, the mixture shall be completely applied within one hour. Seed remaining in contact with fertilizer for more than one hour shall be rejected and additional seed at the specified rate shall be added at no additional cost.
6. The slurry mixture shall be spread uniformly (approximately one slurry unit per 10,000 square feet) upon the areas designated.
7. Hydraulic seeding equipment shall be capable of maintaining a continuous agitation so that a homogeneous mixture can be applied through a spray nozzle. The pump shall be capable of producing sufficient pressure to maintain a continuous, non-fluctuating spray capable of reaching the extremities of the seeding area with the pump unit located on the roadbed. Sufficient hose shall be provided to reach areas not practical to seed from the nozzle unit situated on the roadbed.

C. Dry Method

1. Mechanical spreaders, seed drills, landscape seeders, cultipacker seeders, fertilizer spreaders, or other mechanical spreading equipment approved by the OWNER's Representative may be used when seed and fertilizer are to be applied in dry form.
2. Fertilizer, and ground limestone if required, shall be spread separately at the specified rates and then incorporated in one operation to a minimum depth of two inches. Weather and soil conditions permitting, seeded areas shall be compacted, within twenty-four hours from the time the seeding is completed, by cultipacker, roller, or other equipment approved by the OWNER's Representative.
3. Compacting equipment shall be operated at right angles to the slope. Compaction shall not be performed when the soil is in such condition that it will be picked up by the compacting equipment, nor shall heavy soils be compacted at all if so directed by the OWNER's Representative.
4. Hand operated seeding devices may be substituted provided that the rate of application for both seed and nutrient is twice that of dry mechanical method and that the end result required is attained. Hand-operated seeding devices may be used only upon prior written approval of the OWNER's Representative.

3.04 MAINTENANCE OF SEEDED AREAS

A. The CONTRACTOR shall protect seeded areas against traffic by warning signs or barricades, as approved by the OWNER's Representative. Surfaces gullied or otherwise damaged following seeding shall be repaired by re-grading, re-seeding, and re-mulching, as directed by the OWNER's Representative, and the CONTRACTOR shall otherwise maintain seeded areas in a satisfactory condition until final inspection and acceptance of the WORK.

B. The seeded areas shall be watered by the CONTRACTOR as required for proper germination and growth. Equipment used in watering shall be capable of reaching all seeded areas from the traveled way.

3.05 INSPECTION AND ACCEPTANCE

A. Acceptance of seeded areas shall be based on a uniform stand of vegetation at the time of final inspection. Areas failing to show a uniform stand after germination shall be scarified and reseeded as herein specified.

END OF SECTION 329200

SECTION 329400 - TOPSOIL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and placing topsoil at the locations shown on the Drawings.

1.02 SUBMITTALS

A. Topsoil source including current year laboratory test results for gradation, organic content and pH content.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Topsoil furnished by the CONTRACTOR shall consist of a natural friable surface soil without admixtures of undesirable subsoil, refuse, or foreign materials. It shall be reasonably free from roots, hard clay, coarse gravel, stones larger than two inches in any dimension, noxious weeds, tall grass, brush, sticks, stubble or other material which would be detrimental to the proper development of vegetative growth.

1. Topsoil Source: Obtain topsoil from naturally well drained sites where topsoil occurs at least 4-inches deep. Topsoil shall not be obtained from bogs or marshes.

B. Topsoil shall conform to the following grading:

SIEVE SIZE	PERCENTAGE PASSING
1-inch	100%
½ inch	95% - 100%
No. 4	75% - 100%
No. 10	60% - 100%
No. 200	10% - 60%

C. Topsoil shall contain not less than 3%, nor more than 20% organic matter, by weight.

D. The OWNER's Representative shall be notified of the location from which the CONTRACTOR proposes to furnish topsoil at least thirty calendar days prior to delivery of topsoil to the project from that location. The topsoil and its source will be inspected and tested by the OWNER's Representative before approval will be granted for its use.

E. Topsoil sources lacking organic matter may be used if, prior to delivery to the Project, sufficient organic matter in the form of pulverized peat moss or rich organic soil from other sources is thoroughly mixed with the topsoil to provide a product meeting the above requirements.

F. Organic material for incorporation into topsoil, if required, shall be partially decomposed fibrous or cellular stems and leaves of any of several species of Sphagnum mosses, or rotted manure. Organic material may require chopping or shredding to insure thorough mixing with the topsoil.

G. All topsoil shall be fertilized as follows:

1. The application rates of the fertilizer and limestone per 1,000 square feet of ground area of topsoil furnished by the CONTRACTOR shall be determined by the OWNER's Representative, based on soil analysis tests so that the total natural and applied chemical constituents are as follows:

Nitrogen	1.0 lb. minimum - 1.5 lb. maximum per 1,000 square feet
Phosphoric Acid	1.0 lb. minimum - 2.0 lb. maximum per 1,000 square feet
Potassium	1.0 lb. minimum - 2.0 lb. maximum per 1,000 square feet
Limestone	Limestone requirements shall conform to the Table below.

LIMESTONE REQUIREMENTS

Soil pH	Limestone Tons per Acre
Above 6.0	0
5.0 - 6.0	1.5
Below 5.0	3.0

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. The topsoil shall be evenly spread on the designated areas to a depth which, after settlement and compaction, shall be 4-inches, unless otherwise directed by the OWNER's Representative. Spreading shall not be done when the ground or topsoil is frozen, excessively wet, or otherwise in a condition detrimental to the WORK, as determined by the OWNER's Representative. Roadway surfaces shall be kept clean during hauling and spreading operations.

B. After spreading has been completed, large clods, stones larger than one inch in any dimension, roots, stumps, and other litter shall be raked up and removed.

C. All areas beyond the construction limits that are disturbed during construction which are not covered with pavement, concrete, or base course, shall be graded to a neat, uniform grade line and appearance, as determined by the OWNER's Representative, and covered with a neat uniform layer, 4-inch minimum thickness of topsoil and hydroseeded.

D. The final grading of the topsoil prior to hydroseeding shall be to a tolerance that will not permit ponding of water in excess of one inch in depth.

E. No topsoil shall be placed more than 30 days prior to seeding.

END OF SECTION 329400

SECTION 331116 - WATER PIPE

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing buried water pipe and fittings, connecting to existing ductile iron arctic water pipe, thrust blocks, tie rods, electrical continuity, disinfection and testing. The CONTRACTOR shall install the water pipe and fittings to the horizontal and vertical alignment shown on the Drawings and shall complete all associated WORK described in this Section.

1.03 SUBMITTALS

A. HDPE Water Pipe, Fittings, Joints and Bends: Material certifications stating conformance with requirements of this section.

PART 2 – PRODUCTS

2.01 PIPE

A. High-Density Polyethylene (HDPE) pipe shall be produced with approved bimodal PE 3408 / PE 100 / PE 4710 listed resins. The resin shall be DOW Continuum DGDC 2480K, High Density Polyethylene – PE 100 / PE 4710, or approved equal. The pipe shall have a minimum pressure rating of 160 pounds per square inch, and a standard dimension ratio (SDR) of 11. All HDPE water pipe shall have a standard iron pipe size (IPS) outside diameter.

