a. Install bracket using two screws. Use proper anchor for substrate.
b. Attach sign to bracket using set-screw.
c. Mount signs as described in Contract Drawings.

2. Cabinet Signs:

a. Remove adhesive protective layer.
b. Position sign correctly and apply to door.
c. Roll sign to secure to door, taking care not to damage sign.
d. Mount signs as described in Contract Drawings.

END OF SECTION

SECTION 10 2200 - PARTITIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Framing system
2. Glazing materials
3. Doors and frames
4. Hardware
5. Accessories
6. Finishes

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:

1. Scheduling: Manufacturer production time shall not exceed four weeks from date of receipt of approved shop drawings.

B. Preinstallation Meeting Attendees and Procedures: Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Demountable partition system components. Mark required options. Include standard details applicable to Project.
2. Doors and hardware.
3. Glazing.
4. Accessories.

B. Shop Drawings:

1. Plans, elevations, sections, and details.
2. Show anchorages to other construction, including concealed supports in walls.
3. Door locations, hardware, and details.

C. Samples: Provide manufactures standard size samples for verification of support system and each type, color, and texture of exposed finish, full thickness:

1. Aluminum Extrusion Components.
2. Cladding Finishes.
3. Linear Trim and Base.
4. Door Face Finishes.
5. Glass.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Partitions and facing.

B. Warranty Documentation: For specified system.

C. Installation drawing: Indicating final locations of components.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Specialize in designing and manufacturing stick-built partitions and have production facilities capable of single-source responsibilities and warranty.
2. Installers: Manufacturer or approved by Manufacturer.

B. Certifications: From Contractor for sound transmission characteristics.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver products until building is enclosed.

B. Store products inside building.

C. Protect components and finishes from damage.

D. Handle in accordance with the manufacturer's instructions.

1.7 FIELD CONDITIONS

A. Ambient Conditions: Perform work within following limitations:

1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.
2. Temperature: 60 degrees F (15.5 C), minimum, 90 maximum degrees F (32.2 C), maximum.
3. Humidity: 25 percent, minimum, 55 percent, maximum.

B. Existing Conditions: Verify site dimensions before project approval and fabrication. Show site dimensions on production drawing.

1.8 WARRANTY

A. Manufacturer Warranties:

1. Partition System Components: Repair or replacement of defective components of site assembled structure, cladding system and components.
2. Warranty Period: 10-year limited warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Falkbuilt Ltd Frameless Glass Partition System.

B. Additional Approved Manufacturers:

1. Dirt
2. Dorma
3. Klein
4. Modernus

2.2 SYSTEM DESCRIPTION

A. Factory fabricated, site installed partitions, including:

1. Steel framing structure.
2. Face mounted finished cladding.
3. Doors, millwork, finishes, building services components, technology, and accessories.

2.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Stick-built partitions shall be capable of withstanding the effects of gravity loads, dead loads, and the following loads and stresses within limits and under conditions indicated:

1. Deflection: Lateral deflection tested under a uniformly distributed load of 5 psf (0.24 kN/m2), maximum.

a. Glass Walls: L/175 or 3/4 inch (19 mm) whichever is less.

2. Seismic Performance: Partitions shall withstand effects of seismic events without collapse, loss of anchorage, or loss of panels.

B. Surface-Burning Characteristics: Tested in accordance with ASTM E84 by a qualified independent testing agency.

C. Acoustical Performance: Provide stick-built partitions with STC rating indicated, determined by testing to ASTM E90 and classified in accordance with ASTM E413.

2.4 FRAMING SYSTEM

A. Description: Modular system for partitions that can be readily dismantled and reinstalled in other locations.

B. Framing, Fixed Glazed Wall System: ASTM B221 Alloy 6063-T6 Extruded aluminum, Framed and Butt-jointed.

1. Product:

a. Lydia: Non-adjustable glass wall.

2. Profile Dimensions:

a. Base Height: 2-1/2 inches.
b. Head Height: 2-1/2 inches.
c. Width: 2-1/2 inches.

d. Frame Depth: 1-5/8 inches.

3. Glass Thickness: 1/2 inch.

4. Finish: Clear Anodized.
5. Leveler Stem: Manufacturer's standard screw adjusted leveling system.

a. Base Adjustability Range: Plus or minus 1/2 inch.
b. Head Adjustability Range: Plus or minus 1 inch.

6. Fasteners: Zinc plated steel, type F.

2.5 GLAZING MATERIALS

A. Safety Glazing Labels: Permanent certification label in visible location of SGCC or other agency acceptable to authorities having jurisdiction.

B. Base Glass:

1. Clear Glass: ASTM C1036, Type I, Class 1, Quality-Q3.
2. Heat-Strengthened Glass: ASTM C1048, Type 1, Class 1, Quality Q3:

a. Heat Strengthened Glass: Kind HS.
b. Tempered Glass: Kind FT.

2.6 DOORS AND FRAMES

A. Swinging Doors:

1. All-Glass Swinging Doors:

a. Glass: 1/2 inch tempered.
b. Hinge: Pivot.
c. Pivots: Top and bottom.

B. Sliding Doors:

1. Glass Sliding Doors:

a. Glass: 1/2 inch tempered.
b. Frame: All-Glass.

1) Finish: Clear Anodized.

c. Slide Guide: Manufacturer supplied top aluminum rail and floor guide.
d. Drop-seal acoustical door hardware only where noted on drawings.

2.7 HARDWARE

A. Hardware:

1. Bar Pull: Non-locking.

a. Length: 48 inch (1200mm).

b. Diameter: 1-1/4 inch.
c. Finish: Brushed stainless steel.

2. Bar Pull: Locking.

a. Length: 48 inch (1500mm).
b. Diameter: 1-1/4 inch (31.50 mm).
c. Finish: Brushed stainless steel.
d. Core: 7 pin SFIC Locking Core.

B. Hinges:

1. Pivots: Manufacturer's standard.
2. Pin Type: Manufacturer's standard.
3. Finish: Clear anodized.

2.8 FABRICATION

A. Framing:

1. Fabricate components for installation with concealed fasteners and pressure fit.
2. Fabricate components for installation utilizing fasteners for use in gypsum board ceilings, seismic applications, and doors at base building components.
3. Fabricate components for concealed anchorage and assembly fasteners.
4. Where partitions join fixed construction or require sound attenuation, use manufacturer's standard seals around perimeter.
5. Conceal wiring in frame components. Bundle, lace, and train conductors to terminal points with no excess.

B. Panels:

1. Fabricate to size before delivery.

C. Prepare doors and frames for hardware.

D. Swinging Doors: Fabricate for 1/8 inch jamb and head clearance, 1/4 inch floor clearance.

2.9 STAINLESS STEEL FINISHES

A. Stainless Steel: NAAMM AMP 503, Number 6.

2.10 ALUMINUM FINISHES

A. Anodizing: AAMA 611 Class I or AAMA 612 with electro-deposition organic seal.

1. Color: Clear.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Manufacturer of partitions, or manufacturer approved and trained installer.

3.2 EXAMINATION

A. Verify locations of concealed construction for support and anchorage.

B. Verify that openings are plumb, level, and square.

C. Verify that floor and ceiling surfaces are in plane.

3.3 PREPARATION

A. Clean floor, wall, and ceiling contact surfaces.

B. Vacuum clean carpet below sill members.

3.4 INSTALLATION

A. General:

1. Comply with manufacturer's installation instructions.
2. Do not cut metal components except where trimming is indicated on Shop Drawings.
3. Install system without gaps at joints with other construction.

B. Framing:

1. Install framing plumb, accurately aligned, and free of warp or twist.
2. Install components with securely fastened full-contact joints.
3. Anchor framing system rigidly and securely to adjacent construction without damaging surfaces.
4. Install perimeter gaskets without gaps to provide continuous light and acoustical seals.

C. Glazing:

1. Install glass panels per factory-numbered sequence.
2. Install glass on resilient setting blocks in glazing channels.
3. Install glazing gaskets with joints only at corners and to provide continuous barrier to air and sound.
4. Install glass panels with open vertical joints of uniform width.

D. Swinging Doors:

1. Install doors with uniform jamb and head clearance.
2. Adjust doors for smooth, accurate operation and secure latching.
3. Adjust closers for ADA compliance.

E. Sliding Doors:

1. Align track for smooth, quiet operation.
2. Adjust end stops for accurate closed and fully open positions.

F. Systems Integration:

1. Coordinate wiring connections.

G. Tolerances:

1. Plumb: 1/8 inch maximum deviation.

2. Plane: 1/8 inch maximum deviation in 12 feet (4 m).

3. Level: 1/8 inch maximum deviation in 12 feet (4 m) for top of sill.

3.5 CLEANING

A. Clean in accordance with the manufacturer's instructions.

1. Do not use alkaline or abrasive agents.
2. Do not scratch or mar finishes.

B. Provide new replacements for components that are damaged or have soiling or staining that cannot be satisfactorily cleaned.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration: Manufacturer's Authorized Representative will coordinate demonstration with Owner's staff.

3.7 PROTECTION

A. Protection: Protect from damage through the duration of construction activities.

END OF SECTION

SECTION 10 2600 - RIGID VINYL RUBRAILS

PART 1 – GENERAL

1.01 SUMMARY

A. Rubrails for wall protection and decoration

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)
C. National Fire Protection Association (NFPA)
D. Society of Automotive Engineers (SAE)
E. Underwriters Laboratory (UL)
G. Uniform Building Code (UBC)

1.04 SYSTEM DESCRIPTION

A. Performance Requirements: Provide Rigid Vinyl Rubrails that conform to the following requirements of regulatory agencies and the quality control of IPC Door and Wall Protection Systems, InPro Corporation.

1. Fire Performance Characteristics: Provide UL Classified Rigid Vinyl Rubrails conforming with the NFPA Class A fire rating. Surface burning characteristics as determined by UL-723 (ASTM E-84), for Rubrails installed with 3M Fastbond 30, InPro Bond Adhesive, or Formulated Solutions, LLC "XT-2000+" Adhesive shall be a maximum flame spread of 20 and a maximum smoke developed of 350 for .060" (1.5mm) thick material.
2. Impact Strength: Provide rigid vinyl sheet materials that have an Impact Strength of 30.4 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
3. Chemical and Stain Resistance: Provide rubrails that show resistance to stain when tested in accordance with applicable provisions of ASTM D-543.
4. Fungal and Bacterial Resistance: Provide rigid vinyl that does not support fungal or bacterial growth as tested in accordance with ASTM G-21 and ASTM G-22.
5. Color Consistency: Provide components matched in accordance with SAE J-1545 - (Delta E) with a color difference no greater than 1.0 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

1.05 SUBMITTALS

A. Product Data: Manufacturer's printed product data for each type of Rigid Vinyl Rubrails specified.

B. Detail Drawings: Mounting details with the appropriate adhesives for specific project substrates.

C. Samples: Verification samples of Rigid Vinyl Rubrails, 8" (203mm) piece, of each type and color indicated.

D. Manufacturer's Installation Instruction: Printed installation instructions for Palladium® Rigid Vinyl Rubrails.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in unopened factory packaging to the jobsite

B. Inspect materials at delivery to assure that specified products have been received.

C. Store in original packaging in a climate controlled location away from direct sunlight.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Products must be installed in an interior climate controlled environment.

1.08 WARRANTY

A. Standard Limited Lifetime Warranty against material and manufacturing defects.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturers:

1. IPC Door and Wall Protection Systems,
   InPro Corporation, PO Box 406 Muskego, WI 53150 USA;
   Telephone: 800-222-5556, Fax: 888-715-8407,
   http://www.inprocorp.com

2. CS Acrovyn, Hughesville, PA
   Telephone: 800-233-8493, Fax: 570-546-5941
   www.c-sgroup.com

3. Pawling Corporation, Wassaic, New York
   Telephone: 800-431-3456
   www.pawling.com

C. Provide all Rigid Vinyl Rubrails from a single source.

2.02 MANUFACTURED UNITS

A. Rubrails

1. Palladium® Rigid Vinyl Rubrails

   a. Thickness: 0.040″
   b. Backing: Unbacked
   c. Height: Maximum 24"
   d. Length: 8'

2. CS Acrovyn Crash Rails Model RS-40N

   a. Thickness: 0.040″
   b. Height: 12″
   c. Length: 8′

3. Pawling Corporation Rub Rails Model CR-40

a. Thickness 0.040"
b. Height: 12"
c. Length: 8'

2.03 MATERIALS

A. Vinyl: Rigid Vinyl Rubrails shall be manufactured from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers.

2.04 ACCESSORIES

A. Adhesives: As recommended by rubrail manufacturer.

2.05 FINISHES

A. Color to be selected by the architect.

B. Surface Finish: Smooth.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions in which the Rigid Vinyl Rubrails systems will be installed.

1. Complete all finishing operations, including painting, before beginning installation.

B. Wall surface shall be dry and free from dirt, grease and loose paint.

3.02 PREPARATION

A. General: Prior to installation, clean substrate to remove dust, debris and loose particles. Paint substrate with a paint or primer that does not contain polyvinyl acetate (PVA).

3.03 INSTALLATION

A. General: Locate the Rigid Vinyl Rubrails as indicated on the approved detail drawing for the appropriate substrate and in compliance with the manufacturer's installation instructions. Install rubrail level and plumb at the height indicated on the drawings.

B. Installation of Rigid Vinyl Rubrails

3. Adhere to substrate with a nonflammable, high strength, water-dispersed contact adhesive, with very little odor. Smooth roll surface.

3.04 CLEANING

A. At completion of the installation, clean surfaces in accordance with the manufacturer's clean-up and maintenance instructions.

END OF SECTION

SECTION 10 2613 - CORNER GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install corner guards as described in Contract Documents.

1.2 REFERENCES

A. Definitions:

1. Flame Spread: The propagation of flame over a surface.
2. Flame Spread Index: The numerical value assigned to a material tested in accordance with ASTM E84.
3. Smoke-Developed Index: The numerical value assigned to a material tested in accordance with ASTM E84.

B. Reference Standards:

1. ASTM International:

a. ASTM D256-10(2018), 'Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics'.
b. ASTM D543-14, 'Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents'.
c. ASTM E84-18b, 'Standard Test Method for Surface Burning Characteristics of Building Materials'.

2. Underwriters Laboratories / American National Standards Institute:

a. UL/ANSI 723, 'Standard for Safety Test for Surface Burning Characteristics of Building Materials' 11th Edition).

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data: Color selections.
2. Shop Drawings:

a. Show locations, extent and installation details.
b. Show method of attachment.

3. Sample:

a. Provide 12 inches sample show color, texture, pattern, and guard.

B. Informational Submittals:

1. Test And Evaluation Reports:

a. Copies of Quality Assurance requirements for 'Class A' flame spread rating.

2. Qualification Statement:

a. Installer:

1) Provide Qualification documentation if requested by Architect or Owner.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Operations and Maintenance Data:

1) Maintenance, and cleaning instructions.

b. Record Documentation:

1) Manufacturers documentation:

a) Manufacturer's literature.
b) Color selection.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. System shall be recognized for intended use by applicable building codes.
2. Fire Test Response Characteristics:

a. UL classified conforming to NFPA Class A fire rating with surface burning characteristics as tested materials in accordance with UL 723 (ASTM E84).

1) Flame Spread: 10.
2) Smoke Developed: 350 to 450.

b. 20 ft/lbs/ per square inch as tested in accordance with ASTM D256, Notched Izod Test.

B. Qualifications:

1. Installers:

a. Installer shall have performed at least three (3) installations of similar size, scope, and complexity in each of the past two (2) years.
b. Provide documentation if requested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:

1. Deliver materials in sealed containers with Manufacturer's labels intact.

B. Storage And Handling Requirements:

1. Store materials in protected area in original, undamaged packaging in a cool, dry place out of direct sunlight and exposure to elements. Minimum room temperature of 40 deg F and a maximum of 100 deg F should be maintained.
2. Material must be stored flat.

1.6 FIELD CONDITIONS

A. Ambient Conditions:

1. Material must be acclimated in an environment of 65 deg F to 75 deg F for at least twenty-four (24) hours prior to beginning installation.
2. Installation areas must be enclosed and weatherproofed before installation commences.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:

1. Vinyl Corner Guards:

a. Category Four Approved Manufacturers. See Section 01 6200 for definition of Categories.

1) Acrovyn, Div Construction Specialties Group, Muncie, PA www.c-sgroup.com.
2) American Floor Products Co, Rockville, MD www.afco-usa.com.
3) IPC Door and Wall Protection Systems, Muskego, WI www.inprocorp.com.
4) Koroseal Wall Protection Systems, Fairlawn, OH www.korogard.com.
5) Pawling Corp, Pawling, NY www.pawling.com.