1. The pipe and fitting material shall have a cell classification of 445574 in accordance with ASTM D3350.
2. Compounds shall have a PPI recommended Design Basis (HDB) of 1,600 psi at 68˚F (20˚C). Compounds shall have a PI recommended HDB of 1,000 psi at 176˚F (80˚C).
3. Slow Crack Growth Resistance shall be measured in accordance with ASTM F1473 (PENT). The minimum required time to failure shall be 4,000 hours.
4. HDPE pipe shall comply with AWWA Specifications C906.
5. The material shall be listed by the N.S.F. for potable water service.
6. In-plant blending shall not be allowed.
7. Butt fusion of the pipe and fittings shall be performed in accordance with the manufacturer’s recommendations as to the equipment and technique. The fusion operation shall be performed by an individual who has demonstrated the ability to fuse polyethylene pipe in a manner recommended by the pipe supplier. The individual performing the fusing procedure must hold a current certification for fusing HDPE as stated in Title 49.1 DOT Certification.
8. Install tracer wire on top of all HDPE water mains in accordance with the manufacturer’s recommendations. Tracer wire shall be suitable for direct bury applications and shall be 10 AWG with 30-mil HDPE jacket (jacket color blue),

capable of a 575 pound average tensile break load. Tracer wire shall be Copperhead Industries Reinforced Tracer Wire. Tracer wire shall be installed in continuous lengths with no splices. Terminate each end of tracer wire at ground surface in a valve box top section with cap. Provide a minimum of five (5) feet of additional wire neatly coiled within valve box at each end. Splices may be allowed at the direction of the OWNER's Representative. If a splice is allowed, use Copperhead Industries Connector, Part #3WB-01 (blue).

2.02 JOINTS

A. Unless otherwise shown on the Drawings, or as specified below, pipe joints shall be push-on rubber gasket type conforming to the requirements of AWWA C111.

B. Restrained joint water pipe shall be U.S. Pipe TR FLEX, U.S. Pipe field Loc Gasket, EBBA IRON "Mega-lug System," Griffin Snap Lock, Pacific State Lock Mechanical type, or approved equal. Restrained push-on joints for pipe shall be designed for a water working pressure of 250 psi and shall be capable of being deflected a minimum of 3° per joint, for pipe sizes through 18-inches, after assembly.

2.03 FITTINGS

A. Fittings for all water pipe and restrained joint water pipe shall be U.S. Pipe TR FLEX, push-on gasket fittings compatible with U.S. Pipe Field Loc Gasket, mechanical joint fittings with EBBA IRON "Mega-lug System" Griffin Snap Lock, Pacific State Lock Mechanical Type, or approved equal.

B. For connecting to existing water mains, the CONTRACTOR shall use a mechanical joint tee and a mechanical joint cutting-in-sleeve similar to Clow F-1220 or Mueller H-843, or a cast iron coupling similar to Rockwell 431, or approved equal. The length of all sleeves and couplings shall equal or exceed the diameter of the pipe.

C. All valve clusters consisting of a tee and one or more valves, including fire hydrant legs, shall be monolithically restrained with EBBA Iron "Mega-lug System," or approved equal.

D. All HDPE molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the OWNER's Representative.

E. The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the WORK as shown on the Drawings, in these Specifications, or as directed by the OWNER's Representative.

F. All HDPE fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the OWNER's Representative. No size on size wet taps shall be permitted.

G. All transitions from HDPE pipe to ductile iron shall be made per the HDPE pipe manufacturer's recommendations and specifications and approval of the OWNER's Representative.

1. Transition from HDPE to ductile iron fittings and valves shall be approved by the OWNER's Representative before installation.
2. No solid sleeves shall be allowed between such material transitions.
3. Fittings and transitions shall be as manufactured by Phillips Driscopipe, Inc., 1000 Series Pressure Pipe, Chevron Chemical Compnay Plexco/Spiralite Pipe, or equal.
4. The pipe supplier must certify compliance with the above requirements.

2.04 THAW WIRE

A. Thaw wire and continuity straps shall be No. 2 copper wire, stranded, with THW insulation or equal. Exothermic welding to attach continuity straps on DIP and fittings shall be "Cadweld" or approved equal and coated with bituminous coating.

2.05 UNDERGROUND MARKING TAPE

A. Underground marking tape shall be blue, six inch wide, four mil thick, polyethylene tape with black lettering with the following wording: "Caution: Waterline Buried Below." Marking tape shall be installed 12-inches above the top of all water pipe.

2.06 STEEL STRAPS

A. Steel straps shall be stainless steel with minimum cross sectional area of at least 1/2 square inch per 4 cubic yards of concrete. Straps shall be located symmetrically around the perimeter of the pipe.

2.07 CONCRETE

A. Concrete for thrust blocks shall conform to Section 321313 – Site Concrete.

PART 3 – EXECUTION

3.01 GENERAL

A. The CONTRACTOR shall preserve and protect all existing utilities and other facilities including but not limited to: telephone, television, electrical, water and sewer utilities, surface or storm drainage and survey monuments. The CONTRACTOR shall immediately repair or replace utilities or other facilities damaged during construction. The CONTRACTOR shall support and protect any underground utility conduits, pipes, or service lines where they cross the trench.

B. The CONTRACTOR shall give at least 24-hour notice to the Eaglecrest Maintenance Personnel prior to:

1. needing water or sewer main line locates;
2. interruption of water service in any area; or

3. use of water from any fire hydrant

Any water service disruption shall be restored as soon as possible. The CONTRACTOR shall comply with the current policy on "Water and Sewer Line Locates" of the CBJ Public Works Department, Water and Wastewater Utilities Divisions.

3.02 INSTALLATION

A. Water pipe shall be installed in accordance with the manufacturer's printed specifications and instructions, and in conformance with AWWA C151.

B. The water pipe shall be handled carefully to prevent damage to the pipe, pipe lining, or coating. Water pipe and fittings shall be loaded and unloaded using hoists and slings to avoid shock or damage, and under no circumstances shall they be dropped, skidded, or rolled. If any part of the coating or lining is damaged, repair thereof shall be made in a manner satisfactory to the OWNER's Representative at the CONTRACTOR's expense.

C. All water pipe and fittings shall be inspected for defects. Damaged pipe will be rejected and the CONTRACTOR shall immediately place all damaged pipe apart from the undamaged and shall remove the damaged pipe from the site within 24-hours.

D. Whenever it becomes necessary to cut a length of water pipe, the cut shall be made by abrasive saw or by special pipe cutter.

E. All pipe ends shall be square with the longitudinal axis of the water pipe and shall be reamed and smoothed to ensure a good connection.

F. The water pipe shall be laid to the horizontal and vertical alignment shown on the Drawings. A minimum six foot cover shall be maintained from finish grade to top of water pipe, unless otherwise shown on the Drawings. Fittings shall be installed at the location shown on the Drawings.

G. To prevent dirt and other foreign material from entering the pipe and fittings during handling and installation, the open end of the pipe shall be protected by a water-tight plug at all times except when joining the next section of pipe.

H. Under no circumstances shall pipe deflections, either horizontal or vertical, exceed the manufacturer's printed recommendations. Where deflections would exceed the manufacturer's recommendations, fittings shall be used.

I. Vertical deflections to avoid obstructions that exceed allowable water pipe joint deflections shall be accomplished by the use of fittings and either joint restraints or vertical thrust blocking conforming to the Drawings. Additional fittings to those indicated on the Drawings will be required to accomplish these vertical deflections.

J. Concrete thrust blocks shall be furnished and installed in accordance with the Drawings.

K. Pressurized water pipe ends shall be plugged and thrust blocks installed. Volume and bearing area of thrust blocks for end plugs shall be equal to applicable standards for bends greater than 45°.

L. Existing water pipes and appurtenances to be removed or abandoned shall be as designated on the Drawings or directed by the OWNER's Representative. Abandoned water services shall be plugged at the cut ends. Abandoned water pipes shall be removed as shown on the Drawings, or mechanically plugged if not required to be removed.

M. All pipe fittings shall be restrained with EBBA Iron "Megalug System," or approved equal.

N. All joints within 50-feet of tees or bends equal to or greater than 45° shall be restrained joints.

O. Continuous water services shall be provided for all structures, except for interruptions necessary for connection of temporary or new piping to the existing service or mainline piping.

P. The CONTRACTOR is responsible for maintaining continuous water service at volume and pressure to match existing to all structures with existing, temporary or new piping, except as provided in this Section.

Q. HDPE pipe shall be joined in continuous lengths on the jobsite above ground. The joining method shall be the butt fusion method and shall be performed in strict accordance with the manufacturer's recommendations.

1. Flange and mechanical joint adapters shall be attached to the HDPE pipe and fittings using butt fusion. Align and center the flange or mechanical joint adapter relative to the pipe. Flanges and mechanical joint adapters shall be square with the receiving valve or other flange before tightening of bolts. Bolts shall not be used to draw the flanges into alignment. Bolt threads shall be lubricated and flat washers shall be used under flange nuts. Bolts shall be tightened in accordance with the manufacturer's recommendations. All bolts and associated hardware shall be stainless steel. The tightening torque shall be as indicated by the manufacturer. Gasket material shall conform to NSF 61.

2. Install tracer wire per manufacturer's recommendations. Tracer wire shall be installed in continuous lengths with no splices. Terminate each end of tracer wire at a valve box, or furnish and install a valve box top section and cap for termination. Terminate tracer wire at ground surface and provide a minimum of five (5) feet of additional wire neatly coiled within valve box. The trace wire shall be tested for continuity following all trench backfilling operations.

3.03 FLUSHING, TESTING AND DISINFECTION

A. Prior to acceptance, the CONTRACTOR shall "Open-Bore" flush the water pipe then perform hydrostatic tests, electrical continuity tests, and disinfection and coliform tests. Testing may be done in any sequence. However, in the event the disinfection, coliform and continuity tests have been performed and repairs are made to the water pipe system in order to pass the hydrostatic test, all previous tests and the "Open-Bore" flushing shall be repeated to the satisfaction of the OWNER's Representative.

3.04 OPEN-BORE FLUSHING

A. Open bore flushing is required of all installed water pipes to remove any foreign matter. The CONTRACTOR shall furnish, install and remove all pumps, fittings and pipes necessary to perform the flushing; shall provide all additional excavation and backfill;

and shall dispose of all water and debris flushed from the water pipe. Flushing through fire hydrants, reduced outlets or fittings shall not be permitted unless specifically authorized in writing by the OWNER's Representative. The CONTRACTOR shall notify the OWNER's Representative, in writing, 48-hours in advance of any flushing operation. A flushing scheme and schedule shall be submitted by the CONTRACTOR for review and approval by the OWNER's Representative prior to flushing. The schedule for flushing must be approved by Eaglecrest Maintenance Personnel. The CONTRACTOR shall be responsible for obtaining any permits necessary for flushing operations.

3.05 HYDROSTATIC TESTING

A. Hydrostatic testing will be conducted in the presence of the OWNER's Representative on newly installed water pipes after "Open-Bore" flushing, in accordance with the requirements of AWWA C600 and as stated hereafter. The CONTRACTOR shall furnish all assistance, equipment, labor, materials, and supplies necessary to complete the test to the satisfaction of the OWNER's Representative. The CONTRACTOR shall suitably valve-off or plug the outlet to existing or previously-tested water pipe prior to performing the required hydrostatic test. Prior to testing, all air shall be expelled from the water pipe. If permanent air vents are not available to accommodate testing, the CONTRACTOR shall install corporation stops and blow-off lines so the air can be expelled as the line is filled with water.

B. Pressure Testing

1. The hydrostatic pressure for main line pipe shall be a minimum of 150 psi or 1½ times the operating pressure of the water pipe (measured at the highest elevation of the newly-installed water pipe), whichever is greater, unless otherwise directed by the OWNER's Representative. Acceptance pressure testing shall be done with all service lines installed, corporation stops open, and pressure against the closed curb stops. The duration of each hydrostatic pressure test on main line pipe shall be one hour. Pumping will cease after the required test pressure has been reached. If the pressure remains constant for one hour without additional pumping, or pressure drop is less than five psi, that section of water pipe is acceptable.
2. The hydrostatic pressure for fire line testing shall be a minimum of 200 psi for two (2) hours as defined by National Fire Protection Association (NFPA) 24. Acceptance pressure testing shall be done with all service lines installed, corporation stops open, and pressure against the closed curb stops. Pumping will cease after the required test pressure has been reached. If the pressure remains constant for two hours without additional pumping, or pressure drop is less than five psi, that section of water pipe is acceptable.

C. If the pressure drops five (5) psi or more during the initial one hour hydrostatic pressure test, the CONTRACTOR shall conduct a leakage test. Leakage shall be determined by measuring "make-up" water necessary to restore the specified test pressure. The quantity of water lost from the water pipe shall not exceed the number of gallons per hour as determined by the following formula:

$$L = \frac{ND(P)^{0.5}}{7400}$$

L = Allowable leakage in gallons per hour
N = Summation of mechanical and push-on joints in length of water pipe tested
D = Diameter of water pipe in inches
P = Test pressure in pounds per square inch

D. Should the tested section fail to meet the pressure test as specified, the CONTRACTOR shall locate and repair the defects and then retest the water pipe as specified above. Any specific leakage point detected shall be corrected by the CONTRACTOR to the satisfaction of the OWNER's Representative regardless of the allowable leakage specified above.

E. All tests shall be made with the auxiliary gate valves open and pressure against the hydrant. After the hydrostatic test has been successfully completed, each valve shall be tested by closing in turn and relieving the pressure beyond. This test of the valves will be acceptable if there is no immediate loss of pressure on the gauge when the pressure comes against the valve being checked. The CONTRACTOR shall verify that the pressure differential across the valve does not exceed the rated working pressure of the valve.