B. Materials:

1. Vinyl Corner Guards:

a. Design Criteria:

1) Surface mounted, 0.078 inch minimum thick, nominal high-impact vinyl / acrylic or polyvinyl chloride (PVC) extrusions designed to absorb and resist abrasions under impact.
2) Chemical and stain resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.

b. Color and Texture: As selected by Architect from Manufacturer's premium colors.
c. Design Standard: Acrovyn VA Series, 1-1/2 inches by 1-1/2 inches.

C. Fabrication:

1. Fabricate wall protection systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes.

2.2 ACCESSORIES

A. Adhesive: As supplied or recommended by Corner Guard Manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:

1. Examine substrate and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.
2. Notify Architect of unsuitable conditions in writing.
3. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation:

1. Prior to installation, clean substrate to remove dirt, debris and loose particles. Perform additional preparation procedures as required by manufacturer's instructions.

B. Protection:

1. Take all necessary steps to prevent damage to material during installation as required in manufacturer's installation instructions.

3.3 INSTALLATION

A. Acceptable Installers:

1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

B. Install the Work of this section in strict accordance with manufacturer's recommendations, using only approved mounting hardware, and locating all components firmly into position, level and plumb.

C. Maintain ambient conditions for at least forth eight (48) hours.

D. Install corner guards at exterior wall corners of Foyers, Corridors, Work Rooms, and Offices. Install corner guards from top of base to ceiling.

E. Apply adhesive carefully to insure continuous contact between wall and guard. Take care to avoid soiling or leaving visible adhesive on wall or base.

3.4 CLEANING

A. General:

1. Immediately upon completion of installation, clean guards and accessories in accordance with manufacturer's recommended cleaning method.
2. Remove surplus materials, rubbish and debris resulting from installation as work progresses and upon completion of work.

3.5 PROTECTION

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

END OF SECTION

SECTION 10 2813 - COMMERCIAL TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Included But Is Not Limited To:

1. Selected accessories for Rest Rooms:

a. Grab Bars.
b. Mirrors.
c. Sanitary Napkin Disposal Container.
d. Single Robe Hook.

2. Custodial Room accessories:

a. Utility Shelf.

B. Related Requirements:

1. Section 06 1100: 'Wood Framing' for blocking.
2. Section 06 2001: 'Common Finish Carpentry Requirements' for installation.

C. Products Installed But Not Furnished Under This Section:

1. Selected accessories for Rest Rooms:

a. Towel dispensers.
b. Soap dispensers.
c. Toilet tissue dispensers.

D. Related Requirements:

1. Section 01 1200: 'Multiple Contract Summary' soap dispensers, paper towel dispensers, and toilet tissue dispensers furnished and installed by Owner (FM Group).

1.2 REFERENCES

A. Association Publications:

1. United States Access Board:

a. Americans with Disabilities Act (ADA):

1) ADA Standards:

a) ADA Accessibility Guidelines (ADAAG) (2004 or latest version).

B. Reference Standards:

1. ASTM International:

a. A153/A153M-16a, 'Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware'.
b. ASTM A653/A653M-17, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
c. ASTM A666-15, 'Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar'.
d. ASTM C1036-18, 'Standard Specification for Flat Glass'.
e. ASTM F446-85(2009), 'Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area'.

2. International Code Council / American National Standards Institute:

a. ICC/ANSI A117.1-2017, 'Accessible and Usable Buildings and Facilities'.

3. International Standard Organization:

a. ISO 25537:2008, 'Glass in Building - Silvered Flat Glass Mirror.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Manufacturer's product data sheets indicating operating characteristics, materials and finishes.
b. Mounting requirements and rough-in dimensions.

2. Shop Drawings:

a. Schedule showing items used, location where installed, and proper attaching devices for substrate.

B. Informational Submittals:

1. Manufacturers' Instructions:

a. Provide operation, care and cleaning instructions.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Warranty Documentation:

1) Final, executed copy of Warranty for each product.

b. Record Documentation:

1) Manufacturers documentation:

a) Manufacturer's literature or cut sheets.

1.4 QUALITY ASSURANCE

A. Source Limitations:

1. For products listed together in same Part 2 articles, obtain products from single source from single manufacturer.

1.5 WARRANTY

A. Manufacturer Warranty:

1. Manufacturer's standard warranty.

B. Special Mirror Warranty:

1. Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage or frame corrosion defects within specified warranty period:

a. Warranty Period: fifteen (15) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OWNER FUNISHED PRODUCTS

A. Furnished by Owner and Installed by Contractor:

1. Towel Dispensers.
2. Soap dispensers.
3. Toilet tissue dispensers.

2.2 MANUFACTURED UNITS

A. Manufacturers:

1. Manufacturer Contact List:

a. AJW Architectural Products, A&J Washroom Accessories, Inc., New Windsor, NY www.ajwashroom.com.
b. American Specialties Inc (ASI), Yonkers, NY www.americanspecialties.com.
c. Bobrick Washroom Equipment Inc, North Hollywood, CA www.bobrick.com or Bobrick Washroom Equipment of Canada Ltd, Scarborough, ON (416) 298-1611.
d. Bradley Corp, Menomonee Falls, WI www.bradleycorp.com.
e. General Accessory Manufacturing Co (GAMCO), Durant, OK www.gamcousa.com.

B. Materials:

1. Design Criteria:

a. Stainless Steel: ASTM A666 Type 304 (18-8); satin finish exposed surfaces unless otherwise indicated.
b. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
c. Fasteners:

1) Exposed: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant.
2) Concealed: Galvanized Steel.

2. Rest Rooms:

a. Mirrors:

1) Channel-Frame Mirror:

a) Frame: Type 304 or Type 430, 20 gauge stainless steel channel frame.
b) Roll-formed one piece construction.
c) Exposed surfaces have #4 satin finish.
d) Edges and corners are burr free.
e) Glass: 1/4 inch silver coated and hermetically sealed. Guaranteed for 15 years against silver spoilage. Mirrors meet ASTM C1036 requirements.
f) Concealed surface mounted wall hanger.

2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) AJW Architectural Products: Model U711.
b) American Specialties (ASI): Model 0620.
c) Bobrick: Model B-165.
d) Bradley: Model 781.
e) General Accessory (GAMCO): Model C Series.

b. Sanitary Napkin Disposal Container:

1) Design Criteria:

a) Surface mounted type 304, 22 gauge stainless steel with #4 satin finish. Seamless construction with radius and hemmed edges.
b) Stainless steel piano hinge.

2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) AJW Architectural Products: Model U590.
b) American Specialties (ASI): Model 0852.
c) Bobrick: Model B-270.
d) Bradley: Model 4781-15.
e) General Accessory (GAMCO): Model ND-1.

c. Single Robe Hook:

1) Surface mounted type 304, 22 gauge stainless steel with #4 satin finish.
2) Concealed mounting bracket.
3) Stainless steel locking setscrew on bottom.
4) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) AJW Architectural Products: Model UX110SF.
b) American Specialties (ASI): Model 7340-S.
c) Bobrick: Model B6717.
d) Bradley: Model 9114.
e) General Accessory (GAMCO): Model 76717.

d. Grab Bars:

1) Configuration shown on Contract Drawings. Include center support for longer lengths when required:
2) Design Criteria:

a) Comply with ADA guidelines and ADAAG accessible design for structural strength and local and state codes.
b) Concealed mount.
c) 18 ga, type 304 stainless steel tubing.

d) 1-1/2 inch diameter.
e) Provide center support when required.

f) Snap-on flange covers.
g) Peened (non-slip) finish.
h) Sustain loads in excess of 900 lbs.

3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) AJW Architectural Products: Model UG3 Series.
b) American Specialties (ASI): Model 3800 Series.
c) Bobrick: Model B-6806 Series.
d) Bradley: Model 812 Series.
e) General Accessory (GAMCO): Model 150 Series.

3. Custodial Rooms:

a. Utility Shelf:

1) Provide mop / broom hangers, shelf, and rod for hanging rags.
2) Size as shown on Contract Drawings.
3) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) AJW Architectural Products: Model UJ41.
b) American Specialties (ASI): Model 1300 Series.
c) Bobrick: Model B-224 Series.
d) Bradley: Model 9933 Series.
e) General Accessory (GAMCO): Model US Series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with ADA Accessibility Guidelines and installation heights as shown on Contract Drawings.

B. Assemble fixtures and associated fittings and trim in accordance with manufacturer's instructions.

C. Install using mounting devices proper for base structure.

D. Install equipment level, plumb, and firmly in place in accordance with manufacturer's rough-in drawings.

E. Grab Bars:

1. Install as per Manufacturers written installation instructions.
2. Install grab bars to withstand downward force of not less than 250 lbf per ASTM F446.

3.2 REPAIR

A. Repair or replace defective work, including damaged equipment and components.

B. Repair or replace malfunctioning equipment, or equipment with parts that bind or are misaligned.

3.3 CLEANING

A. Clean unit surfaces and leave in ready-to-use condition.

3.4 ADJUSTING

A. Test each piece of equipment provided with moving parts to assure proper operation, freedom of movement, and alignment. Install new batteries in battery-powered items.

3.5 CLOSEOUT ACTIVITIES

A. Turn over keys, tools, maintenance instructions, and maintenance stock to Owner.

END OF SECTION

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:

1. Wall hung extinguishers and brackets.
2. Extinguishers with cabinets.

B. Related Requirements:

1. Section 06 1100: 'Wood Framing' for blocking in wood-framed walls.
2. Section 06 2001: 'Common Finish Carpentry Requirements' for installation.
3. Section 09 2216: 'Non-Structural Metal Framing' for blocking in metal-framed walls.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Manufacturer's literature or cut sheets for cabinets and extinguishers.

B. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Warranty Documentation:

1) Include copy of final, executed warranty.

b. Record Documentation:

1) Testing and Inspection Reports:

a) Testing Agency Inspecting Reports of Drilled-In Mechanical Anchors / Adhesive Anchors / Screw Anchors.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:

1. Fire extinguishers shall be inspected and have annual inspection tag attached before Substantial Completion.

1.4 WARRANTY

A. Manufacturer Warranty:

1. Manufacturer's standard, written warranty on fire extinguisher.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Manufacturers:

1. Fire Extinguishers:

a. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.

1) Amerex Corp, Trussville, AL www.amerex-fire.com.
2) Ansul Incorporated, Marinette, WI www.ansul.com.
3) Buckeye Fire Equipment, Kings Mountain, NC www.buckeyef.com.
4) Extinguishers private-labeled by manufacturers approved above are approved, with appropriate documentation.

2. Cabinets And Brackets:

a. Type One Acceptable Manufacturers:

1) J L Industries, Bloomington, MN www.jlindustries.com.
2) Larsen's Manufacturing Co, Minneapolis, MN www.larsensmfg.com.
3) Modern Metal Products / Technico, Owatonna, MN www.modern-metal.com.
4) National Fire Equipment Ltd, Scarborough, ON www.nationalfire.com.
5) Potter-Roemer, Cerritos, CA www.potterroemer.com.
6) Samson Products Inc, City of Commerce, CA www.samsonproducts.com.
7) Seton Inc, Richmond Hill, ON (905) 764-1122.
8) Equal as approved by Architect before bidding. See Section 01 6200.

B. Type One Acceptable Distributors:

1. W.W. Grainger, Inc., Lake Forest, IL www.grainger.com.
2. Equal as approved by Architect before bidding. See Section 01 6200.

C. Fire Extinguishers:

1. Design Criteria:

a. Ten pound dry chemical ABC stored pressurized type equipped with pressure gauge and which does not need recharging except after use.
b. Instructions for repairs, maintenance, and recharging shall be attached.
c. Unit shall be tested and approved by UL and have minimum 4A:60-B:C UL rating. UL rating shall appear on extinguisher labels and be attached to and a part of fire extinguisher units.

D. Fire Extinguisher Cabinets:

1. Design Criteria:

a. Two-piece, semi-recessed and have white baked enameled steel tubs with clear anodized aluminum return trim and doors, clear acrylic glazing, 'Safe-T-Lock,' and cylinder locks.
b. Supply each cabinet with one specified fire extinguisher.

2. Type One Acceptable Manufacturers:

a. Basis of Design Product: Academy 1027 V10 by J L Industries.

b. Equal as approved by Architect before bidding from Acceptable Manufacturer's equivalent product. See Section 01 6200.

E. Wall-Mounted Brackets:

1. Design Criteria:

a. Heavy duty with minimum of double strap/bracket.

2. Category Four Approved Bracket. See Section 01 6200 for definitions of Categories:

a. Basis of Design Product: No. 846 by Larsen's.
b. Equal as approved by Architect before bidding from Approved Manufacturer's equivalent product.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Special Techniques:

1. Securely mount cabinets and hangers plumb with wall surfaces.
2. Trim for cabinets shall be neat in appearance.

END OF SECTION

SECTION 10 5516 - MAIL COLLECTION BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But Not Installed Under This Section:

1. Locking Security Mailbox and post as described in Contract Documents.

B. Related Requirements:

1. Section 03 3111: Mounting of ground post.
2. Section 06 2001: Installation.

1.2 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Manufacturer's literature or cut sheets and installation instructions.

B. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Record Documentation:

1) Manufacturers documentation:

a) Manufacturer's literature.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:

1. Approved by United States Postmaster General for curbside delivery (USPS Std 7B).

1.4 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:

1. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:

1. Protect from damage.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers:

1. Type One Acceptable Manufacturers.

a. Quality Standard:

1) Mailbox: Oasis Jr. Model AM6200.
2) Ground post: Oasis Jr. Model AM 5105.
3) Any authorized dealer for Architectural Mailboxes.

b. Equal as approved by Architect before bidding. See Section 01 6200.

B. Description:

1. Mailbox:

a. Large incoming hopper style door to allow delivery of small to medium sized parcels with internal security baffle, and locking lower compartment.
b. Size: 11-1/2 inch wide x 15 inches high with a depth of 18 inches at the top and 15 inches at bottom.
c. Body: 16 gage steel sheet.
d. Doors: 14 gage steel sheet.
e. Assembly Hardware:

1) Stainless steel rivets and hinges.
2) Zinc plated assembly screws.

f. Lock: Zinc plated cam lock with zinc die cast cylinder.
g. Door seals.

2. Ground Post:

a. Size: 4 inchwide x 4 inch deep x 46-1/2 inches high.
b. Steel tube: 16 gage galvanized.
c. Mounting plate: 12 inches wide x 6 inch deep.
d. Mounting hardware.

C. Finishes:

1. Powder Coating:

a. Durable, uniform, smooth protective finish.

2. Color:

a. Black.

2.2 ACCESSORIES

A. Street Address numbers on front access door.

1. Verify size with Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Follow Manufacturer's installation instructions.

B. Contact local Postal authorities for mounting height and set-back distance from road.

C. Mount ground post in concrete.

END OF SECTION

SECTION 10 7113 - EXTERIOR SUN CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Supply fully fabricated custom Exterior Sun Control Devices based on the Architect's approved shop drawings.

1.2 RELATED REQUIREMENTS

A. Section 05 4000 - Cold-Formed Metal Framing: Backing Supports, attachment, clips, and blocking to receive sun control devices.

1.3 REFERENCE STANDARDS

A. AAMA 2605 - High Performance Organic Coatings on Architectural Extrusions and Panels.

B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum.

C. AAMA 611 - Voluntary Specifications for anodized architectural aluminum.

D. American Welding Society- AWS D1.2, Structural Welding Code-Aluminum.

E. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

F. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.

G. ASTM B 221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

H. National Association of Architectural Metal Manufactures (NAAMM).

I. USGBC - Leadership in Energy and Environmental Design (LEED) Green Building Rating Systems.

1.4 SUBMITTALS

A. Product Data:

1. Standard components, sizes, shapes, and hardware description.
2. Sun Control manufacturer's data sheets on each product to be used, including:

    a. Finish manufacturer's data sheet showing physical and performance characteristics.
    b. Storage and handling requirements and recommendations.
    c. Installation instructions and recommendations.
    d. Specimen warranty for finish, as specified herein.
    e. Maintenance instructions.

B. Shop Drawings representing Designer's intent: Plans, elevations, sections, details with profiles, styles, part numbers, dimensions, materials, finishes, connections, method of anchorage, type of anchors and backing supports.

1. Differentiate between shop fabrication and field installation.
2. Indicate substrates and adjacent work specified in related sections with which the exterior sun control devices must be coordinated.

C. Samples: Submit samples, as requested, of each component, and fasteners to be utilized in Sun Control assembly with appropriate finish.

D. Structural calculations. Provide engineering calculations for the Sun Control Devices and mounting brackets, prepared by an engineer registered in the state the project is located.

E. Warranty: Provide written warranty that Sun Control products will be free of defective materials or workmanship for a period of one year from date of installation.

F. Certifications: Manufacturer's certification that Sun Control meets design criteria, Drawings and specification requirements.

1.5 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.

B. Exterior Sun Control Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with continuous experience of 5 years.

C. Installer Qualifications: Experienced in performing work of the type specified in this section.

1. With minimum 3 years of documented experience in installation of exterior Sun Control devices similar to the Work of this Section.
2. Approved by Sun Control Device manufacturer.