F. Sections to be tested shall be limited to 1,500 feet, unless otherwise approved in writing by the OWNER's Representative.

G. Defective materials or poor quality of WORK, discovered as a result of the hydrostatic tests, shall be replaced by the CONTRACTOR. Whenever it is necessary to replace defective material or correct the workmanship, the hydrostatic test shall be repeated until a satisfactory test is obtained.

H. The OWNER's Representative shall be present for all hydrostatic and leakage tests. The CONTRACTOR shall notify the OWNER's Representative at least 24 hours prior to any test and shall notify the OWNER's Representative at least two hours in advance of the scheduled time if the test is to be cancelled or postponed.

I. After completion of testing, all test and air vent pipe shall be removed and the corporation stop closed at the water pipe, in the presence of the OWNER's Representative.

J. HDPE pipe testing procedures shall conform to ASTM F2164-10. The hydrostatic pressure shall be a minimum of 150 psi or 150 percent of the operating pressure of the water pipe, whichever is greater, unless otherwise directed by the OWNER's Representative. Acceptance pressure testing shall be done with all service lines installed, corporation stops open and pressure against the closed curb stops.

1. Check for leaks or significant pressure drops. Correct all leaks and significant pressure drops that require more makeup water than allowable and retest pipe.

3.06 ELECTRICAL CONTINUITY

A Electrical continuity is required for six inch or smaller water pipe and fire hydrant assemblies, and shall be provided by two electrical continuity straps installed on each

side of the water pipe joint or fittings. Electrical continuity tests will be performed by the CBJ Water Utility Division staff with a "Hovey" water pipe thawing machine, unless scheduling conflicts or mechanical problems with the thawing machine prevent the CBJ Water Utility Division staff from performing the testing within the time period required by the CONTRACTOR. In those cases that the CBJ Water Utility Division staff is unable to conduct the testing, the CONTRACTOR shall conduct the testing with its own personnel and equipment. The testing shall be performed in a manner that is approved by the OWNER's Representative. All resilient gate valves 6 inch and smaller are required to have a thaw wire either bolted or cad welded to the valve body, and raised through the inside of the of the valve box, therefore making it available for both continuity testing and thawing. An additional thaw wire will still need to be attached to the main and coiled around the outside of the box according to current CBJ Standards.

If the initial testing of an installation fails (the continuity testing will be conducted by the CBJ), the additional testing required shall be at the CONTRACTOR's expense. The CBJ Water Utility Division staff will maintain a circuit of 300 amps DC current for a period of 90 seconds. Current loss, through the test circuit, shall not exceed 10%. Continuity test sections shall not exceed 500 lineal feet. All test leads brought up to the surface shall be removed to a depth of two feet below finish grade upon completion of the tests.

3.07 DISINFECTION

A. Disinfection by chlorination of all new water pipe shall be completed and a satisfactory bacteriological report obtained prior to placing the pipe in service. "Open-bore" flushing shall be completed before chlorination is begun.

B. Chlorine shall be applied by one of the following methods:

1. liquid chlorine gas-water mixture;
2. direct chlorine gas feed; or
3. hypochlorite commercial products such as HTH, Perchloren, Macho-chlor, or approved equal.

The chlorinating agent shall be applied at the beginning of the section adjacent to the feeder connection, insuring treatment of the entire water pipe. Water shall be fed slowly into the new water pipe with chlorine applied in amounts to produce a dosage of 50 ppm. Application of the chlorine solution shall continue until the required residual of not less than 50 ppm free chlorine is evident at all extremities of the newly constructed line.

C. The chlorine gas-water mixture shall be applied by means of a solution-feed chlorinating device. Chlorine gas shall be fed directly from a chlorine cylinder equipped with a suitable device for regulating the rate of flow and the effective diffusion of gas within the water pipe. Hypochlorite products shall be placed or injected into the water pipe. During the chlorination process, all intermediate valves and accessories shall be operated. Valves shall be manipulated so that the strong chlorine solution in the water pipe being treated will not flow back into the pipe supplying the water.

D. The following table is to be used as a guide for chlorinating pipes by the calcium hypochlorite and water mixture method. The given dosage per 100 feet results in a chlorine solution of 40 to 50 ppm. This dosage takes into account that CONTRACTOR's

most frequently use granular HTH, which is 65% pure. If another chlorinating agent is used, the dosage must be adjusted.

PIPE DIAMETER	DOSAGE PER 100 FEET
6”	1.35 oz.

E. A residual of not less than 50 ppm free chlorine shall be produced in all parts of the water pipe. After 24-hours detention there shall be a minimum free chlorine residual of 25 ppm in all parts of the water pipe. This residual shall then be neutralized in the pipe by injecting an approved reducing agent such as sulfur dioxide, sodium bisulfate, sodium sulfite or sodium thiosulfate.

F. After the water pipe system has been thoroughly flushed, samples will be taken at representative locations in the system by the OWNER’s Representative, placed in sterile bottles, and submitted to an approved laboratory for bacteriological examination. The presence of bacteria in any sample shall be verified with a second sample at the same location. If verified, the pipe disinfection procedure shall be repeated and additional samples taken for bacteriological examination. Pipe disinfection shall be repeated, at the CONTRACTOR’s expense, until satisfactory results are obtained. The first testing sequence will be paid for by the OWNER. Any further testing and sampling required due to insufficient disinfection (positive coliform tests) will be paid for by the CONTRACTOR.

G. The water shall be flushed from the water pipe at its extremities, including all curb stops, until the replacement water chlorine residuals are equal to those of the permanent source of supply. The de-chlorinated water and water used for flushing shall be disposed of in a manner approved by the OWNER’s Representative and in conformance with current requirements of the Alaska Department of Fish and Game and the Alaska Department of Environmental Conservation.

END OF SECTION 331116

SECTION 331117 - PIPE INSULATION

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing pipe insulation for water pipe and service pipe at locations shown on the Drawings and as directed by the OWNER's Representative.

PART 2 – PRODUCTS

2.01 RIGID INSULATION

A. Rigid insulation shall be rigid board closed cell poly-Styrofoam material containing a flame retardant additive specifically designed for underground pipe or pavement installations, equivalent to Dow Chemical Company Styrofoam HI, and approved by the OWNER's Representative.

2.02 SPRAYED-ON INSULATION

A. Sprayed-on urethane foam insulation applied directly to the pipe exterior with an elastomeric coating, may be approved by the OWNER's Representative, provided the material has demonstrated a satisfactory performance history in underground installation and has the following physical properties:

Density	2 pcf, Minimum
Compressive Strength (ASTM D 1621)	35 psi, Minimum at 5% Deflective or Yield
Water Absorption (ASTM C 177)	0.25% by Vol. Maximum
Thermal Conductivity (ASTM C 177)	$\frac{\text{Max. 0.23 BTU}}{\text{Hr.Ft.}^2\text{ EF.In. Thickness}}$

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. When water pipes or service pipes have less than 5-feet of cover to finished grade or vertical clearance at a storm drain culvert crossing, either above or below, they shall be insulated as shown on the Drawings.