D. Provide sun control devices from a single source. Sub-contracting of Sun Control assembly is not acceptable.

E. Welding Qualifications: Any welding performed either in the fabrication of the sun control devices or brackets must follow AWS welding standards.

F. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.

1. Locate on project site as indicated on Drawings.
2. Provide units finished as specified.
3. Mock-up may remain as part of the Work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.

1. Protect finishes by applying heavy duty removable plastic film during production.
2. Package for protection against transportation damage.
3. Provide markings to identify components consistently with drawings.
4. Exercise care in unloading, storing and installing sun control devices to prevent bending, warping, twisting and surface damage.

B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.

1.7 WARRANTY

A. See manufacturer for additional information on extended warranty periods for high performance coatings for aluminum Sun Control Devices.

1. Anodized- Architectural Class-1: Clear film thicker than 0.7 mil.- up to a 5 year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. C.R. Laurence Co, Inc., 2503 E. Vernon Ave., Los Angeles, CA 90058-3488; Tel: (800) 421-6144 Ext. 7770 or (323) 588-1281 Ext. 7770; Fax: (866) 921-0532 or (323) 584-5258; Email: archmetals@crlaurence.com.

B. Arcadia, Inc., 231 E. Vernon, Vernon, CA; Tel: (323) 269-7300.

2.2 EXTERIOR SUN SHADE SYSTEM

A. Basis of Design: C.R. Laurence Custom Fabricated, pre-finished Aluminum Sun Control Devices.

B. Components:

1. Outriggers: 1/4 - 1/2 inch thick aluminum plate; ASTM B 209, 5052-H32 alloy.

    a. Square configuration
    b. Outrigger cover plates shall be furnished of 6061-T6 aluminum plates at each end of sunshade run to cover extension fasteners.

2. Mounting bracket options.

    a. Wall mount bracket

3. Fascia: 1/8 inch thick aluminum extrusion; ASTM B 221, 6063-T5 alloy.

    a. Square tube fascia; 8 inch.

4. Blade options:

    a. Rectangular tubes; Extruded aluminum rectangular shape; ASTM B 221, 6063-T5 alloy; size: 1 x 6 inch.

5. Back plate: 1/2 inch thick by 8 inch wide aluminum bar; ASTM B 209, 6061-T6 alloy; continuous for full length of unit for mounting to structure.
6. Anchors and Inserts: Use stainless steel anchors and inserts for installation and elsewhere as required for corrosion resistance. Use stainless steel or lead expansion bolt devices for drill-in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
7. Fasteners: Fasteners shall be stainless steel bolts, studs, sheet metal screws, and other types of size and spacing as recommended by manufacturer for specific installation conditions and as detailed on approved shop drawings. Fasteners shall be concealed to the fullest extent possible.
8. No blade fasteners shall be visible after installation of sections. Provide cover plates at each outrigger end to conceal fasteners. Only mounting hardware shall be visible after installation.

2.3 FABRICATION

A. Provide fixed Sun Control Devices and accessories of design, material, sizes, depth, arrangement, and thickness as indicated on Drawings and as required for optimal performance with respect to strength; durability; and uniform appearance.

B. Corners: Miter corners as indicated on shop drawings.

C. Fabrication tolerances: Maximum allowable tolerances.

1. Bow: + - 1/4 inch.
2. Dimensional width or length: + - 1/8 inch.
3. Squareness: + - 1/8 inch.

2.4 FINISHES

A. High performance powder coating: Spraylat Newlar thermosetting powder coating; exceeds the performance requirements of AAMA 2605. Corrosion protection: Meets 4000 hr. salt spray when tested in accordance with ASTM B117. Color to match adjacent storefront color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrate conditions in areas to receive the work. Verify dimensions, tolerances, and interface with adjacent work. Do not proceed until any unsatisfactory conditions have been corrected.

B. Upon receipt of Sun Control Devices, thoroughly examine units for damage. Promptly report any observed damage to C.R. Laurence in writing. Include digital photographs of any observed damage as well as a copy of the Bill of Lading disclosing the damage.

3.2 PREPARATION

A. Prior to fabrication, field verify required dimensions.

B. Coordinate Sun Control installation with provision of exterior wall system and window framing system to ensure proper structural support is provided, attachment of sun control devices is compatible with substrate, and weather tightness of exterior envelop is maintained.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions and recommendations for installation of the work.

B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.

C. Anchor Sun Control Devices to building substrate as indicated on drawings, and as specified.

D. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of galvanic action between metals.

E. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

F. Set units level, plumb and true to line, with uniform joints.

G. Sun Control Device installation:

1. Layout and verify centerline dimensions prior to setting outriggers wall brackets.
2. Install the two outer most outriggers wall brackets plumb and level to the substrate.
3. Then, shoot a line from outrigger to outrigger to find the depth dimension of the outer line.
4. Proceed with the installation by attaching the middle outrigger, shimming as required.
5. Shims: Non-ferrous, as recommended by manufacturer. Verify centerline dimensions after shims are installed.

H. Erection Tolerances:

1. Variation from level: +/- 1/8 inch maximum in 20 ft.- 0 inch runs, non-cumulative.
2. Maximum Offset From True Alignment Between Adjacent Members Butting or In-Line: +/- 1/32 inch.

I. Do not field cut or trim units. Cut and trim component parts during erection only with the approval of the manufacturer, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly as directed.

3.4 CLEANING

A. Remove site cuttings from finish surfaces.

B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

C. Clean aluminum surfaces in accordance with recommendations found in AAMA 609 and 610. Do not use aggressive alkaline, TSP, acid cleaners, or abrasive cleaners on aluminum surfaces.

END OF SECTION 10 7113

SECTION 10 8200 – LOUVERED ROOF TOP EQUIPMENT SCREENS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvered roof top equipment screens

B. See Division 5 Section "Structural Metal Framing" for structural framing supporting louver sections.

1.2 PERFORMANCE REQUIREMENTS

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

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

1. Wind Loads: Determine loads based on a uniform pressure of 30 lb./sq. ft. (1435 Pa), acting inward or outward.

1.3 SUBMITTALS

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

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

C. Samples: For each type of metal finish required.

D. Submittal: For louvers indicated to comply with structural performance requirements and design criteria indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221M, Alloy 6063-T5.

B. Aluminum Sheet: ASTM B 209M, Alloy 3003 with temper as required for forming.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.

2.2 FABRICATION, GENERAL

A. Join concealed frame members to each other and to fixed louver blades with fillet welds concealed from view welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 EXTRUDED-ALUMINUM ROOF TOP EQUIPMENT SCREEN

A. Horizontal Blade Louvered Roof Top Equipment Screen

1. Basis-of-Design Product: Architectural Louvers Co. (Harray, LLC); Model V4JS. Subject to compliance with requirements, provide the specified product or comparable product by one of the following:

    a. Manufacturers of equivalent products submitted and approved prior to bidding.

2. Louver Blade Depth: 4 inches (100 mm)

3. Blade Profile: Plain blade without center baffle.

4. Blade Nominal Thickness: Not less than 0.080 inch (2.03 mm).

5. Framing Support Nominal Thickness: Not less than 0.125 inch (3.2 mm)

6. Louver Performance Requirements:

    a. Free Area: Not less than 8.0 sq. ft. (0.74 sq. m) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver assembly.

    b. Horizontal Drag Coefficient: Not greater than 0.63 on a cross sectional profile, allowing for a 37% reduction in wind load imposed horizontally upon supporting structural framing.

2.4 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

EXECUTION

INSTALLATION

A. Locate and place equipment screens level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather-tight connection.

C. Provide perimeter reveals and openings of uniform width to allow for thermal expansion, as indicated.

D. Repair damaged finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory and refinish entire unit or provide new units.

END OF SECTION

DIVISION 11 - EQUIPMENT:

11 3114 Serving Area Residential Appliances

SECTION 11 3114 - RESIDENTIAL SERVING AREA APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Refrigerator.
2. Microwave Oven.

B. Related Requirements:

1. Section 01 6400: Owner will furnish specified appliances. PART 2 of this Section establishes quality of materials for information of Contractor, Architect, and Owner's Representatives. General Contractor to install all Owner Furnished Products.
2. Section 06 4114: 'Wood-Veneer-Faced Architectural Cabinets' for appliance included in cabinet.
3. Division 26: 'Electrical' for outlets and electrical service.

1.2 SUBMITTALS

A. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Record Documentation:

1) Manufacturers documentation:

a) Manufacturer's literature packaged for each appliance.

1.3 DELIVERY, STORAGE, AND HANDLING REQUIREMENTS

A. Delivery And Acceptance Requirements:

1. General Contractor responsibility:

a. Supervise unloading and handling for Owner Furnished Products.

B. Storage And Handling Requirements:

1. General Contractor responsibility:

a. Provide secure location protected from weather and other trades.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS

A. Category Two National Contract Manufacturers. See Section 01 6200 for definitions of Categories:

1. Refrigerator / Freezer:

    a. Approved Manufacturer:

        1) General Electric.

2. Microwave Oven:

    a. Approved Manufacturer:

        1) Amana.
        2) General Electric.
        3) Panasonic.
        4) Samsung.

PART 3 - EXECUTION – NOT USED

END OF SECTION

DIVISION 12 - FURNISHINGS:

12 3661 Quartz Agglomerate Countertops

SECTION 12 3661- QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: As shown on drawings.

C. Countertops: 1/2-inch-thick, quartz agglomerate with front edge built up with same material.

D. Backsplashes: 1/2-inch- thick, quartz agglomerate.

E. Joints: Fabricate countertops without joints.

F. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

2.4 QUARTZ PRODUCTS

A. Quartz: M02.

1. Manufacturers: Subject to compliance with requirements, provide products by Cosentino.
2. Quartz color and finish: BQ2088P Ethereal Glow Polished.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

B. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.

C. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

D. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.

E. Install aprons to backing and countertops with adhesive.

F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

G. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3661

DIVISION 21 – FIRE SUPPRESSION:

21 1313 Wet-Pipe Sprinkler System

SECTION 21 1313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete wet-pipe fire sprinkler system as specified in Contract Documents.

B. Related Requirements:
   1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.

1.2 REFERENCES

A. Association Publications:
   1. Underwriters Laboratories, Inc.:

B. Reference Standards:
   1. American Society of Mechanical Engineers:
      a. ASME B1.20.1-2013 'Pipe Threads, General Purpose, Inch'.
      b. ASME B16.1-2015, 'Grey Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250'.
   2. ASTM International:
      a. ASTM A53/A53M-18, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
      b. ASTM A135/A135M-09(2014), 'Standard Specification for Electric-Resistance-Welded Steel Pipe'.
   3. National Fire Protection Association:
      a. NFPA 13: 'Standard for the Installation of Sprinkler Systems' (2019 or most recent edition adopted by AHJ).
      b. NFPA 24 'Standard for the Installation of Private Fire Service Mains and Their Appurtenances' (2019 or most recent edition adopted by AHJ.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Size sprinkler system using NFPA 13 hydraulic calculation design method based on water supply evaluation performed at building site:
      b. Submittal Procedure:
         1) After award of Contract and before purchase of equipment, submit shop drawings with specifications and hydraulic calculations to jurisdiction having authority for fire prevention for review.
         2) After integrating AHJ's comments into drawings, licensed certified fire protection engineer of record or fire protection system designer who designed fire protection system shall stamp, sign, and date each sheet of shop drawings and first page of specifications and calculations.
         3) Submit stamped documents to Owner and to AHJ for fire prevention for final review and approval.
         4) After final approval, submit approved stamped documents to Fire Sprinkler Consultant.
         5) Failure of system to meet requirements of authority having jurisdiction and/or approved stamped construction documents shall be corrected at no additional cost to Owner.

B. Informational Submittals:
   1. Certificates:

a. Provide one (1) copy of completed NFPA 13 'Contractor's Material and Test Certification for Aboveground Piping' as specified in 'Field Quality Control' in Part 3 of this specification:

2. Qualification Statement:
   a. Licensed fire protection engineer or fire protection system designer:
      1) Licensed for area of Project.
      2) Certified by NICET to level three minimum.
      3) Provide Qualification documentation if requested by Fire Sprinkler Consultant or Owner's Representative.
   b. Installer:
      1) Provide Qualification documentation if requested by Fire Sprinkler Consultant or Owner's Representative.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Operations and Maintenance Data:
      1) Maintenance and instructions.
         a) List of system components used indicating name and model of each item.
         b) Manufacturer's maintenance instructions for each component installed in Project.
         c) Instructions shall include installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.

D. Maintenance Material Submittals:
1. Extra Stock Materials:
   a. Spare sprinkler heads in the quantity recommended by NFPA 13 selected in representative proportion to quantity used in Project and in accordance with NFPA 13 (Six (6) spare sprinkler heads minimum). Do not include dry barrel Pendent and dry barrel Sidewall sprinkler heads.
   b. Provide spare heads in cabinet with sprinkler head wrench for each type of head used. After approval of cabinet and contents, mount cabinet in convenient location in Riser Room.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:
1. Unless noted otherwise, system shall conform to:
   a. NFPA 13, 'Light & Ordinary Hazard Occupancies'.
   b. NFPA 24, 'Service Mains and Their Appurtenances, Private'.
   c. Requirements of local water department and local authority having jurisdiction for fire protection.

B. Qualifications:
1. Licensed fire protection engineer or fire protection system designer certified by NICET to level three minimum and engaged in design of fire protection systems. Engineer / designer shall:
2. Installer:
   a. Licensed for area of Project.
   b. Minimum five (5) years' experience in fire protection system installations.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Description:
1. Automatic wet-pipe fire sprinkler system starting at flange in Fire Riser Room and extending throughout heated portions of building.
2. Cold attic areas and roof overbuild areas over Entry Lobbies and Vestibules protected with dry pendent heads.

B. Performance:

1. Design Criteria:
    a. Area of Application and Corresponding Design Density:
        1) Serving Area and Mechanical, Electrical, and Janitorial Areas:
            a) Ordinary Hazard Group 1.
            b) Design density = 0.15 gpm per sq ft over 1,500 sq ft
        2) Storage Areas:
            a) Ordinary Hazard Group 2.
            b) Design density = 0.20 gpm per sq ft over 1,500 sq ft
        3) All Other Areas:
            a) Light Hazard.
            b) Design density = 0.10 gpm per sq ft over 1,500 sq ft
    b. Maximum Coverage per Sprinkler Head:
        1) Ordinary Hazard Areas: 130 sq ft
        2) Attic Areas: 120 sq ft
        3) Light Hazard Areas: 225 sq ft
    c. Design Area shall be hydraulically most remote area in accordance with NFPA 13.
        1) Provide a 10% safety allowance under adjusted water flow supply curve.
    d. Maximum velocity of water flow within piping: 20 feet per sec.

C. Components:
1. General: Use only domestically manufactured cast iron pipe fittings, valves, sprinkler heads, and other components.
    a. Pipe of foreign manufacture is not acceptable.
2. Pipe:
    a. Schedule 40 Welded Steel:
        1) Exterior, Above Ground: Schedule 40 hot-dip galvanized welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
        2) Interior, Above Ground: Schedule 40 black welded steel meeting requirements of ASTM A53/A53M, ASTM A135/A135M or ASTM A795/A795M.
        3) Connections:
            a) 2 inches And Smaller: Screwed, flanged, or roll grooved coupling system.
            b) 2-1/2 inches And Larger: Flanged or roll grooved coupling system.
3. Fittings:
    a. Usage:
        1) 2 inches And Smaller: Welded, screwed, flanged, or roll grooved coupling system. For use with schedule 40 carbon steel pipe.
        2) 2-1/2 inches And Larger: Welded, flanged, or roll grooved coupling system.
    b. Types And Quality:
        1) Screwed:
            a) Cast iron meeting requirements of ANSI B16.4 or ductile iron meeting requirements of ANSI B16.3 and ASTM A536, Grade 65-45-12.
        2) Flanged: Steel meeting requirements of ANSI B16.5.
        3) Press Fittings
            a) Viega MegaPress (UL and FM)
        4) Welded:
            a) Carbon steel meeting requirements of ASTM A234/A234M.
            b) Weld pipe using methods complying with AWS B2.1, level AR-3. Welding procedures and performance of welders shall comply with AWS B2.1, level AR3.
        5) Roll Grooved Pipe Coupling System:
            a) Ductile iron meeting requirements of ASTM A395/A395M and ASTM A536, and UL listed.
            b) Grooved products used on Project shall be from same manufacturer. Grooving tools shall be as recommended by manufacturer of grooved products.
            c) Approved Products:

	Gruvlok	Tyco (Grinnell)	Victaulic
Rigid Couplings	7401	772	Style 005

Flexible Couplings [1]	7000	705	Style 75
Flange Adaptors [2]	7012	71	Style 744
Grooved Coupling Gaskets [3]	'E' EPDM	Grade 'E' EPDM	'E' EPDM [4]

[1] Use in locations where vibration attenuation, stress relief, thermal expansion, or seismic design is required / needed.
[2] Class 125 or 150.
[3] Temperature rated 30 to 150 deg F
[4] Grade 'A'.

c. Use of saddle or hole cut type mechanical tees is NOT APPROVED.

4. Flexible sprinkler head connections
    1) Design Criteria:
        a) UL / CASA approved.
        b) FM approved (tagged and visually has braided stainless covering)
    2) Approved Products: See Section 01 6200 for definitions of Categories:
        a) Viking - FlexHead
        b) FlexHead industries- :FlexHead
        c) Victaulic – Vicflex (Braded Hose)

5. Valves:
    a. Butterfly Valves:
        1) Design Criteria:
            a) UL / CASA approved.
            b) Indicating type.
        2) Approved Products:
            a) Milwaukee:
            b) Nibco:
            c) Tyco (Grinnell):
            d) Victaulic: Series 705W Grooved end type with internal supv. switches.
            e) Kennedy:
    b. Gate Valves:
        1) Design Criteria:
            a) UL / CASA approved.
            b) Outside Screw and Yoke Type (O.S.&Y).
            c) Class 150 psi.
        2) Approved Products:
            a) Nibco:
            b) Mueller: R-2360-6 Flanged Ends.
            c) Victaulic: Series 771 Grooved Ends
    c. Ball Valves:
        1) Design Criteria:
            a) UL / CASA approved.
            b) Valve tamper switch.
        2) Approved Products: See Section 01 6200 for definitions of Categories:
            a) Milwaukee: BB-SCS02 with threaded ends.
            b) Nibco: KT-505 with threaded ends.
            c) Nibco: KG-505 with grooved ends.
            d) Victaulic: Series 728 with grooved or threaded ends.
    d. Swing Check Valves:
        1) 1/2 to 3 inch horizontal check.
            a) Approved Products:
                (1) Nibco: KT-403-W.
                (2) Victaulic: Series 712.
                (3) Viking: G-1 Grooved ends.
        2) 2 to 4 inch Horizontal check:
            a) Approved Products:

(1) Tyco (Grinnell): CV-1F Grooved ends.
(2) Victaulic: Series 712.
(3) Viking: G-1 Grooved ends.

3) 3 to 12 inch Horizontal check:
a) Approved Products:
(1) Nibco: F-938-31.
(2) Mueller: A-2120-6.
(3) Viking: F-1 grooved and flanged.

e. Wafer Type Check Valves:
1) Design Criteria:
a) 4 to 8 inch cast iron body.
2) Approved Products:
a) Nibco: KW-900-W.
b) Mueller: A-2102.
c) Kennedy: Fig.706.

f. Grooved-End Check Valves:
1) Design Criteria:
a) UL / CASA listed and approved to 250 psi maximum operating pressure.
b) 2-1/2 to 12 inch ductile iron body.
c) Disc And Seat:
(1) Viking: Model VK462.
2) Approved Products.
a) Nibco: KG-900-W grooved ends.
b) Victaulic: Series 717.
c) Kennedy: Fig.426.

g. Alarm Check Valves:
1) Approved Products:
a) Reliable: E with gauges and drain.
b) Tyco (Grinnell): Model AV-1-300.
c) Victaulic: Series 751 with gauges and drain.
d) Viking: J-1 with gauges and drain.

h. Backflow Preventer: Make and model shown on Drawings or as required by local codes.

i. Retard Chamber:
1) Design Criteria:
a) Self-draining.
2) Approved Products:
a) Reliable: E-1.
b) Victaulic: Series 752.
c) Viking: C-1.

j. Inspector's Test Valve:
1) Design Criteria:
a) Bronze body with threaded or grooved ends.
b) Combination sight glass / orifice.
2) Approved Products.
a) Tyco (Grinnell): Model F350.
b) Victaulic: Testmaster Alarm Test Module Style 720.

6. Sprinkler Heads:
a. Concealed Pendant:
1) Design Criteria:
a) Adjustable cover.
b) UL / CASA listed and approved.
c) Coordinate concealed cover finish with Fire Sprinkler Consultant.
2) Acceptable Products:
a) Wet Pendant, Flat Profile:
(1) Reliable: F4FR.

(2) Victaulic: Model 3802.
(3) Viking: Model VK462.
(4) Tyco (Grinnell): Model RF11.
(5) Dry Flexible :
(1) Pendent, Concealed Pendent, Horizontal Sidewall
(a) Victaulic VicFlex Style VS1 Dry Sprinkler.
b) Dry Pendant:
(1) Flat Profile:
(a) Tyco (Grinnell): DS-C.
(b) Victaulic: V3618.

b. Horizontal Sidewall Sprinkler:
1) Design Criteria:
a) UL / CASA listed and approved.
b) Recess adjustable.
2) Type One Acceptable Products:
a) Wet System:
(1) Reliable: F1FR.
(2) Tyco (Grinnell): Model TY-FRB.
(3) Victualic: Model V2710.
(4) Viking: VK305.

c. Attic Sprinklers, Upright:
1) Design Criteria:
a) UL / CASA listed and approved.
b) Approved for use in roof structures, combustible and non-combustible, with ceiling below.
2) Approved Products:
a) Tyco: BB, SD, or HIP.

d. Pendant Sprinklers:
1) Design Criteria:
a) UL / CASA listed and approved.
b) Where guards or escutcheons are required, use chrome plated sprinkler guards and escutcheons that are listed, that are approved by Sprinkler Manufacturer for use with head, and that are supplied by Sprinkler Manufacturer.
2) Acceptable Products:
a) Reliable: F1FR.
b) Tyco: TY-FRB.
c) Victaulic: Model V2704.
d) Viking: VK302.
e) Equal as approved by Fire Sprinkler Consultant before bidding. See Section 01 6200.

7. Water Flow Alarm:Electric Flow Alarm:
1) Design Criteria:
a) UL / CASA listed and approved.
2) Approved Products:
a) Potter Electric: Horn Strobe, SASH-120, 120VAC.
b) System Sensor: Horn Strobe, P2RHK-120, 120 VAC.

8. Pressure Gauges:
a. Mechanical Water Pressure Gauges:
1) Design Criteria:
a) UL / CASA listed and approved.
b) 3-1/2 inch diameter dial.
c) 0 to 300 in 5 psi increments.
2) Approved Products: See Section 01 6200 for definitions of Categories:
a) Reliable: UA.
b) HO Trerice: 500.
c) Viking: 01124A.

10. Waterflow Detectors:
    a. Electrical Water Flow Switch:
        1) Design Criteria:
            a) UL / CASA listed.
            b) Switch activates with flow of 10 gpm or more.
            c) Two single pole double throw switches.
            d) Automatic reset.
        2) Approved Products:
            a) Potter-Roemer: Model 6201 thru 6208.
            b) System Sensor: WFD20 thru WFD80.
            c) Viking: VSR-F.
11. Tamper Switch
    a. Weather and Tamper Resistant Switch.
        1) Design Criteria:
            a) UL / CASA listed.
            b) Mount to monitor valve and not interfere with operation.
            c) Shall operate in horizontal and vertical position.
        2) Approved Products.
            a) Control Valves, Butterfly Valves, Post Indicator Valves:
                (1) Potter Electric: Model PCVS.
                (2) Notifier: Model PIBV2.
                (3) System Sensor: Model PIBV2.
            b) O.S. & Y Valves:
                (1) Potter Electric: Model OSYSU.
                (2) System sensor: Model OSY2.
12. Automatic Drain Device:
    a. Design Criteria:
        1) Straight Design, 3/4 inch
    b. Approved Products:
        1) Nibco: Ball-Drip.
        2) Potter-Roemer: Figure 5982.
        3) Viking: B-1.
13. Fire Department Connection:
    a. Two-way Inlet with single clapper:
        1) Quality Standards:
            a) Round 'AUTO SPKR' identification plate, red enamel finish aluminum plate:
                (1) Croker: Fig 6766.
                (2) Potter-Roemer Fig. 5966.
        2) Approved Products.
            a) Rough chrome plated:
                (1) Croker: 6405-RC.
                (2) Potter-Roemer: Fig. 5710-C.
            b) Caps and Chains:
                (1) Croker: 6747 RC.
                (2) Potter-Roemer: 4625.
14. Riser Manifold Assembly:
    a. Design Criteria:
        1) Groove x Groove Manifold Body.
        2) Water Flow Alarm Switch, VSC with Vane, UL / CASA listed and approved.
        3) 300 psi Water Pressure Gauge.
        4) Test and Drain Valve with Manifold Drain Trim and 1/2 inch diameter test Orifice.
        5) Pressure Relief Valve, 175 psi , non-adjustable, pipe discharge to test Drain Valve.
    b. Approved Products:
        1) Tyco: Model 513.
        2) Victaulic: Style 747P.

2.2 ACCESSORIES

A. Hangers, Rods, And Clamps:
   1. Design Criteria:
      a. Galvanized, unless specified otherwise, and UL/CASA listed and labeled for service intended.
      b. Hanger supports for sprinkler piping to conformance with NFPA 13.

B. Posted System Diagram:
   1. Provide single floor plan diagram showing wet pipe system elements.
   2. Laminate diagram with plastic and mat or frame suitable for hanging near riser.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers.
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Drawings:
   1. Fire Protection Drawings show general arrangement of piping. Follow as closely as actual building construction and work of other trades will permit. Install system so it drains.

3.3 INSTALLATION

A. Connect system to flange provided under Section 33 1119: 'Fire Suppression Utility Water Distribution Piping'. After installation of riser, fill annular space between pipe and slab with flexible mastic.

B. Install sprinkler systems in accordance with requirements of latest edition of NFPA 13 and as specified below:
   1. Provide maintenance access to equipment.
   2. Conceal sprinkler lines installed in occupied areas. In Mezzanine areas, route pipe to side or underneath Mezzanine walkway. Do not impede egress from Attic.
   3. Install to enable drainage of system.
      a. Install main drain from riser according to NFPA 13.
   4. Install piping system, except for dry heads, so it will not be exposed to freezing temperatures.
   5. Do not use dropped, damaged, or used sprinkler heads.
   6. Install tamper switches and flow detectors where located by Fire Sprinkler Consultant.
   7. Except for Siamese connection, install automatic ball drip device in lowest point of piping to fire department connection and drain to floor drain or to exterior of building.
   8. Brace and support system to meet seismic zone requirements for building site.

C. Flush system at full design flow rate for minimum five minutes. Route water to outside of building. Protect landscaping and other exterior elements from damage during flow tests.

3.4 FIELD QUALITY CONTROL

A. Field Tests:
   1. Pressure Test:

a. Hydrostatically test system to 200 psi minimum for two (2) hours as required by 'Contractor's Material And Testing certificate for Aboveground Piping':

2. Water Flow Test:
   a. Test to determine static and residual pressures and corresponding flow rate at point of connection to utility water main.
   b. Adjust water flow test data for seasonal fluctuations and future growth as recommended by Water Utility and AHJ.
   c. At point of connection to utility water main, combine inside and outside hose stream allowances.
3. Check piping in relation to insulation envelope to be certain piping and auxiliary drains are properly enclosed inside building insulation envelope. Report unsatisfactory conditions to Fire Sprinkler Consultant.
4. Tests shall be witnessed by Fire Sprinkler Consultant and representative of local jurisdiction over fire prevention.

3.5 CLOSE-OUT ACTIVITIES

A. Instruction of Owner:
   1. Instruction Sessions:
      a. Instruct Owner's personnel in operation and maintenance of system utilizing 'Operation And Maintenance Manual' when so doing. Minimum instruction period shall be four (4) hours.
      b. Instruction sessions shall occur after Substantial Completion inspection when system is properly working and before final payment is made.
      c. Provide Owner with latest version of NFPA 25.

B. Training:
   1. Installer required to provide FM Training from latest version of NFPA 25 with checklist and brief explanation of following inspections:
      a. Weekly Inspection.
      b. Monthly Inspection.
      c. Quarterly Inspection.
      d. Semi-Annual Inspection.
      e. Annual Inspection.

END OF SECTION

DIVISION 22 - PLUMBING:

22 0501	Common Plumbing Requirements
22 0529	Hangers and Supports for Plumbing Piping
22 0553	Identification for Plumbing Pipes and Equipment
22 0719	Plumbing Piping Insulation
22 1116	Domestic Water Piping
22 1119	Domestic Water Piping Specialties
22 1313	Facility Sanitary Sewers
22 3423	Gas Domestic Water Heaters
22 4213	Commercial Water Closets and Urinals
22 4216	Commercial Sinks
22 4700	Drinking Fountains and Water Coolers

SECTION 22 0501 - COMMON PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for plumbing systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Furnish and install sealants relating to installation of systems installed under this Division.
   4. Furnish and install Firestop Penetration Systems for plumbing systems penetrations as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Sleeves, inserts, supports, and equipment for plumbing systems installed under other Sections.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.
         1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data (Modify and add to requirements of Section 01 7800):
         1) At beginning of PLUMBING section of Operations And Maintenance Manual, provide master index showing items included:
            a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and Plumbing subcontractor.
            b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
               (1) List of plumbing equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
               (2) Manufacturer's maintenance instructions for each piece of plumbing equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance instructions.
            c) Provide operating instructions to include:
               (1) General description of fire protection system.
               (2) Step by step procedure to follow for shutting down system or putting system into operation.
      b. Warranty Documentation:
         1) Include copies of warranties required in individual Sections of Division 22.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Perform work in accordance with applicable provisions of Plumbing Codes applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.

2. Installer:
    a. Licensed for area of Project.
    b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.

1.4 WARRANTY

A. Manufacturer Warranty:
    1. Provide certificates of warranty for each piece of equipment made out in favor of Owner.

B. Special Warranty:
    1. Guarantee plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

B. Pipe And Pipe Fittings:
    1. Weld-O-Let and Screw-O-Let fittings are acceptable.

C. Sleeves:
    1. General:
        a. Two sizes larger than bare pipe or insulation on insulated pipe.
    2. In Concrete And Masonry:
        a. Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.
    3. In Framing And Suspended Floor Slabs:
        a. Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga galvanized sheet metal.

D. Valves:
    1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Drawings:
    1. Plumbing Drawings show general arrangement of piping, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
    2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing Drawings.
    3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
    4. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true

intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

5. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.2 INSTALLATION

A. Interface With Other Work:
   1. Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
   2. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and confirm that they are properly installed.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:
   1. Arrange pipes and equipment to permit ready access to valves, cocks, unions, traps, and to clear openings of doors and access panels.
   2. Adjust locations of pipes, equipment, and fixtures to accommodate work to interferences anticipated and encountered.
   3. Install plumbing work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
   4. Determine exact route and location of each pipe before fabrication.
      a. Right-Of-Way:
         1) Lines that pitch shall have right-of-way over those that do not pitch. For example, plumbing drains shall normally have right-of-way.
         2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
      b. Offsets, Transitions, and Changes in Direction:
         1) Make offsets, transitions, and changes in direction in pipes as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
         2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Penetration Firestops:
   1. Install Penetration Firestop System appropriate for penetration at plumbing systems penetrations through walls, ceilings, roofs, and top plates of walls.

E. Sealants:
   1. Seal openings through building exterior caused by penetrations of elements of plumbing systems.
   2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

F. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus:
   1. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper installation of plumbing systems.
   2. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings:
      a. Arrange so as to facilitate removal of tube bundles.
      b. Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
         1) Make connections of dissimilar metals with di-electric unions.
         2) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
      c. Do not use reducing bushings, bull head tees, close nipples, or running couplings. Street elbows are allowed only on potable water pipe 3/4 inch in diameter and smaller.

d. Install piping systems so they may be easily drained
e. Install piping to insure noiseless circulation.
f. Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.

3. Do not install piping in shear walls.
4. Cut piping accurately to measurements established at site. Remove burr and cutting slag from pipes.
5. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
6. Make changes in direction with proper fittings.
7. Expansion of Thermoplastic Pipe:
   a. Provide for expansion in every 30 feet of straight run.
   b. Provide 12 inch offset below roof line in each vent line penetrating roof.

G. Sleeves:
1. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete slabs on grade.
2. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Seal sleeves with specified sealants.
3. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
4. Sleeves through floors and foundation walls shall be watertight.

H. Escutcheons:
1. Provide spring clamp plates where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
1. Perform tests on plumbing piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:
1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.
2. Repeat tests on new material, if requested.

3.4 CLEANING

A. Remove dirt, grease, and other foreign matter from each length of piping before installation:
1. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
2. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
3. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

B. Clean exposed piping, equipment, and fixtures. Remove stickers from fixtures and adjust flush valves.

3.5 CLOSEOUT ACTIVITIES

A. Instruction of Owner:
1. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of plumbing systems utilizing Operation And Maintenance Manual when so doing.
2. Conduct instruction period after Substantial Completion inspection when systems are properly working and before final payment is made.