B. Rigid insulation shall be installed as shown in the Drawings or as directed by the OWNER's Representative. Insulation shall be placed between 6 and 12-inches from the

water pipe or service pipe with the width centered on the longitudinal axis of the water pipe or service pipe as shown on the Drawings.

C. Sprayed-on urethane foam insulation shall be a minimum of 4-inches thick and be installed in strict conformance to the manufacturer's recommendations. Precautions to protect CONTRACTOR personnel, Project inspectors, and the public in general shall be taken by the CONTRACTOR in compliance with OSHA Standards and the manufacturer's recommendations.

END OF SECTION 331117

SECTION 333113 - SANITARY SEWER PIPE

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing sanitary sewer pipe, in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Drawings.

B. This WORK includes furnishings and installing connecting bands, branch connections, elbows or other fittings, and all appurtenances required to complete the sanitary sewer and connect to existing sanitary sewer pipe.

1.03 SUBMITTALS

A. Sanitary Sewer Pipe: Material certifications stating conformance with the requirements of this Section.

PART 2 - PRODUCTS

2.01 PVC SEWER PIPE

A. PVC Sewer Pipe, 4-inch through 15-inch in diameter, inclusive, shall have a standard dimension ratio (SDR) of 35, and conform to ASTM D 3034. Before any PVC pipe is used on this Project, the CONTRACTOR shall supply certifications, signed by an authorized agent of the seller or manufacturer, stating that the material has been sampled, tested, and inspected in accordance with ASTM D 3034.

B. PVC Sewer Pipe greater than 15-inch in diameter shall conform to ASTM F 679. Before any PVC pipe is used, the CONTRACTOR shall supply certifications, signed by an authorized agent of the seller or manufacturer, stating that the material has been sampled, tested, and inspected in accordance with ASTM F 679.

C. The pipe shall have integral wall bell and spigot joints conforming to ASTM D 3212. The bell shall consist of an integral wall section with a solid cross-section elastomeric ring, factory assembled, securely locked in place to prevent displacement.

D. Flexible water-tight connections, approved by the OWNER’s Representative, shall be used at PVC pipe connections to manholes and other rigid structures.

2.02 UNDERGROUND MARKING TAPE

A. Underground marking tape shall be green, at least 4-inches wide, four mil thick, polyethylene tape, with a metallic backing capable of being traced with locators. The tape shall have black letters with the following wording: "Caution: Sewer Line Buried

Below." The marking tape shall be installed 12-inches above the top of all sewer mains and services.

PART 3 - EXECUTION

3.01 CONSTRUCTION

A. Excavation, bedding, and backfill shall conform to the requirements of Section 312002 - Trenching. Underground marking tape shall be installed as shown on the Drawings.

B. Sheeting and bracing required for trenches shall be removed to the elevation of the conduit, but no sheeting will be allowed to be pulled, removed, or disturbed below the conduit. Sheeting and bracing shall meet OSHA requirements.

C. Before lowering into the trench, the pipe shall be inspected for defects. All cracked, chipped, or broken pipe shall be discarded. The ends and interior of the pipe shall be clean. Belled ends shall be laid upgrade. Handling of the pipe shall be accomplished in a manner that will not damage the pipe. The joint shall be made in the manner recommended by the manufacturer. Care shall be taken not to buckle or disturb previously laid pipe.

D. Pipe shall be laid accurately to the staked line and grade as indicated on the Drawings.

E. Pipe shall be cleaned of all foreign matter, and water shall be kept out of trenches until joints have been completed. When WORK is not in progress, open ends of pipe and fittings shall be securely closed to keep foreign matter and animals from entering.

F. Each joint shall be inspected to ensure that it is properly made before backfilling is done. Care shall be taken to prevent any dirt or foreign matter from entering the open end of the pipe. Where it is necessary to cut pipe, such cuts shall be neatly made in an approved manner. The laid pipe shall be true to line and grade and, when completed, the sewer shall have a smooth and uniform invert. No section of gravity sewer, including service connections, shall have an adverse grade which would pond water in the invert of the sewer.

G. Connections to pipe stubs of a different pipe material shall be made with DFW/HPI non-shear-type connector, as shown in CBJ Standard Detail 218 - Coupling for Dissimilar Sanitary Sewer Pipes. Connectors must be approved by the OWNER’s Representative prior to installation.

H. Connections to existing sewer mains and manholes shall be made in such a manner so as to not damage the existing facility. Such connections shall be made so that no projections or rough surfaces occur within the pipe.

I. All Sanitary Sewer Cleanouts shall be provided with a cast iron ring and cover which shall be locking-type Olympic Foundry No. M-1025, or approved equal as shown in the Drawings. The cover shall be clearly marked with the word "SEWER" cast into it.

J. Where gravity flow sanitary sewers cross above or less than 18-inches below waterlines, or approximately parallel water lines within 10-feet horizontally, the sewer pipe shall

meet the requirements of ductile iron pipe or PVC pressure pipe, as described in Part 2 of this Section.

3.02 TESTING

A. Prior to testing, the sewer shall be complete, trenches shall be fully backfilled and compacted to finish grade, or, if the sewer is under pavement, finish pavement subgrade.

B. For WORK involving placement of new sanitary sewer collection systems, all sections of pipe shall be tested for leakage using the Exfiltration Test for either air or water as specified hereafter; or, at the sole direction of the OWNER's Representative, when the normal water table is above the sewer throughout the section under test, the OWNER's Representative may permit use of the Infiltration Test procedure specified hereafter. Where leakage is in excess of the specified rate, the sewer shall be repaired by the CONTRACTOR as required to comply with the leakage test requirements. The OWNER's Representative may require the CONTRACTOR to repair obvious leaks even though the total length of the test section falls within the maximum allowable leakage for the test used.

C. Defective pipe joints shall be repaired in a manner that the repaired pipe joint will have some flexibility and the effectiveness of the repair will not be affected by differential movement of the adjoining pipes. A "CSSI" or DFW/HPI non-shear coupling, as per CBJ Standard Detail 218 - Coupling for Dissimilar Sanitary Sewer Pipes, or approved equal, will be acceptable in making such repairs.

D. The OWNER's Representative will make one complete TV inspection after all sewers have passed the specified watertightness test. All defects regarding sewer alignment and grade, damaged pipe, and visible leaks observed during this inspection, shall be corrected by the CONTRACTOR. The CONTRACTOR shall de-water the sewers as required for the performance of the TV inspection work by the OWNER's Representative. The CONTRACTOR shall be responsible for all costs associated with any TV inspection required following the initial TV inspection, if any defects were observed during this or any subsequent TV inspections.

3.03 FILTRATION TEST (USING AIR)

A. The CONTRACTOR shall furnish all facilities and personnel for conducting the test under the observation of the OWNER's Representative. The equipment and personnel shall be subject to the approval of the OWNER's Representative. Joints only may be tested in pipe 36 inches in diameter or larger, at the option of the CONTRACTOR.

B. Immediately following the pipe cleaning, the pipe installation shall be tested with low pressure air. Air shall be slowly supplied to the plugged pipe installation until the internal air pressure reaches five pounds per square inch greater than the average back pressure of any ground water that may submerge the pipe. At least two minutes shall be allowed for temperature stabilization before proceeding further.

C. The pipeline shall be considered acceptable when tested at an average pressure of four psi greater than the average pressure of any ground water that may submerge the pipe if the section under test does not lose air at a rate greater than 0.0030 cubic feet per minute per square foot of internal surface.

D. The requirements of this Specification shall be considered satisfied if the time required for the pressure to decrease from 4.5 psi to 3.5 psi above average ground water pressure is greater than that shown using the following formula:

$$T = 28.33\ D$$

Where T = time in seconds
D = pipe diameter in inches

E. Pressure gauges should be incremented in not more than one-half pound increments for accurate tests.

F. Braces shall be required to hold plugs in place and to prevent the sudden release of the compressed air. Due to the large forces that could be exerted by an escaping plug during the testing of the pipe, no one shall be allowed in the manholes in which plugs have been placed while tests are being conducted. The CONTRACTOR's testing equipment shall have a pressure relief device that will prohibit the pressure in the pipeline from exceeding 10-pounds per square inch.

3.04 EXFILTRATION TEST (USING WATER)

A. Where groundwater is below the pipe to be tested, a minimum of head of eight feet of water above the crown at the upper end of the test section shall be maintained for a period of four hours, during which time it will be presumed that full absorption of the pipe body has taken place, and thereafter for a further period of one hour for the actual test of leakage. During this one hour period, the measured loss shall not exceed the rate given below:

Type of Pipe	Allowable Exfiltration Rate
PVC	E = 0.0004 DL

E = Allowable leakage in gallons per hour
D = Nominal inside diameter of pipe in inches
L = Length of pipe being tested in feet

B. Where groundwater is above any pipe to be tested, the minimum head of the test will be raised to provide an elevation head of eight feet above the groundwater.

C. The maximum length of sewer in any test section shall be 500-feet.

3.05 INFILTRATION TEST

A. Infiltration testing may be allowed at the OWNER's Representative option when the natural ground water table is above the crown of the higher end of the test section and the external water pressure exerted on the pipe is equivalent to the exfiltration test. The maximum allowable limit for infiltration shall be as determined by the formulas defined in the above section Exfiltration Test (Using Water).

END OF SECTION 333113

SECTION 333913 - SANITARY SEWER MANHOLES AND CLEANOUTS

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing sanitary sewer manholes and cleanouts complete, in place as shown in the Drawings. It shall also include raising or lowering existing sanitary sewer manholes and cleanouts to conform to the final grade as shown on the Drawings.

1.03 SUBMITTALS

A. Manholes: Shop Drawings showing method of construction and reinforcement, invert elevations, and overall dimensions.

B. Frames and Grates: Catalogue cuts and materials certification.

PART 2 - PRODUCTS

2.01 MANHOLES

A. All manholes shall consist of precast concrete sections, including integral base section, riser sections, cones, and flat slab tops and shall conform to ASTM C 478 and the dimensions shown on the Drawings. All precast sections shall have joints sealed with "RAM-NEK" or "RUB-R-NEK" gasketing material, or approved equal, installed as specified by the manufacturer. Cones shall be eccentric. Manhole steps shall be cast in all precast manhole sections. Pipe penetration gaskets shall be cast into all precast manholes. Grade rings shall be standard product, manufactured particularly for use in manhole construction, sized to fit the cones on which they are placed, and the wall thickness shall be not less than that of the cones. Grade rings shall be not less than two inches high, nor more than four inches high. Grade rings shall be Infra-Riser® or approved equal.

B. Portland cement concrete cast in place shall conform to Section 321313 – Site Concrete.

2.02 FRAMES, COVERS AND STEPS

A. Manhole frames and covers shall be watertight, of ductile iron, and conform to the design and dimensions shown on the Drawings. Ductile iron castings shall conform to the requirements of AASHTO M 103. Grade shall be optional unless otherwise designated. Contact surfaces between frames and covers shall be machined to provide a uniform contact surface. When watertight locking devices are specified, the CONTRACTOR shall submit Shop Drawings for approval by the OWNER's Representative.

B. All manhole covers shall have the word "SEWER" cast into the top in letters approximately three inches high.

C. Manhole steps shall be constructed of polypropylene conforming to ASTM D4101, and shall meet current state and federal safety standards.

D. Frames and covers shall be ductile iron, conforming to ASTM A-48, Class 30. The cover shall be designed for the appropriate classification of traffic and shall have the word "SEWER' cast into the top with prominent letters. Bearing surfaces between the frame and cover shall be machined to smooth, plane surfaces. Frames and covers shall be Inland Foundry No. 743, or approved equal.

2.03 MISCELLANEOUS

A. All pipes, bends and fittings used in cleanouts, drop connections, and pipe stubs for future connections to manholes shall conform to Section 333113 – Sanitary Sewer Pipe.

B. Bentonite-Cement sealing plaster shall consist of two parts bentonite, one part Type 3 cement, and one part sand, with sufficient water to obtain workable consistency.

C. Mortar shall consist of one part portland cement to two parts clean, well-graded sand which will pass a No. 4 screen. Admixtures may be used not exceeding the following percentages of weight of cement; hydrated lime, 10%; diatomaceous earth or other inert material, 5%. Consistency of mortar shall be such that it will readily adhere to the surface. Mortar mixed for longer than thirty minutes shall not be used. A non-shrink mortar may be submitted for approval as a substitute.

D. Grout shall be a non-shrink type approved by the OWNER's Representative.

E. Pipe penetration gasket through the manhole wall shall be cast-in-place Dura-Seal III, or approved equal, as manufactured by Dura-Tech, Inc., Kor-N-Seal Cavity O-Ring, or approved equal, as manufactured by NPC Inc. shall be used for filling the preformed void in the connection gasket.

F. Manhole exterior joint waterproofing shall be a Miradri system as manufactured by Carlisle CCW, including Carlisle – CWW-715 Damp Concrete Contact Adhesive, CWW 704 primer, CCW Miradri 861 Membrane, and CCW 704 mastic, or approved equal that includes a membrane and adhesive system for positive water exclusion. The membrane shall extend at least 18" each side of manhole joints, except this width may be reduced to 9" each side of manhole joints if the joint is less than four feet below finished grade and the joint is above the maximum water table.

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. Precast concrete manhole bases sections shall be set on a level base of twelve inches of compacted D-1 or 2-inch minus shot rock as shown in the Drawings. Provisions shall be made to prevent flotation of the manhole.

B. All lifting holes shall be plugged with Bentonite-Cement sealing plaster and sealed with a Miradri System patch, or approved equal, to a minimum of six inches from the edges of the opening, as required to prevent leakage.

C. After completion of the manhole, all plugs shall be completely removed from the sewers and all loose material shall be removed from the manhole.

D. Service connections shall not be installed into manholes unless otherwise shown on the Drawings or directed by the OWNER's Representative. Where service connections into manholes are allowed, the top of the service sewer pipe shall be 0.2 feet higher than the top of the downstream main sewer pipe. The manhole invert shall be channeled for the service connection sewers in the same manner as for main sewers.