3.6 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

END OF SECTION

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common hanger and support requirements and procedures for plumbing systems.

B. Products Installed But Not Furnished Under This Section:
   1. Paint identification for gas piping used in HVAC equipment.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Materials:
   1. Hangers, Rods, And Inserts
      a. Galvanized and UL approved for service intended.
      b. Support horizontal piping from hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
         1) Support insulated pipes 2 inches in diameter and smaller with adjustable swivel ring hanger with insulation protection shield. Gauge and length of shield shall be in accordance with Anvil design data.
            a) Acceptable Products:
               (1) Swivel Ring Hanger: Anvil Fig. 69.
               (2) Insulation Protection Shield: Anvil Fig. 167.
               (3) Equals by Cooper B-Line.
         2) Support insulated pipes 2-1/2 inches in diameter and larger with clevis hanger or roller assembly with an insulation protection shield. Gauge and length of shield shall be according to Anvil design data.
            a) Acceptable Products:
               (1) Clevis Hanger: Anvil Fig. 260.
               (2) Roller Assembly: Anvil Fig. 171.
               (3) Insulation Protection Shield: Anvil Fig. 167.
               (4) Equals by Cooper B-Line.
         3) Support uninsulated copper pipe 2 inches in diameter and smaller from swivel ring hanger, copper plated and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from swivel ring hanger.
            a) Acceptable Products:
               (1) Swivel Ring Hanger For Copper Pipe: Anvil Fig. CT-69.
               (2) Swivel Ring Hanger For Other Pipe: Anvil Fig. 69.
               (3) Equals by Cooper B-Line.

4) Support uninsulated copper pipe 2-1/2 inches in diameter and larger from clevis hanger, copper plated hangers and otherwise fully suitable for use with copper tubing. Support non-copper uninsulated pipes from clevis hanger.
   a) Acceptable Products:
      (1) Clevis Hanger For Copper Pipe: Anvil Fig. CT-65.
      (2) (3) Equals by Cooper B-Line.

c. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches
7/8 inch	8 to 12 inches

d. Support rods for multiple pipe supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
Number	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

1) Size trapeze angles so bending stress is less than 10,000 psi

e. Riser Clamps For Vertical Piping:
   1) Acceptable Products:
      a) Anvil Fig. 261.
      b) Equals by Cooper B-Line.

f. Concrete Inserts:
   1) Individual Inserts:
      a) Suitable for special nuts size 3/8 inch through 7/8 inch with yoke to receive concrete reinforcing rods, and with malleable iron lugs for attaching to forms.
      b) Acceptable Products:
         (1) Anvil Fig. 282.
         (2) Equals by Cooper B-Line.
   2) Continuous Inserts:
      a) Class Two Quality Standard: Equal to Unistrut P-3200 series.

g. Steel Deck Bracket:
   1) Class Two Quality Standard: Equal to Unistrut P1000 with clamp nut, minimum 6 inch length.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping:
   1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
      a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using Unistrut and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.

b. Supports For Horizontal Piping:
   1) Support metal piping at 96 inches on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
   2) Support thermoplastic pipe at 48 inches on center maximum.
   3) Provide support at each elbow. Install additional support as required.

c. Supports for Vertical Piping:
   1) Place riser clamps at each floor or ceiling level.
   2) Securely support clamps by structural members, which in turn are supported directly from building structure.
   3) Provide clamps as necessary to brace pipe to wall.

d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.

2. Gas piping Identification:
   a. Apply paint identification for gas piping used with HVAC equipment as specified in Section 23 0553.

END OF SECTION

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPES AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install identification of plumbing piping and equipment as described in Contract Documents.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Labels:
      a. Equipment Identification:
         1) Black formica, with white reveal when engraved.
         2) Lettering to be 3/16 inch high minimum.
   2. Paint:
      a. One Coat Primer:
         1) 6-2 Quick Drying Latex Primer Sealer over fabric covers.
         2) 6-205 Metal Primer under dark color paint.
         3) 6-6 Metal Primer under light color paint.
      b. Finish Coats: Two coats 53 Line Acrylic Enamel.
      c. Acceptable Products. .
         1) Paint of equal quality from Manufacturers may be submitted for Architect's approval before use.

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:
   1. Identify following items with specified labels fastened to equipment with screws:
      a. Water Heaters.
   2. Engrave following data from Equipment Schedules on Drawings onto labels:
      a. Equipment mark.
      b. Room(s) served.

B. Painting:
   1. Only painted legends, directional arrows, and color bands are acceptable.
   2. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
      a. Adjacent to each item of equipment.
      b. At point of entry and exit where piping goes through wall.
      c. On each riser and junction.
      d. Every 25 feet on long continuous lines.

3.2 ATTACHMENTS

A. Schedules:
   1. Pipe Identification Schedule:
      a. Apply stenciled symbols as follows:

Pipe Use	Abbreviation	Direction of Flow
Domestic Cold Water	CW	
Domestic Hot Water	HW	
Domestic Recirc Water	HW Recirc	

END OF SECTION

SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install insulation on hot and cold water lines, fittings, valves, and accessories as described in Contract Documents.
   2. Furnish and install insulation on roof drain piping as described in Contract Documents.

B. Related Requirements:
   1. Section 22 1116: 'Domestic Water Piping'.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Materials:
   1. Above Grade Metal Piping:
      a. Insulation For Piping:
         1) Snap-on glass fiber or melamine foam pipe insulation, or heavy density pipe insulation with factory vapor jacket.

         2) Insulation Thickness:

Service Water Temperature	Pipe Sizes		
	Up to 1-1/4 In	1-1/2 to 2 In	Over 2 In
170 - 180 Deg F	One In	1-1/2 In	2 In
140 - 160 Deg F	1/2 In	One In	1-1/2 In
45 - 130 Deg F	1/2 In	1/2 In	One In

         3) Acceptable Manufacturers:
            a) Childers Products.
            b) Knauf.
            c) Manson.
            d) Owens-Corning.
            e) Johns-Manville.
      b. Fitting, Valve, And Accessory Covers:
         1) PVC.
         2) Performance Standard: Zeston by Johns-Manville.
         3) Type One Acceptable Manufacturers:
            a) Knauf.
            b) Speedline.
            c) Johns-Manville.
            d) Equal as approved by Architect before bidding.
   2. Below Grade Metal Piping:
      a. Insulation:
         1) 1/2 inch thick.
         2) Acceptable Products.
            a) SS Tubolit by Armacell.
            b) ImcoLock by Imcoa.

c) Nomalock or Therma-Cel by Nomaco.

b. Joint Sealant:

1) Acceptable Products.

a) Armacell 520.

b) Nomaco K-Flex R-373.

3. PVC Piping, Above And Below Grade - Facility Storm Drain:

a. Insulation:

1) 1/2 inch thick.

2) Acceptable Products.

a) SS Tubolit by Armacell.

b) ImcoLock by Imcoa.

c) Nomalock or Therma-Cel by Nomaco.

b. Joint Sealant:

1) Acceptable Products.

a) Armacell 520.

b) Nomaco K-Flex R-373.

PART 3 - EXECUTION

3.1 APPLICATION

A. Above Grade Piping:

1. Apply insulation to clean, dry piping with joints tightly butted.
2. Install insulation in manner to facilitate removal for repairs. Place sections or blocks so least possible damage to insulation will result from inspection or repairs of piping or equipment.
3. Piping up to 1-1/4 inch Diameter:
   a. Adhere 'factory applied vapor barrier jacket lap' smoothly and securely at longitudinal laps with white vapor barrier adhesive.
   b. Adhere 3 inch wide self-sealing butt joint strips over end joints.
4. Piping 1-1/2 inches Diameter And Larger:
   a. Use broken-joint construction in application of two-layer covering.
   b. Fill cracks and depressions with insulating cement mixed to thick plastic paste.
      1) Apply by hand in several layers to make up total specified thickness.
      2) Final layer shall have smooth uniform finish before application of covering.
5. Fittings, Valves, And Accessories:
   a. Do not apply insulation over flanged joints or victaulic couplings until piping has been brought up to operating temperature and flange bolts have been fully tightened. Insulate valves so wheel, stem, and packing nut are exposed.
   b. Insulate with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
   c. Piping Up To 1-1/4 Inch Diameter:
      1) Cover insulation with one piece fitting cover secured by stapling or taping ends to adjacent pipe covering.
   d. Piping 1-1/2 inches To 2 Inches
      1) Insulate with hydraulic setting insulating cement or equal, to thickness equal to adjoining pipe insulation.
      2) Apply final coat of fitting mastic over insulating cement.
   e. Piping 2-1/2 inch And Larger:
      1) Insulate with segments of molded insulation securely wired in place and coated with skim coat of insulating cement.
      2) Apply fitting mastic, fitting tape and finish with final coat of fitting mastic.
6. Pipe Hangers:
   a. Do not allow pipes to come in contact with hangers.
   b. Pipe Shield:
      1) Provide schedule 40 PVC by 6 inch long at each clevis and/or unistrut type hanger.

2) Provide 16 ga by 6 long galvanized shields at each pipe hanger to protect pipe insulation from crushing by clevis hanger or Unistrut type hanger.

c. At Pipe Hangers:

1) Provide rigid calcium silicate insulation 100 psi compressive strength at least 2 inches beyond shield.

7. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

B. Below Grade Piping:

1. Slip underground pipe insulation onto pipe and seal butt joints.
2. Where slip-on technique is not possible, slit insulation, apply to pipe, and seal seams and joints.

END OF SECTION

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavating and backfilling required by work of this Section.
   2. Furnish and install potable water piping complete with necessary valves, connections, and accessories inside building and connect with outside utility lines 5 feet from building perimeter as described in Contract Documents.

B. Related Requirements:

1.2 REFERENCES

A. Reference Standards:
   1. American National Standards Institute / American Society of Sanitary Engineers:
      a. ANSI/ASSE 1003-2009, 'Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems'.
      b. ANSI/ASSE 1017-2009, 'Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems'.
   2. ASTM International:
      a. ASTM B88-16, 'Standard Specification for Seamless Copper Water Tube'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's Literature:
         1) Copper pipe Type “L” pipe and fittings.

B. Informational Submittals:
   1. Test And Evaluation Reports:
      a. Written report of sterilization test.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

1.5 WARRANTY

A. Manufacturer Warranty:
   1. Manufacturer’s Warranty covering property damage caused by defective product including renovation costs or replacement costs.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Materials:
1. Design Criteria:
   a. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
2. Pipe:
   a. Copper:
      1) Above-Grade:
         a) Meet requirements of ASTM B88, Type L.
      2) Below-Grade:
         a) Meet requirements of ASTM B88, Type K. 3/4 inch minimum under slabs.
         b) 2 inches And Smaller: Annealed soft drawn.
3. Fittings:
   a. For Copper Pipe: Wrought copper.
4. Connections For Copper Pipe:
   a. Above-Grade:
      1) Sweat copper type with 95/5 or 96/4 Tin-Antimony solder, Bridgit solder, or Silvabrite 100 solder. Use only lead-free solder.
      2) Viega ProPress System
   b. Below Grade:
      1) Brazed using following type rods:
         a) Copper to Copper Connections:
            (1) AWS Classification BCuP-4 Copper Phosphorus (6 percent silver).
            (2) AWS Classification BCuP-5 Copper Phosphorus (15 percent silver).
      2) Copper to Brass or Copper to Steel Connections: AWS Classification BAg-5 Silver (45 percent silver).
      3) Do not use rods containing Cadmium.
      4) Brazing Flux:
         a) Approved Products:
            (1) Stay-Silv white brazing flux by Harris Product Group.
            (2) High quality silver solder flux by Handy & Harmon.
      5) Joints under slabs acceptable only if allowed by local codes.
5. Ball Valves:
   a. Use ball valves exclusively unless otherwise specified. Ball valves shall be by single manufacturer from approved list below.
   b. Valves shall be two-piece, full port for 150 psi SWP.
      1) Operate with flow in either direction, suitable for throttling and tight shut-off.
      2) Body: Bronze, 150 psig wsp at 350 deg F and 400 psig wog.
      3) Seat: Bubble tight at 100 psig under water.
   c. Quality Standard: Nibco T585 or S585.
      1) Equal by Conbraco 'Apollo,' Hammond, Milwaukee, or Watts.
6. Combination Pressure Reducing Valve / Strainer:
   a. Integral stainless steel strainer, or separate 'Y' strainer installed upstream of pressure reducing valve.
   b. Meet ANSI/ASSE 1003 or CSA B356 requirements.
   c. Built-in thermal expansion bypass check valve.
   d. Quality Standard: Watts LFU5B:
      1) Equal by Cash Acme, Cla-Val Hi Capacity, Conbraco 36C, Honeywell-Braukmann, Spence Hi Capacity, Watts, or Wilkins.
7. Mixing Valve For Lavatories:
   a. Solid brass construction and CSA B125 certified.
   b. Includes integral check valves and inlet screen. Features advanced paraffin-based actuation technology.

c. Flow of 5.7 GPM with maximum 10 psi pressure drop. Perform to minimum flow of 0.5 GPM in accordance with ASSE 1070.
d. Set for 110 deg F Service.
e. Match Construction Drawings for connection sizes.
f. Quality Standard: Powers LFLM495. See Section 01 6200.
g. Acceptable Manufacturers: Acorn, Chicago Faucets, Leonard, Powers, Sloan, Symmons and Watts.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate cold water lines a minimum of 6 inches from hot water line.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Before pipes are covered, test systems in presence of Architect at 125 psig hydrostatic pressure for four (4) hours and show no leaks.
2. Disconnect equipment not suitable for 125 psig pressure from piping system during test period.

3.3 CLEANING

A. Sterilize potable water system with solution containing 200 parts per million minimum of available chlorine and maintaining pH of 7.5 minimum. Introduce chlorinating materials into system in manner approved by Architect/Engineer. Allow sterilization solution to remain for twenty-four (24) hours and open and close valves and faucets several times during that time.

B. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.

C. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.

END OF SECTION

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install miscellaneous potable water piping specialties as described in Contract Documents.

1.2 REFERENCES

A. Reference Standards:
   1. NSF International Standard / American National Standards Institute:
      a. NSF/ANSI 61-2014a, 'Drinking Water System Components - Health Effects'.
      b. NSF/ANSI 372-2011, 'Drinking Water System Components - Lead Content'.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

PART 2 - PRODUCTS

2.1 ACCESSORIES

A. Materials:
   1. Trap Guard Trap Seal:
      a. Approved Products.
         1) Trap Guard by Proset:
            a) Install per Manufacturer's recommendations.
         2) Sure Seal by Sure Seal:
            a) Install per Manufacturer's recommendation.
   2. Pressure Reducing Station:
      a. Design Criteria:
         1) Meet NSF International Standards for Lead Free.
      b. Pressure Gauges:
         1) Gauges shall have following features:
            a) Cast aluminum case.
            b) Chrome plated ring.
            c) Impact resistant window.
            d) Phosphor bronze alloy steel bourdon tube.
            e) 1/2 percent scale range accuracy.
            f) 4-1/2 inch diameter dial face.
            g) Range 0 to 100 psig.
         2) Class One Quality Standard: 500X by H O Trerice.
            a) Equal by Ashcroft or Weiss. See Section 01 6200.
      c. Brass Gauge Cocks:
         1) Approved Products.
            a) 1092 by Ashcroft.

b) 865 by H O Trerice.

4. Exterior Hydrants:
   a. Design Criteria:
      1) Provide with integral anti-siphon device. Key-operated.
      2) Non-freeze: Provide 12 inches from inside face of outside wall into heated space.
   b. Approved Products.
      1) Josam: 71050.
      2) Jay R. Smith: 5609-QT.
      3) Prier: C-634.
      4) Wade: W-8600.
      5) Watts: HY-725.
      6) Woodford: 67.
      7) Zurn: Z-1310.
5. Water Hammer Arrestors:
   a. Design Criteria:
      1) Meet NSF International Standards for Lead Free.
      2) Nesting type, air pre-charged bellows with casing.
      3) Bellows constructed of stabilized 18-8 stainless steel.
   b. Approved Products.
      1) Josam: 75003.
      2) Jay R. Smith: 5020.
      3) Sioux Chief: 650 Series.
      4) Wade: 20.
6. Double Check Valve Backflow Preventer:
   a. Design Criteria:
      1) Meet NSF International Standards for Lead Free.
      2) 175 psi maximum working water pressure.
      3) 180 deg F maximum working water temperature.
      4) Provide ball valves.
      5) Provide inlet strainer.
   b. Approved Products.
      1) ConBraco: DCLF4A.
      2) Watts: LF007.
      3) Zurn: 375XLVSR.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Trap Guards: Install trap guards at each floor drain per manufacturers written instructions.

B. Pressure Reducing Station: Install pressure reducing station at building water service entry as indicated. Install PRV per manufacturer's instructions and in serviceable location.

C. Exterior Hydrants: Install non-freeze exterior hydrant where indicated. Install hydrant 24" above finished grade line.

D. Water Hammer Arrestors: Install water hammer arrestors where indicated on the drawings or where required to protect water lines from hydraulic shock. Install ball isolation valve at each water hammer arrester for service.

E. Gauges: Connect to pipe with 1/4 inch connections utilizing gauge cocks.

F. Double Check Valve Assembly: Install double check valve assembly at building water service entry as indicated. Install DCVA horizontally on wall in accordance with manufacturer's instructions. Maintain service clearance.

END OF SECTION

SECTION 22 1313 - FACILITY STORM AND SANITARY SEWERS

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install storm drain, soil, waste, and vent piping systems within building and connect with outside utility lines 5 feet out from building where applicable.
   2. Perform excavation and backfill required by work of this Section.

1.2 REFERENCES

A. Reference Standards:
   1. American Water Works Association (AWWA):
      a. ASTM D2321-18, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
      b. ASTM D3034–16, 'Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Performance:
   1. Design Criteria:
      a. Minimum size of storm and waste piping installed under floor slab on grade shall be 2 inches
   2. Piping And Fittings: PVC Schedule 40 cellular core plastic pipe and pipe fittings meeting requirements of ASTM F891, joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
      a. Furnish wall cleanouts with chrome wall cover and screw.
   3. Cleanouts:
      a. Furnish wall cleanouts with chrome wall cover and screw.
      b. Acceptable Products:
         1) Finish Floors:
            a) Josam: 56010.
            b) J. R. Smith: 4023.
            c) Mifab: C1100C-R-1.
            d) Wade: W-6000.
            e) Watts: CO-200-R.
            f) Zurn: Z-1402.
         2) Resilient Flooring:
            a) Josam: 56010-12.
            b) J. R. Smith: 4140.
            c) Mifab: C1100C-T-1.
            d) Wade: W-6000-T.
            e) Watts: CO-200-T.
            f) Zurn: Z-1400.
         3) Finished Wall:
            a) Josam: 58790.
            b) J. R. Smith: 4530.
            c) Mifab: C1460RD.
            d) Wade: W8560E.
            e) Watts: CO-460-RD.
            f) Zurn: Z-1446.

4) Exposed Drain Lines:
   a) Josam: 58910.
   b) J. R. Smith: 4510.
   c) Mifab: C1460.
   d) Wade: W8560B.
   e) Watts: CO-460.
   f) Zurn: Z-1440.
5) General Purpose:
   a) Josam: 58900.
   b) J. R. Smith: 4400.
   c) Mifab: C1300-MF
   d) Wade: W8550E.
   e) Watts: CO-380.
   f) Zurn: Z-1440.
6) Equal as approved by Architect before installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Drawings.
   2. Excavate to required depth and grade to obtain fall required. Grade soil and waste lines within building perimeter 1/4 inch fall in one foot in direction of flow.
   3. Bottom of trenches shall be hard. Tamp as required.
   4. Remove debris from trench before laying of pipe.
   5. Do not cut trenches near footings without consulting Architect.

B. Thermoplastic Pipe And Fittings:
   1. General: Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
   2. Above Grade: Locate pipe hangers every 4 feet on center maximum and at elbows.
   3. Below Grade:
      a. Install in accordance with Manufacturer's recommendations and ASTM D2321.
      b. Stabilize unstable trench bottoms.
      c. Bed pipe true to line and grade with continuous support from firm base.
         1) Bedding depth: 4 to 6 inches
         2) Material and compaction to meet ASTM standard noted above.
      d. Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
      e. Trench width at top of pipe:
         1) Minimum: 18 inches or diameter of pipe plus 12 inches, whichever is greater.
         2) Maximum: Outside diameter of pipe plus 24 inches
      f. Do not use backhoe or power equipment to assemble pipe.
      g. Initial backfill shall be 12 inches above top of pipe with material specified in referenced ASTM standard.
      h. Minimum cover over top of pipe not under building slab:
         1) 36 inches before wheel loading.
         2) 48 inches before compaction.

C. Install piping so cleanouts may be installed as follows:
   1. At every 135 degrees of accumulative change in direction for horizontal lines.
   2. Every 100 feet of horizontal run.

3. Extend piping to accessible surface. Do not install piping so cleanouts must be installed in carpeted floors. In such locations, configure piping so wall type cleanouts may be used.

D. Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have seal trap in connection with complete venting system so gasses pass freely to atmosphere with no pressure or siphon condition on water seal.

E. Vent entire waste system to atmosphere. Join lines together in fewest practicable numbers before projecting above roof. Set back vent lines so they will not pierce roof near edge or valley. Vent line terminations shall be:
1. 24 inches minimum above roof and 12 inches minimum from any vertical surface.
2. Same size as vent pipe.

F. Install roof drains, primary and secondary, where indicated. Extend roof drain piping as indicated. Coordinate installation of roof drain piping with structural, mechanical, electrical and plumbing trades. Maintain required pipe slope.

G. Furnish and install firestopping at penetrations of fire-rated structures as required under Sections 07 8400 and 22 0501.

H. If test Tees are used for testing, plug Tees so wall finish can be installed. Do not leave as exposed cleanouts.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Conduct tests for leaks and defective work. Notify Architect before testing.
2. Thermoplastic Pipe System:
   a. Before backfilling and compacting of trenches, Fill storm drain, waste and vent systems with water to roof level or 10 feet minimum, and show no leaks for two hours. Correct leaks and defective work.
   b. After backfilling and compacting of trenches is complete but before placing floor slab, re-test as specified above. Uncover pipe and correct leaks and defective work. Re-backfill and compact and re-test.

END OF SECTION

SECTION 22 3423 - GAS DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install gas-fired storage type water heater as described in Contract Documents.

1.2 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
      b. Warranty Documentation:

1.3 QUALITY ASSURANCE

1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.
2. Anchoring Components:
   a. Seismic and California certified/approved and labeled:
      1) Straps/anchoring systems.
      2) Fasteners.

1.4 WARRANTY

A. Manufacturer Warranty:
   1. Provide Manufacture standard warranty from date of Substantial Completion covering both tank and component parts for leakage or other malfunction caused by defects in materials and/or workmanship.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Materials:
   1. Design Criteria:
      a. All (wetted) drinking water products, components, and materials used in drinking water systems must meet NSF International Standards for Lead Free.
   2. Condensing Type Water Heaters:
      a. Stainless steel or 90/10 cupronickel heat exchanger, pressure tested and rated for 150 psi w.p. complete with thermostat, high limit control, gas pressure regulator, 100 percent safety shutoff and powered combustion air blower. AGA and CGA approved.
      b. 94 percent thermal efficiency.
      c. Temperature and pressure relief valve sized to match heat input and set to relieve at 120 psi
      d. Vacuum relief valve meeting requirements of CSA ANSI Z21.22.
      e. 34 - Gallon
         1) Approved Products.

a) Polaris Model PGC3 34-130-2NV by American (34 gallons).

2.2 ACCESSORIES

A. Anchoring Components:
   1. Seismic and California certified/approved and labeled.
      a. One inch by 18 ga galvanized steel straps.

B. Recirculation Pump and Circulation Pump Control:
   1. Circulation Pump.
   2. Controller with aquastat temperature sensor.

C. Thermal Expansion Absorbers:
   1. Bladder type for use with potable water systems.
   2. Type One Acceptable Products:
      a. Therm-X-Trol ST-5 by Amtrol Inc
      b. Equal as approved by Architect before bidding.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gas fired water heater where indicated on the drawings and per details. Install water heater complete with two-inch-deep aluminum drip pan. Pipe drip pan drain line full size to floor drain. Install water heater on one-inch-thick neoprene vibration isolators inside the drain pan to elevate the water heater above the bottom of the drain pan.

B. Make all required water and gas piping connections to the water heater per manufacturer's instructions.

C. Install water heater combustion air/flue piping in Schedule 40 PVC per manufacturer's instructions. Extend combustion air and flue piping to roof; terminate with manufacturer's concentric flue kit.

D. Install temperature-pressure relief valve on hot water heater and pipe discharge to directly above funnel of floor drain.

E. Anchor water heater to wall using two anchoring straps and specified screws.
   1. Anchors shall be installed with one on vertical upper 1/3 and one on lower 1/3 of water heater.

F. Install hot water circulation pump and pump controls per manufacturer's instructions.

G. Seismic Anchoring Systems shall be installed following Manufacturers requirements to California certifications or for minimum requirement, use Lag Bolts into studs.

3.2 ADJUSTING

A. Set discharge water temperature at 140 deg F or as indicated on Contract Drawings.

END OF SECTION

SECTION 22 4213 - COMMERCIAL WATER CLOSETS AND URINALS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install plumbing fixtures as described in Contract Documents.

B. Related Requirements:
   1. Section 07 9213: 'Elastomeric Joint Sealants' for sealants used between fixtures and other substrates.
   2. Section 22 0501: 'Common Plumbing Requirements'.
   3. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

A. Definitions:
   1. High-Efficiency Toilet (HET): Toilets with effective flush volume of 1.28 gallons or less.

B. Reference Standards:
   1. American Society of Mechanical Engineers
      a. ASME A112.19.2-2018/CSA B45.1-18, 'Ceramic Plumbing Fixtures'.

1.3 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations and Maintenance Manual specified in Section 01 7800:
      a. Operation and Maintenance Data:
         1) Sensor Operated operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Performance:
   1. Design Criteria:
      a. Meet or exceed ASME A112.19.2/CSA B45.1 for Vitreous China Plumbing Fixtures.
      b. Interior exposed pipe, valves, and fixture trim, including trim behind custom casework doors, shall be chrome plated.
      c. All materials NOT required to be low lead compliant.
      d. Do not use toilets with effective flush volume of less than 1.28 gallons

B. Materials:
   1. Water Closets:
      a. Floor Mounted (Top Spud) with matched Flush Valve:
         1) HET (High-Efficiency Toilet) - Standard Fixture (WC-1):
            a) Water usage of 1.28 gallons per flush.
            b) Battery operated.

(1) Approved Products. American Standard: Madera Elongated 3451.00 with American Standard 6065.161.002.
(2) Kohler: Wellworth K-4406 with Tripoint DC 1.28 GPF WC Flushometer K-10956-SV.
(3) Sloan ST-2009-A with flushometer Sloan G2 OPTIMA Plus 8111-1.28.

2) HET (High-Efficiency Toilet) - Handicap Accessible Fixture (WC-2):
a) Water usage of 1.28 gallons per flush.
b) 18 inch maximum rim height.
c) Approved Products.
(1) American Standard: Madera FloWise Elongated 3461.001 with Flushometer American Standard 6065.121.002.
(2) Kohler: Highline EL ADA K-4405 with Tripoint DC 1.28 GPF WC Flushometer K-10956-SV.
(3) Sloan ST-2009-A with Flushometer Sloan G2 OPTIMA Plus 8111-1.28.

2. Water Closet Accessories:
a. Flush Valves:
1) Water Closets must have required flush valves.
b. Seats:
1) Provide split front type with check hinge.
2) Approved Products.
a) Standard And Handicap Accessible Fixtures:
(1) American Standard: 5905.100SS.
(2) Bemis: 1655SSC.
(3) Beneke: 527 SS.
(4) Church: 9500SSC.
(5) Kohler: K-4731-C.
(6) Olsonite: 95SSC.
(7) Toto SC534.
c. Flush Valve Filter:
1) Required in following flush valves:
a) Sloan.
b) Zurn.
2) Approved Products.
a) SFDG1 'Dirt Grabber' by South Fork Manufacturing.

3. Urinals:
a. HEU (High-Efficiency Urinal) - Standard Fixture (U-1):
1) Water usage of 0.5 gallons per flush.
2) Approved Products.
a) American Standard: Washbrook FloWise 6590.001.
b) Gerber: Monitor 27-730.
c) Kohler: Bardon K-4904-ET.
d) Sloan SU-1009.
e) Toto: UT447E.
b. HEU (High-Efficiency Urinal) - Handicap Accessible Fixture (U-2):
1) Water usage of 0.5 gallons per flush.
2) Approved Products.
a) American Standard: Washbrook FloWise 6590.001.
b) Gerber: Monitor 27-730.
c) Kohler: Bardon K-4904-ET.
d) Sloan SU-1009.
e) Toto: UT447E.

4. Urinal Accessories:
a. Carrier / Support:
1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Josam.
b) Jay R. Smith.
c) Mifab.

d) Wade.
e) Zurn.

b. Flush Valve:
1) HEU (High-Efficiency Urinal) - Standard:
a) Proximity sensor type with battery.
b) Low flow, 0.5 gallon per flush maximum.
c) Approved Products.
(1) American Standard 6063.051.
(2) Delany: PL 1451-0.5.
(3) Delta: 81T231BTA factory set to 0.5 gallons per flush.
(4) Moen: 8315.
(5) Sloan: 8186-0.5.
(6) Zurn: ZER6003AV-EWS with maintenance override button.

c. Flush Valve Filter:
1) Required in following flush valves:
a) Sloan.
b) Zurn.
2) Approved Products.
a) SFDG1 'Dirt Grabber' by South Fork Manufacturing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each fixture with separate vent line. Do not circuit vent.

B. Install water closets and urinals per manufacturer's instructions and were indicated. Make all required water waste and vent connections.

C. Ensure provisions are made for proper support of fixtures and that rough-in piping is accurately set and protected from movement and damage.
1. Seal wall-mounted fixtures around edges to wall with sealant specified in Section 07 9213 'Elastomeric Joint Sealants'.
2. Attach wall-hung fixtures to carriers.
3. Support fixture hanger or arm free of finished wall.

D. Adjust flush valves for proper flow.

E. Flush Valve Water Closets and Urinals: Install with accessible stop or control valve in each branch supply line.

F. Mounting:
1. Urinals:
a. Standard: 24 inches from floor to bottom lip.
b. Handicap Accessible: 17 inches maximum from floor to bottom lip.

G. Water Closets:
1. Floor Fixtures:
a. Make fixture connections with approved brand of cast iron flange, soldered or caulked securely to waste pipe. Make joints between fixtures and flanges tight with approved fixture setting compound or gaskets. Caulk between fixtures with sealant specified in Section 07 9213. Point edges.

H. Flush Valve Filters:
1. Install in Sloan and Zurn only flush valves.
2. Install after water lines have been flushed out, but before turning water into flush valve.

3.2 CLEANING

A. Polish chrome finish at completion of Project.

END OF SECTION

SECTION 22 4216 - COMMERCIAL LAVATORIES AND SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install plumbing fixtures as described in Contract Documents.

B. Related Requirements:
   1. Section 07 9213: 'Elastomeric Joint Sealants' for sealants used between fixtures and other substrates.
   2. Section 22 0501: 'Common Plumbing Requirements'.
   3. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

A. Reference Standard:
   1. American National Standards Institute / International Code Council:
      a. ANSI/ICC A117.1-2017, 'Standard for Accessible and Usable Buildings and Facilities'.
   2. American Society of Mechanical Engineers
      a. ASME A112.18.1-2018/CSA B125.1-18, 'Plumbing Supply Fittings'.
      b. ASME A112.19.1-2018/CSA B45.2-18, 'Enamelled Cast Iron Fixtures'.
      c. ASME A112.19.3-2017/CSA B45.4-17, 'Stainless steel plumbing fixtures'.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

1.4 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations and Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Final, executed copy of Warranty.

1.5 WARRANTY

A. Manufacturer Warranty:
   1. Manufacturer's standard Warranty against material or Manufacturing defects.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Performance:
1. Design Criteria:
a. Interior exposed pipe, valves, and fixture trim, including trim behind custom casework doors, shall be chrome plated.
b. Faucets and other fixture fittings shall conform to requirements of ASME A112.18.1/CSA B125.1.
c. Lavatories shall conform to requirements of:
1) Enamelled cast iron fixtures.
a) ASME A112.19.1/CSA B45.2.
b) CSA B45.2/ASME A112.19.1.
2) Stainless steel plumbing fixtures:
a) ASME A112.19.3/CSA B45.4.
b) CSA B45.4/ASME A112.19.3.

B. Components:
a. Standard and Handicap Accessible Self Supporting Lavatories(L-1 and L-2):
1) Size: 20 by 18 inches nominal.
2) Approved Products.
a) American Standard: Lucern 0355.012.
b) Kohler: Greenwich K-2032.
3) Carrier / Support:
a) Approved Products.
(1) Josam: 17100.
(2) Jay R. Smith: 0700.
(3) Mifab: MC-41.
(4) Wade: 520-M36.
b. Lavatory Fittings:
1) Faucet and Drain:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
b) Accessories:
(1) Cast brass spout.
(2) Hard-wired automatic faucet.
(3) Cast brass spout with chrome finish.
(4) 4 inches cover plate.
(5) Single supply configuration.
(6) Solenoid valve.
(7) Control module and transformer.
(8) Hermetically sealed electronics.
(9) In-line filter.
c) Approved Product.
(1) Chicago: 116.306.21.1 with 4" CC E-tronic and 327A strainer.
(2) Delta: 591T0250 WITH 33T260 grid strainer.
(3) Gerber: 44-801-4 with 43-970 grid strainer.
(4) Moen: 8306 with McGuire 155A grid strainer.
(5) Speakman: S-8810 with S-3440 grid drain.
(6) Symmons: S6080-AC-G with grid strainer.
(7) Zurn: Z6913-CWB-SSH with grid strainer.
2) Flow Control Fitting:
a) Design Criteria:
(1) Meet NSF International Standards for Lead Free.
b) Accessories:

(1) Provide vandal-proof type in place of aerator. Flow shall be 0.5 gpm.

c) Approved Product.