E. Stubs for future construction shall consist of a section of pipe extending two feet outside the manhole wall, connected as shown on the Drawings. The manhole fillet shall be formed for future connection. The stubs shall be located as shown on the Drawings.

F. Connection to existing manholes shall be made in such a manner that the modified manhole is equal to a new manhole in appearance and performance. A channel, approximately two inches larger all around than the connecting pipe, shall be cut into the existing manhole base. The new pipe shall be connected as shown on the Drawings and Standard Details. The rough-cut channel shall be finished to its final smooth and uniform shape with mortar. The existing sewer(s) shall be maintained in service and the fresh concrete and mortar surface shall be protected from the flowing sewage for a minimum of 24-hours.

G. The joint exterior waterproofing system shall be installed as recommended by the system manufacturer and as described in this Section.

H. All manholes will be visually inspected by the OWNER's Representative; there shall be no evidence of leakage of water into any manhole from outside sources or any imperfections which may allow such leakage.

I. At least 25% of the completed manholes, as selected by the OWNER's Representative, shall be tested for water-tightness by the CONTRACTOR. The test shall be made, with all connecting pipes plugged, by filling the manhole with clean water to within two inches of the bottom of the cast iron frame. The leakage rate shall not exceed three gallons per day per foot of depth, or fifty gallons per day, whichever is less, over a test period of not less than two hours when the water table is not an adverse factor. For every manhole that fails to meet the test, four additional manholes shall be tested.

J. The CONTRACTOR shall repair all imperfections and leaks disclosed by either visual inspection or testing. The method of repair shall be subject to approval by the OWNER's Representative.

K. Manhole Grade Ring Adjustment Units are required for each new sanitary sewer manhole, reconstructed sanitary sewer manhole, and adjustment of existing manhole to grade.

1. Each manhole shall contain at least one recycled rubber riser, with thickness varying to match frame and cover to finish grade requirements, to form the final surface for installation of the frame.
2. The total height of the rubber adjustment riser shall be a minimum of 1" and a maximum of 3".
3. Concrete and steel surfaces to receive sealing compound shall be clean, dry and free of grease or oils.
4. Adjustment risers shall be bonded to adjacent surfaces by laying a continuous bead, 5/16" thick cold applied joint sealant compound conforming to ASTM-D 1850 (PL Premium POLYURETHANE Door, Window & Siding Sealant *or* PL Premium POLYURETHANE Concrete & Masonry Sealant, formerly Chemrex CX-22) or

equivalent, on the top surface of the concrete course, or the bottom surface of the riser, on a diameter 1" smaller than the outside diameter of the rubber adjustment riser.

5. The adjustment riser shall then be seated firmly in place, ensuring it is centered over the opening. Apply a second continuous strip of sealant to the top surface of adjustment riser, 0.5" from the outside diameter of the rubber adjustment riser or manhole frame.
6. The adjustment riser must form the final surface for the seating of the frame and cover assembly. Concrete adjustment units must not form the final surface for seating the frame.
7. If more than one adjustment riser is required, a continuous bead of sealant shall be applied between each unit in the same manner as in paragraph 4 above. A continuous bead of sealant shall also be placed on the top surface of the concrete course or on the bottom surface of the bottom riser and to the top surface of the top adjustment riser.
8. The frame shall then be set firmly in place ensuring that it is properly centered over the structure opening and is firmly contacting the rubber riser through the sealant.
9. Adjustment risers shall have an inside diameter that is within 2" of the inside diameter of the concrete structure, and equal to the outside diameter of the concrete structure ±2".

L. Manhole frames and covers shall be set to final grade prior to final paving operations, with the compacted pavement to provide a depression to the top of manhole frame within the allowable limits of 3/8-inch minimum to 3/4-inch maximum, as determined by using an 8-foot long straight edge across the frame in all directions.

1. The frame can be set to final position prior to the laydown machine passing over the structure, or immediately following the laydown machine passing over the structure.
2. The intended purpose of these requirements is that the asphalt pavement is compacted to grade around the frame and cover with no cut out of compacted pavement allowed.
3. If the depression of the frame and cover below finish pavement is found to be out of allowable tolerances after the pavement has cooled to the point that saw cutting and removal of the pavement is necessary, the following corrective action will be required:

    a. A square cut-out of the pavement shall be made to a minimum of 6-inches and maximum of 8-inches outside the edge of frame flange, with this cut-out oriented with the sides at 45° to traffic.
    b. A concrete transition slab shall be constructed as shown in the detail on the Drawings. This slab shall be allowed to cure for a minimum of 48 hours before placing the hot asphalt mix over the transition slab.

M. Manhole riser rings shall be sealed to the top of manhole cone or flattop and to each other with one run of "RAM-NEK" or "RUB-R-NEK" around the inside edge and one run around the outside edge of the riser ring. The units shall be heated and compressed to at least 50% of original thickness of the "RAM-NEK" or "RUB-R-NEK." No grout shall be used to seal the riser rings.

END OF SECTION 333913

SECTION 334100 - STORM SEWER PIPE

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing pipe culverts, storm drains and underdrains, in accordance with these Specifications and in reasonably close conformity with the lines and grades shown on the Drawings or as directed by the OWNER'S Representative. The WORK also includes connecting to existing storm drain pipe.

B. This WORK also includes furnishing and installing connecting bands, branch connections, elbows and end sections required to complete the culvert or drain structure.

C. This WORK also includes installing and connecting foundation drains, roof drains and other drains to existing storm drain structures, including all fittings and elbows to make a satisfactory installation.

1.03 SUBMITTALS

A. Storm Sewer Pipe: Material certifications stating conformance with requirements of this section and manufacturer's catalog cuts of pipe materials and fittings.

PART 2 – PRODUCTS

2.01 PVC PIPE CONDUIT

A. PVC Pipe Conduit shall have a standard dimension ration (SDR) of 35 and conform to ASTM D 3034. Before any PVC pipe is used on this Project, the CONTRACTOR shall supply certifications, signed by an authorized agent of the seller or manufacturer, stating that the material has been sampled, tested, and inspected in accordance with ASTM D 3034.

B. The pipe shall have integral wall bell and spigot joints conforming to ASTM D 3212. The bell shall consist of an integral wall section with a solid cross section elastomeric ring, factory assembled, securely locked in place to prevent displacement.

C. Flexible watertight connections, approved by the OWNER'S Representative, shall be used at PVC pipe connections to manholes and other rigid structures.

2.02 CORRUGATED POLYETHYLENE PIPE

A. Corrugated polyethylene pipe (CPP) shall be high density corrugated polyethylene, smooth interior pipe, and shall be manufactured in conformity with the latest AASHTO M 294, Type S specification, and shall meet the requirements of ASTM D 3350 Cell Classification 324420C, or ASTM D 1248, Class C, Category 4, Grade P33.

B. Pipe shall be joined with “Hancor, Inc. Hi-Q Sure-Lok” (bell-and-spigot) joint, or approved equal, meeting the requirements of AASHTO M 294. The bell shall be an integral part of the pipe and provide a minimum pull-apart strength of 400 pounds.