(1) Omni L-200 Series by Chronomite Laboratories.

3) Supply pipes with stops:

a) Design Criteria:

(1) Meet NSF International Standards for Lead Free.

b) Accessories:

(1) Provide chrome plated quarter-turn brass ball valve, 12 inches long braided stainless steel riser, and chrome-plated steel flange.

c) Approved Products. :

(1) McGuire: BV2165CC.

(2) Zurn: Z8804 LRQ-PC.

4) Trap:

a) Description:

(1) 17 gauge tube 'P' trap, chrome plated.

b) Approved Products.

(1) Dearborn.

(2) Engineered Brass Company (EBC).

(3) Keeney Manufacturing.

(4) McGuire.

(5) Zurn.

5) Safety Covers for Handicap Accessible Lavatories:

a) Description:

(1) Provide protection on water supply pipes and on trap.

b) Approved Products.

(1) Trapwrap by Brocar Products Inc.

(2) Pro Wrap by McGuire Products.

(3) Lav Guard 2 by TrueBro.

(4) Pro Extreme by Plumberex.

2. Stainless Steel Sinks and Fittings:

a. Design Criteria:

1) Self-rimming, 18 gauge stainless steel, satin finish.

b. Single Compartment Sink:

1) Description:

a) Size: 22 by 19.5 inches nominal.

2) Approved Products.

a) Elkay: LR-2219.

b) Just: SL-1921-AG-R.

c) Kindred: LBS 4008P-1.

c. Stainless Steel Sink Fittings:

1) Faucets for Single Compartment Sinks:

a) Design Criteria:

(1) Meet NSF International Standards for Lead Free.

b) Approved Products.

(1) American Standard: Heritage/Amarilis Two-Handle Bottom-Mount Kitchen Faucet with Swivel spout 7270.

(2) Chicago: 1888CP.

(3) Delta: 27C2243-S5.

(4) Gerber: CO-44-002.

(5) Kohler: K-7761-K with handles K-16012-5.

(6) Zurn Commercial Brass: Z-831J3.

2) Supply pipes with stops:

a) Design Criteria:

(1) Meet NSF International Standards for Lead Free.

b) Accessories:

(1) Provide chrome plated quarter-turn brass ball valve, 12 inches long braided stainless steel riser, and chrome-plated steel flange.

c) Approved Products.

(1) McGuire: BV2165CC.

(2) Zurn: Z8804 LRQ-PC.

3) Waste For Standard Stainless Steel Sinks:

a) Category Four Approved Products.

(1) Elkay: LK-99.

(2) Kindred: 1130.

(3) Kohler: K8801.

(4) McGuire: 151.

(5) Zurn Z-8740-PC.

4) Trap:

a) Description:

(1) 17 gauge tube 'P' trap, chrome plated.

b) Approved Products.

(1) Dearborn.

(2) Engineered Brass Company (EBC).

(3) Keeney Manufacturing.

(4) McGuire: MCT150075NCZN.

(5) Zurn.

3. Miscellaneous Sinks and Fittings:

a. Service Sink:

1) Description:

a) Floor Type, enameled cast iron, 28 inches square with vinyl coated rim guard or 24 inches square with Stainless Steel rim guard.

2) Approved Products.

a) American Standard: Florwell Enameled Cast Iron 7741.000 with vinyl rim guard 7745.811.

b) CECO: 871.

c) Kohler: Whitby K-6710.

d) Zurn: 5850.

3) Service Sink Fittings:

a) Supply:

(1) Mounting height of 42 inches

(2) Provide 48 inch hose and clamp unless spout is threaded.

(3) Approved Products.

(a) American Standard: Exposed Yoke Wall-Mount Utility Faucet with top brace 8344.112 with threaded spout.

(b) Chicago: 897 CP.

(c) Delta: 28T9 with 28T911 hose and bracket.

(d) Gerber: C4-44-654.

(d) Kohler: K-8928.

(e) Moen: 8124.

(f) Speakman: SC-5812.

(g) T&S: B-0665-BSTP.

(h) Zurn: Z-843M1.

b) Drain and Strainer:

(1) Approved Products.

(a) American Standard: Grid strainer 7721.038.

(b) Kohler: K-9146, 3 inch IPS.

c) Trap: Cast iron, PVC, or ABS to match piping.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install each fixture with separate vent line. Do not circuit vent.

B. Ensure provisions are made for proper support of fixtures and that rough-in piping is accurately set and protected from movement and damage.

C. Seal wall-mounted fixtures around edges to wall and counter top fixtures to countertop with sealant specified in Section 07 9213.

D. Unless otherwise noted, provide each individual fixture supply with chrome-plated stop valve with hand wheel.

E. Install fixtures with accessible stop or control valve in each hot and cold water branch supply line.

F. Self-Supporting Lavatories: Install using carriers. Support carrier free of finished wall.

G. Install Safety Covers on all under sink / lavatories with exposed water supply pipes and traps.

H. Install Handicap Accessible Lavatories as per ADA height mounting requirements.

3.2 CLEANING

A. Polish chrome finish at completion of Project.

END OF SECTION

SECTION 22 4700 - DRINKING FOUNTAINS AND WATER COOLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install drinking water cooling system units as described in Contract Documents.

B. Related Requirements:
   1. Section 22 0501: 'Common Plumbing Requirements'.
   2. Section 22 1116: 'Domestic Water Piping'.

1.2 REFERENCES

A. Reference Standard:
   1. American National Standards Institute / International Code Council:
      a. ANSI/ICC A117.1-2017, 'Standard for Accessible and Usable Buildings and Facilities'.
   2. NSF International Standard / American National Standards Institute:
      a. Bottle Filling Station:
         1) NSF/ANSI 42-2017, 'Drinking Water Treatments Units – Aesthetic Effects'.
         2) NSF/ANSI 53-2017, 'Drinking Water Treatments Units – Health Effects'.
      b. Water Cooler:
         1) NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
         2) NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.
   3. Underwriters Laboratories (UL):
      a. UL 399: 'Drinking-Water Coolers'.

1.3 SUBMITTALS

A. Closeout Submittals:
   1. Warranty Documentation:
      a. Provide Manufacturer Warranty.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Handicap Accessible Products to meet ANSI/ICC A117 Accessible requirements.
   2. Meet NSF International Standards for materials or products that come into contact with drinking water, drinking water treatment chemicals, or both for chemical contaminants and impurities that are indirectly imparted to drinking water from products, components, and materials used in drinking water systems.

1.5 WARRANTY

A. Manufacturer standard limited warranty on refrigeration system of unit.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Design Criteria:
   1. All drinking water products, components, and materials above and below grade used in drinking water systems must meet NSF International Standards for Lead Free.
   2. Interior exposed pipe, valves, and fixture trim shall be chrome plated.

B. Materials:
   1. Handicap Accessible Bi-Level Cooler and Bottle Filling Station:
      a. Design Criteria:
         1) Vandal proof operating bar on front and both sides.
         2) 8 GPH water at 50 deg F water cooled from 80°F inlet water and 90°F ambient per ASHRAE testing.
         3) 115-120 V, 60 Hz, single phase.
         4) Flexible bubbler.
         5) Build-In strainer.
         6) Meets state and federal requirements for both children or adults as defined by the Americans with Disabilities Act.
      b. Approved Products.
         1) Elkay: Model LZSTL8WSLK.
         2) Halsey Taylor: Model HTHB-HACG8BLPV-WF.
         3) Murdock Manufacturing: Model A172.8UBL-BF12.
         4) Oasis: Model PGEBFSL

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fixtures with accessible stop or control valve.

B. Mounting:
   1. General:
      a. Coordinate location of fountain with location and height of electrical outlet to ensure concealment of outlet by fountain.
      b. Anchor bottom of fountain to wall.
      c. Install 3/8 inch IPS union connection and Chicago No. 441 stop to building supply line.
      d. Install 1-1/4 inch IPS slip cast brass 'P' trap. Install trap so it is concealed.
   2. Accessible Drinking Fountains:
      a. Spout outlets of wheelchair accessible drinking fountains shall be 36 inches maximum above floor.
      b. Spout outlets of drinking fountains for standing persons shall be 38 inches and 43 inches maximum above floor.

3.2 CLEANING

A. Polish chrome finish at completion of Project.

END OF SECTION

DIVISION 23 – HEATING, VENTILATING, AND AIR-CONDITIONING

23 0501	Common HVAC Requirements
23 0529	Hangers and Supports for HVAC Pipe
23 0553	Identification for HVAC Piping and Equipment
23 0713	Duct Insulation
23 0719	HVAC Piping Insulation
23 0933	Electric and Electronic Control System for HVAC
23 1123	Facility Natural-Gas Piping
23 2300	Refrigerant Piping
23 2600	Condensate Drain Piping
23 3001	Common Duct Requirements
23 3114	Low-Pressure Metal Ducts
23 3300	Air Duct Accessories
23 3346	Flexible Ducts
23 3401	Exhaust Fans
23 3713	Diffusers, Registers, and Grilles
23 3714	Louvers and Vents
23 3723	HVAC Gravity Ventilators
23 4100	Air Filters
23 5135	Air Piping
23 5414	Electric-Resistance Ceiling Panels
23 5417	Gas-Fired Furnaces
23 6214	Compressor Units Air Conditioning (5 Ton or Less)

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 3101 Fire Detection and Alarm System

SECTION 28 3101 – FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install fire alarm and detection system as described in Contract Documents.
   2. Furnish and install raceway, cable and conductors, boxes, and miscellaneous items necessary for complete system.

B. Products Furnished But Not Installed Under This Section:
   1. Door Plates for door hold / release devices.

C. Related Requirements:
   1. Division 21: Furnishing and installing of water flow switches, post indicating valves, valve tamper switches, and low air pressure switch.
   2. Section 23 0933: Furnishing and installing of duct smoke detectors in main return air ducts.
   3. Division 26: Quality of and installation standards for wiring, raceway, conduit, and boxes.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 72, 'National Fire Alarm and Signaling Code' (2019 or most recent edition adopted by AHJ).
   2. Underwriters Laboratories:
      a. UL 268, 'Smoke Detectors for Fire Alarm Systems'.
      b. UL 464, 'Audible Signal Appliances'.
      c. UL 521, 'Heat Detectors for Fire Protective Signaling Systems'.
      d. UL 864, 'Control Units and Accessories for Fire Alarm Systems'.
      e. UL 1480, 'Speakers for Fire Alarm, Emergency, and Commercial and Professional'.
      f. UL 1481, 'Power Supplies for Fire-Protective Signaling Systems'.
      g. UL 1971, 'Standard for Signaling Devices for the Hearing Impaired'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Prepared by authorized factory representative and including:
         1) Single line diagram of actual system. Typical riser diagrams are not acceptable.
         2) Complete wiring diagrams.
         3) Manufacturer's original catalog data and descriptive information on each piece of equipment to be used.

B. Informational Submittals:
   1. Certificates:
      a. Certificate of completion, from Manufacturer's Representative, in accordance with NFPA 72 requirements.
   2. Qualification Statement:
      a. Installer:

1) Provide NICET Certification documentation.

C. Closeout Submittals:
1. Include following information in Operations And Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data:
1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
2) Provide instruction manual from Manufacturer that explains what is to be done in event of various indications.
b. Record Documentation:
1) Include copy of approved shop drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. System shall meet approval of authority having jurisdiction (AHJ). NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.
2. Equipment, devices, and cable shall be UL or Factory Mutual listed for use in fire alarm systems.

B. Qualifications:
1. Installer:
a. Project Forman or Person in Charge at all times to be NICET Level III Certified for work performed by this Section.
b. Provide Certificate documentation before installation.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Type One Acceptable Manufacturers:
a. Autocall, Milwaukee, WI www.autocall.com.
b. Fire-Lite Alarms, Northford, CT www.firelite.com.
c. Mircom / Summit Systems Technologies, Cheektowaga (Buffalo), NY, Vaughan (Toronto), Ontario www.mircom.com / www.summit-st.net.
d. Potter Electric Signal Company, St. Louis, MO www.pottersignal.com.
e. Silent Knight Security Systems, Northford CT www.silentknight.com.
f. Equal as approved by Architect before bidding. See Section 01 6200.

B. Performance:
1. Design Criteria:
a. Automatic fire alarm system consisting of control panel, power supplies, alarm initiating devices, notification appliances, and off-site communicating devices. System shall be non-coded and addressable, and monitored for integrity of conductors.
b. Class A loop type initiating device circuits and Class A loop type notification appliance circuits.
c. Class B initiating device circuits and Class B notification appliance circuits including end-of-line devices.
d. Equipment and accessories furnished under this Specification shall be standard products of single manufacturer, or include written statement by Control Panel Manufacturer confirming compatibility of components and inclusion of these components under system warranty.

C. Operation:

1. Operation Sequences:
    a. Operation of manual station or automatic activation of any smoke detector, heat detector, or sprinkler flow device shall:
        1) Cause system notification appliances to operate.
        2) Indicate zone in alarm on control panel.
        3) Initiate off-site alarm notification system.
        4) Indicate zone or device in alarm on remote annunciator.
    b. System shall return to normal when operated device is returned to normal and control panel is manually reset, except alarms may be silenced as specified below.
    c. Alarm may be silenced by switch in control panel.
        1) Ring Back Feature: When silenced, this shall not prevent the resounding of subsequent alarms if another zone should alarm.
    d. When alarms are silenced, zone indicating red LEDs on control panel and remote annunciator shall remain indicated until operated device is returned to normal and control panel is manually reset.
    e. Green pilot LED, or other visual annunciation, shall normally be on indicating that system is receiving normal power. In addition, failure of normal power shall be annunciated.
    f. Trouble alarm and annunciation, operating together, shall signal trouble condition. Following conditions shall signal trouble condition:
        1) Failure of normal power.
        2) Opens or short circuits on indicating circuits.
        3) Disarrangements in system wiring.
        4) Control panel circuit board removal.
        5) Ground faults.
        6) Trouble silencing switch shall silence trouble alarm, but visual annunciation shall remain on until system is restored to normal. As ring-back feature, trouble alarm shall resound as reminder to return silencing switch to normal position.
    g. Supervisory LED, separate from trouble LED, and alarm, operating together, shall signal operation of supervisory device, such as control valve tamper, low air pressure, and low temperature switches. Alarm silence switch shall operate in same manner as trouble alarm.

D. Components:
1. Control Panel:
    a. Listed under UL Standard 864.
    b. Solid-state design with flush or semi-flush mounting.
    c. Control functions shall be behind locked door with annunciating devices visible through door. Single key shall operate all keyed functions in system. Provide three keys.
    d. Each zone shall be electrically supervised in accordance with wiring style specified.
    e. Provide integral surge protection.
    f. Make provisions for connection to off-site alarm notification system including all required programming. Provide separate dry contacts for alarm and supervisory/trouble alarms.
    g. Power Supply:
        1) Provide indication of normal power supply.
        2) Loss of normal power shall activate trouble alarm.
        3) Meet requirements of and size in accordance with UL Standard 1481 and NFPA 72.
        4) Include standby batteries, charger, and automatic transfer equipment.
    h. Visual Annunciation:
        1) Separate indication on each zone for alarm, trouble, or supervisory conditions.
        2) Visual indication shall be by LED lights or other easily identifiable method.
        3) On zoned system, permanently custom label zones by zone name, not number.
        4) Fault or trouble condition on any zone shall not affect any other zone.
    i. Audible Voice Alarm Annunciation:
        1) Alarm signal shall be annunciated by audible voice evacuation message. Message shall be digitally recorded with message content meeting requirements of local code authority. Message shall be field programmable and retained in memory if power is interrupted.
        2) Output level shall be adjustable at control panel.
        3) Alarm signal shall also operate strobe lights, if specified.

4) Provide alarm silence switches at control panel.
5) Trouble alarm shall be horn integral to control panel.
6) Supervisory alarm may be same audible alarm as trouble alarm, but with separate visual annunciation.