C. The bell-and-spigot joint shall incorporate a gasket making it silt-tight. Gaskets shall be installed in the bell, or on the pipe, by the pipe manufacturer.

D. Fittings shall conform to AASHTO M 294. Fabricated fittings shall be welded on the interior and exterior at all junctions. All fittings shall connect to the pipe with a bell and spigot joint.

E. All cut corrugations on CPP pipe shall be cleared of all water and completely grouted to prevent the accumulation of water.

2.03 UNDERGROUND MARKING TAPE

A. Underground Marking Tape shall be yellow, at least 4-inches wide, 4-mil thick, polyethylene tape with a metallic backing capable of being traced with locators. The tape shall have black letters with the following wording: “Caution: Storm Sewer Line Buried Below”, or similar. The marking tape shall be installed 12-inches above the top of all storm sewer mains and services.

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. Excavation, Bedding, and Backfill shall conform to the requirements of Section 312002 – Trenching. All pipes shall have a minimum cover of 12-inches, unless otherwise shown on the Drawings or directed by the OWNER’s Representative.

B. Pipe laying shall begin at the downstream end of the pipe. The lower segment of the pipe shall be in contact with the shaped bedding throughout its full length. Bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe shall be placed facing upstream.

C. Joints shall be made with rubber gaskets.

D. Flexible conduits shall be firmly joined by approved coupling bands.

E. Conduit shall be inspected before any backfill is placed. Any pipe found to be substantially out of alignment, unduly settled, or damaged shall be taken up and relaid or replaced.

F. Installation of all pipes shall conform to the manufacturer's recommended procedures. These Specifications and the Drawings shall take precedence over the manufacturer’s recommendations in the event of conflict, if more restrictive.

G. Pipe culvert shall be installed as shown on the Drawings, unless otherwise directed by the OWNER's Representative. All bends, couplings and other fittings as necessary to connect to existing pipes or flows shall be approved by the OWNER's Representative.

H. All cut corrugations on CPP pipe shall be cleared of all water and completely grouted to prevent the accumulation of water.

END OF SECTION 334100

SECTION 334101 - STORM SEWER MANHOLES, INLETS, AND CATCH BASINS

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. The WORK under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and installing precast concrete storm sewer manholes complete, in place as shown on the Drawings.

1.03 SUBMITTALS

A. Storm Sewer Manholes shop drawings.

B. Frames and Grates: Catalogue cuts and material certifications.

PART 2 – PRODUCTS

2.01 JOINT MORTAR

A Joint mortar shall be non-shrink-type, and shall consist of one part Portland cement and two parts approved sand with water as necessary to obtain the required consistency. Mortar shall be used within 30 minutes after its preparation. If mortar is submerged and cannot be kept dry until cured, a substitute approved by the OWNER'S Representative shall be used.

2.02 FRAMES, GRATES, COVERS AND LADDER RUNGS

A. Frames, grates, covers and ladder rungs shall conform to the plan dimensions and to the following Specification requirements for the designated materials:

1. All frames, grates, and covers shall be ductile iron, conforming to ASTM A-48, Class 30, and shall be designed for heavy duty traffic.
2. Carbon-steel castings shall conform to the requirements of AASHTO M 103. Grade shall be optional unless otherwise designated.
3. All manhole covers shall have the words "STORM DRAIN" cast into the top in letters approximately three inches high.
4. Structural steel shall conform to the requirements of AASHTO M 183.
5. Manhole steps shall be constructed of polypropylene conforming to ASTM D 4101 and shall meet current state and federal safety standards.
6. Galvanizing, where specified for these units, shall conform to the requirements of AASHTO M 111.
7. Malleable iron castings shall conform to the requirements of ASTM A 47. Grade shall be optional unless otherwise designated.

2.03 REINFORCING STEEL

A. Reinforcing steel shall conform to the following applicable requirements:

Deformed Billet-Steel Bars	AASHTO M 31 (ASTM A 615, grade 60)
Welded Steel Wire Fabric	AASHTO M 55 (ASTM A 185)
Cold-Drawn Steel Wire	AASHTO M 32 (ASTM A 82)
Fabricated Steel Bar or Rod Mats	AASHTO M 54 (ASTM A 184)

2.04 PRECAST CONCRETE UNITS

A. Precast concrete units shall conform to the requirements of AASHTO M 199, except that the absorption test will not be required.

B. Cracks in units will be cause for rejection. Honeycombed or patched areas in excess of 30 cumulative square inches will be cause for rejection.

C. Concrete shall conform to Section 321313 – Site Concrete.

D. Manhole steps shall meet current state and federal safety standards.

PART 3 – EXECUTION

3.01 CONSTRUCTION

A. Concrete construction shall conform to the requirements of Section 321313 – Site Concrete.

B. Welding shall be done in accordance with the best modern practice and the applicable requirements of AWS D1.1 except as modified by AASHTO “Standard Specifications for Welding of Structural Steel Highway Bridges”.

C. New and existing metal frames shall be set in full mortar bed.

D. Manholes and catch basins shall be constructed in accordance with the Drawings. There shall be a minimum 16-inch sump constructed in the invert of the manholes or catch basins, unless otherwise specified. After the mortar is set, holding the pipe in place, the pipe is to be cut off evenly so that neither more than two inches, nor less than one inch, of the pipe protrudes into the manhole or catch basin.

E. When a pipe enters the manhole through a wall of a precast unit, the CONTRACTOR shall perform the cutting of the concrete and steel reinforcement in a manner that will not loosen the reinforcement in the wall. The steel reinforcement shall be cut flush with the wall face. All joints and openings cut in the walls shall be grouted.

F. Where indicated on the Drawings, a stub shall be provided for future connections to the manhole. The stub shall be sized and positioned as indicated. The end of the stub shall be stopped with a wooden plug, concrete biscuit, or other adequate methods to prevent water, earth, or other substances from entering pipe.

G. Adjustment of Existing Frame Grates to Grade shall consist of raising or lowering the frame or ring casting one foot or less and providing the necessary adjusting rings, and mortar required to adjust the frame and grate to finish grade, as shown in the Drawings.

H. Replacing Frame and Covers shall consist of removal and disposal of the existing frame, cover and adjustment bricks, blocks and mortar and replacing with a new frame and cover and new precast storm drain manhole barrel section per the Drawings. The new frame and cover shall be adjusted to finish grade as shown in the Drawings.

I. The manholes shall be reconstructed to the required elevation and to conform essentially to the details on the Drawings. This WORK shall conform to the requirements above specified for new construction except that material may be reused if of satisfactory quality and if approved by the OWNER'S Representative.

J. Existing storm flow shall not be impeded during construction.

K. Excavation, bedding and backfilling shall conform to the requirements of Section 312002 – Trenching.

L. Manhole pipe connections shall be made as shown on the Drawings and as required by the manufacturer's recommendations. A snug, watertight seal shall be provided for each pipe connection.

M. All manholes shall be bedded in accordance with the Drawings.

END OF SECTION 334101