2. Off-Site Alarm Notification System:
   a. Provide one (1) analog telephone lines to fire alarm control panel.
   b. Install, program and connect cellular communication device furnished by Owner. Coordinate with Owner at least four (4) weeks in advance for equipment delivery.
   c. Provide dialer system equipment and programming compatible with Owner selected monitoring service (refer to alarm.ldschurch.org for details).
   d. Owner will arrange for monitoring connection contract.
   e. Communicator device shall transmit all zone identification, device identification alarm identification, and all other signals available at panel to Owner's Central Station using standard contact ID codes.
   f. Phone Dialer device shall be of same manufacturer as Fire Alarm Panel or shall be supplied, approved and tested by Fire Alarm Panel Manufacturer.
3. Alarm Initiating Devices:
   a. Smoke Detectors:
      1) Photoelectric type.
      2) Listed under UL Standard 268.
      3) Provide visual indication of alarm on unit.
   b. Duct Smoke Detectors:
      1) Furnished and Installed by Division 23.
      2) Power provided by Division 26.
      3) Connect to Fire Detection And Alarm System by this Section.
   c. Heat Detectors:
      1) Non-settable 135 deg F (57 deg C) fixed temperature.
      2) Provide visible indication that device has operated.
      3) Listed under UL Standard 521.
   d. Low Building Temperature Device:
      1) Set for contact closure at 35 deg F (2 deg C).
      2) Type Two Acceptable Products;
         a) Honeywell T631A1006.
         b) Equal as approved by Architect before installation. See Section 01 6200.
   e. Manual Fire Alarm Boxes:
      1) Non-coded and double-action requiring two actions to initiate alarm. Breakable glass type is not approved.
      2) Box shall mechanically latch when actuated and require key to reset. Key shall match control panel door lock.
4. Notification Appliances:
   a. Color: White.
   b. Combination Speaker / Strobe:
      1) Wall mounted flush or semi-flush.
      2) Audible voice output of 90 dB minimum at 10 feet (3 meters).
      3) Integrally mounted flashing light unit with block letters 'FIRE.' Adjustable light intensity of 15-110 candela and flash rate between one and three Hertz, except where higher rated output devices are indicated on Drawings.
      4) Listed under UL Standard 1480 and UL Standard 1971.
   c. Strobe Only:
      1) Wall mounted flush or semi-flush.
      2) Integrally mounted flashing light unit with block letters 'FIRE.' Adjustable light intensity of 15-110 candela and flash rate between one and three Hertz.
      3) Listed under UL Standard 1971.
5. Accessory Devices:
   a. Notification Appliance Protective Devices: Provide wire guard covers for appliances installed in Cultural Center.
6. Cables And Wiring:
   a. Comply with NEC Article 760.

b. Jacket and insulation color shall be red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire alarm and detection systems as indicated, in accordance with Equipment Manufacturer's written instructions, and complying with applicable portions of NEC, NFPA, and NECA's 'Standard of Installation'.
   1. Mounting Heights:
      a. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor:
         1) Control Panel: 72 inches (1 800 mm) to top.
         2) Wall-Mounted Horn / Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
         3) Wall-Mounted Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
         4) Manual pull stations: 48 inches (1 200 mm).
         5) Remote annunciator panel: 60 inches (1 500 mm).
   2. Locate fire alarm manual stations 24 inches (600 mm) minimum away from any light switch.

B. Identification:
   1. Label zone indicators on control unit indicating location and type of initiating device, i.e., CORRIDOR SMOKE, VALVE TAMPER, AIR SYSTEM SMOKE, etc. Labels shall be engraved plastic laminate, or other permanent labeling system as supplied by Control Unit Manufacturer.
   2. Post copy of wire identification list inside fire alarm panel door or other area accessible to fire alarm service personnel.
   3. Print location of circuit disconnecting means inside panel.

C. Conductors:
   1. Install conductors and make connections to water flow switches, valve tamper switches, low air pressure switches, and duct smoke detectors.
   2. Loop wires through each device on zone for proper supervision. Tee-taps not permitted.
   3. Minimum conductor size shall be 14 AWG unless otherwise specified.

D. Do not install ceiling mounted detectors within 36 inches (900 mm) of air discharge grilles. Do not install manual fire alarm boxes within 24 inches (610 mm) of light switches. Coordinate with other trades as required.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Provide factory-trained representative to perform complete system testing in presence of Owner's representative and local fire department personnel upon completion of installation.
      a. Test each initiating and annunciating device for proper operation, except fixed temperature heat detectors.
      b. Test operation of trouble annunciation on each circuit.
      c. Perform complete testing of control panel functions including off-site monitoring.

3.3 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
   1. Instruct Owner's Representative in proper operation and maintenance procedures.

3.4 PROTECTION

A. Provide dust protection for installed smoke detectors until finish work is completed and building is ready for occupancy.

B. Protect conductors from cuts, abrasion and other damage during construction.

END OF SECTION

SECTION 23 0501 - COMMON HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common requirements and procedures for HVAC systems.
   2. Responsibility for proper operation of electrically powered equipment furnished under this Division.
   3. Interface with Testing And Balancing Agency.
   4. Furnish and install sealants relating to installation of systems installed under this Division.
   5. Furnish and install Firestop Penetration Systems for HVAC system penetrations as described in Contract Documents.
   6. Furnish and install sound, vibration, and seismic control elements.

B. Products Furnished But Not Installed Under This Section:
   1. Sleeves, inserts, and equipment for mechanical systems installed under other Sections.

C. Related Requirements:
   1. Section 26 2913: 'Enclosed Controllers' for magnetic starters and thermal protective devices (heaters) not factory mounted integral part of mechanical equipment.
   2. Division 26: Raceway and conduit, unless specified otherwise, line voltage wiring, outlets, and disconnect switches.
   3. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.
         1) Provide section in submittal for each type of item of equipment. Include Manufacturer's catalog data of each manufactured item and enough information to show compliance with Contract Document requirements. Literature shall show capacities and size of equipment used and be marked indicating each specific item with applicable data underlined.
         2) Include name, address, and phone number of each supplier.
   2. Shop Drawings:
      a. Schematic control diagrams for each separate fan system, heating system, control panel, etc. Each diagram shall show locations of all control and operational components and devices. Mark correct operating settings for each control device on these diagrams.
      b. Diagram for electrical control system showing wiring of related electrical control items such as firestats, fuses, interlocks, electrical switches, and relays. Include drawings showing electrical power requirements and connection locations.
      c. Drawing of each temperature control panel identifying components in panels and their function.
      d. Other shop drawings required by Division 23 trade Sections.
         1) Provide Qualification documentation if requested by Architect or Owner.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data
         1) At beginning of HVAC section of Operations And Maintenance Manual, provide master index showing items included.
            a) Provide name, address, and phone number of Architect, Architect's Mechanical Engineer, General Contractor, and HVAC, Sheet Metal, Refrigeration, and Temperature Control subcontractors.

b) Identify maintenance instructions by using same equipment identification used in Contract Drawings. Maintenance instructions shall include:
(1) List of HVAC equipment used indicating name, model, serial number, and nameplate data of each item together with number and name associated with each system item.
(2) Manufacturer's maintenance instructions for each piece of HVAC equipment installed in Project. Instructions shall include name of vendor, installation instructions, parts numbers and lists, operation instructions of equipment, and maintenance and lubrication instructions.
(3) Summary list of mechanical equipment requiring lubrication showing name of equipment, location, and type and frequency of lubrication.
(4) Manual for Honeywell T7350 thermostat published by Honeywell.

c) Provide operating instructions to include:
(1) General description of each HVAC system.
(2) Step by step procedure to follow in putting each piece of HVAC equipment into operation.
(3) Provide diagrams for electrical control system showing wiring of items such as smoke detectors, fuses, interlocks, electrical switches, and relays.

b. Warranty Documentation:
1) Include copies of warranties required in individual Sections of Division 23.

c. Record Documentation:
1) Manufacturers documentation:
a) Copies of approved shop drawings.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Perform work in accordance with applicable provisions of Gas Ordinances applicable to Project. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
2. In case of differences between building codes, laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Notify Architect in writing of such differences before performing work affected by such differences.
3. Identification:
a. Motor and equipment name plates as well as applicable UL / ULC and AGA / CGA labels shall be in place when Project is turned over to Owner.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
1. Company:
a. Company specializing in performing work of this section.
1) Minimum five (5) years experience in HVAC installations.
2. Installer:
a. Licensed for area of Project.
b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
c. Upon request, submit documentation.

1.4 WARRANTY

A. Manufacturer Warranty:
1. Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record 'start-up' date of each piece of equipment on certificate.

B. Special Warranty:
1. Guarantee HVAC systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Components shall bear Manufacturer's name and trade name. Equipment and materials of same general type shall be of same make throughout work to provide uniform appearance, operation, and maintenance.

B. Pipe And Pipe Fittings:
   1. Use domestic made pipe and pipe fittings on Project.
   2. Weld-O-Let and Screw-O-Let fittings are acceptable.

C. Sleeves:
   1. In Framing: Standard weight galvanized iron pipe, Schedule 40 PVC, or 14 ga galvanized sheet metal two sizes larger than bare pipe or insulation on insulated pipe.
   2. In Concrete And Masonry: Sleeves through outside walls, interior shear walls, and footings shall be schedule 80 black steel pipe with welded plate.

D. Valves:
   1. Valves of same type shall be of same manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Drawings:
   1. HVAC Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
   2. Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over HVAC Drawings.
   3. Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

B. Verification Of Conditions:
   1. Examine premises to understand conditions that may affect performance of work of this Division before submitting proposals for this work. Examine adjoining work on which mechanical work is dependent for efficiency and report work that requires correction.
   2. No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
   3. Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.
   4. Check that slots and openings provided under other Divisions through floors, walls, ceilings, and roofs are properly located. Perform cutting and patching caused by neglecting to coordinate with Divisions providing slots and openings at no additional cost to Owner.

3.2 PREPARATION

A. Changes Due To Equipment Selection:

1. Where equipment specified or otherwise approved requires different arrangement or connections from that shown in Contract Documents, submit drawings, if requested by Architect, showing proposed installations.
2. If proposed changes are approved, install equipment to operate properly and in harmony with intent of Contract Documents. Make incidental changes in piping, ductwork, supports, installation, wiring, heaters, panelboards, and as otherwise necessary.
3. Provide any additional motors, valves, controllers, fittings, and other additional equipment required for proper operation of system resulting from selection of equipment.
4. Be responsible for the proper location of roughing-in and connections provided under other Divisions.

3.3 INSTALLATION

A. Interface With Other Work:
1. Furnish sleeves, inserts, supports, and equipment that are to be installed by others in sufficient time to be incorporated into construction as work proceeds. Locate these items and see they are properly installed.
2. Electrical: Furnish exact location of electrical connections and complete information on motor controls to installer of electrical system.
3. Testing And Balancing:
    a. Put HVAC systems into full operation and continue their operation during each working day of testing and balancing.
    b. Make changes in pulleys, belts, fan speeds, and dampers or add dampers as required for correct balance as recommended by Testing And Balancing Agency and at no additional cost to Owner.

B. Cut carefully to minimize necessity for repairs to previously installed or existing work. Do not cut beams, columns, or trusses.

C. Locating Equipment:
1. Arrange pipes, ducts, and equipment to permit ready access to valves, cocks, unions, traps, filters, starters, motors, control components, and to clear openings of doors and access panels.
2. Adjust locations of pipes, ducts, switches, panels, and equipment to accommodate work to interferences anticipated and encountered.
3. Install HVAC work to permit removal of equipment and parts of equipment requiring periodic replacement or maintenance without damage to or interference with other parts of equipment or structure.
4. Determine exact route and location of each pipe and duct before fabrication.
    a. Right-Of-Way:
        1) Lines that pitch shall have right-of-way over those that do not pitch. For example, steam, steam condensate, and drains shall normally have right-of-way.
        2) Lines whose elevations cannot be changed shall have right-of-way over lines whose elevations can be changed.
    b. Offsets, Transitions, and Changes in Direction:
        1) Make offsets, transitions, and changes in direction in pipes and ducts as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
        2) Furnish and install all traps, air vents, sanitary vents, and devices as required to effect these offsets, transitions, and changes in direction.

D. Piping:
1. Furnish and install complete system of piping, valved as indicated or as necessary to completely control entire apparatus.
    a. Pipe drawings are diagrammatic and indicate general location and connections. Piping may have to be offset, lowered, or raised as required or directed at site. This does not relieve this Division from responsibility for proper erection of systems of piping in every respect.
    b. Arrange piping to not interfere with removal of other equipment, ducts, or devices, or block access to doors, windows, or access openings.
        1) Arrange so as to facilitate removal of tube bundles.
        2) Provide accessible flanges or ground joint unions, as applicable for type of piping specified, at connections to equipment and on bypasses.
            a) Make connections of dissimilar metals with di-electric unions.
            b) Install valves and unions ahead of traps and strainers. Provide unions on both sides of traps.
        3) Do not use reducing bushings, street elbows, bull head tees, close nipples, or running couplings.

4) Install piping systems so they may be easily drained. Provide drain valves at low points and manual air vents at high points in hot water heating and cooling water piping.
5) Install piping to insure noiseless circulation.
6) Place valves and specialties to permit easy operation and access. Valves shall be regulated, packed, and glands adjusted at completion of work before final acceptance.

c. Do not install piping in shear walls.

2. Properly make adequate provisions for expansion, contraction, slope, and anchorage.
   a. Cut piping accurately for fabrication to measurements established at site. Remove burr and cutting slag from pipes.
   b. Work piping into place without springing or forcing. Make piping connections to pumps and other equipment without strain at piping connection. Remove bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected, if requested.
   c. Make changes in direction with proper fittings.
   d. Expansion of Thermoplastic Pipe:
      1) Provide for expansion in every 30 feet of straight run.
      2) Provide 12 inch offset below roof line in each vent line penetrating roof.
3. Provide sleeves around pipes passing through concrete or masonry floors, walls, partitions, or structural members. Do not place sleeves around soil, waste, vent, or roof drain lines passing through concrete floors on grade. Seal sleeves with specified sealants.
   a. Sleeves through floors shall extend 1/4 inch above floor finish in mechanical equipment rooms above basement floor. In other rooms, sleeves shall be flush with floor.
   b. Sleeves through floors and foundation walls shall be watertight.
4. Provide spring clamp plates (escutcheons) where pipes run through walls, floors, or ceilings and are exposed in finished locations of building. Plates shall be chrome plated heavy brass of plain pattern and shall be set tight on pipe and to building surface.
5. Remove dirt, grease, and other foreign matter from each length of piping before installation.
   a. After each section of piping used for movement of water or steam is installed, flush with clean water, except where specified otherwise.
   b. Arrange temporary flushing connections for each section of piping and arrange for flushing total piping system.
   c. Provide temporary cross connections and water supply for flushing and drainage and remove after completion of work.

E. Penetration Firestops: Install Penetration Firestop System appropriate for penetration at HVAC system penetrations through walls, ceilings, roofs, and top plates of walls.

F. Sealants:
1. Seal openings through building exterior caused by penetrations of elements of HVAC systems.
2. Furnish and install acoustical sealant to seal penetrations through acoustically insulated walls and ceilings.

3.4 REPAIR / RESTORATION

A. Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
1. Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown.
2. Surface finishes shall exactly match existing finishes of same materials.

3.5 FIELD QUALITY CONTROL

A. Field Tests:
1. Perform tests on HVAC piping systems. Furnish devices required for testing purposes.

B. Non-Conforming Work:
1. Replace material or workmanship proven defective with sound material at no additional cost to Owner.

3.6 SYSTEM START-UP

A. Off-Season Start-up:
   1. If Substantial Completion inspection occurs during heating season, schedule spring start-up of cooling systems. If inspection occurs during cooling season, schedule autumn start-up for heating systems.
   2. Notify Owner seven days minimum before scheduled start-up.
   3. Time will be allowed to completely service, test, check, and off-season start systems. During allowed time, train Owner's representatives in operation and maintenance of system.
   4. At end of off-season start-up, furnish Owner with letter confirming that above work has been satisfactorily completed.

B. Preparations that are to be completed before start up and operation include, but are not limited to, following:
   1. Dry out electric motors and other equipment to develop and properly maintain constant insulation resistance.
   2. Make adjustments to insure that:
      a. Equipment alignments and clearances are adjusted to allowable tolerances.
      b. Nuts and bolts and other types of anchors and fasteners are properly and securely fastened.
      c. Packed, gasketed, and other types of joints are properly made up and are tight and free from leakage.
      d. Miscellaneous alignings, tightenings, and adjustings are completed so systems are tight and free from leakage and equipment performs as intended.
   3. Motors and accessories are completely operable.
   4. Inspect and test electrical circuitry, connections, and voltages to be properly connected and free from shorts.
   5. Adjust drives for proper alignment and tension.
   6. Make certain filters in equipment for moving air are new and of specified type.
   7. Properly lubricate and run-in bearings in accordance with Manufacturer's directions and recommendations.

3.7 CLEANING

A. Clean exposed piping, ductwork, and equipment.

B. No more than one week before Final Inspection, flush out bearings and clean other lubricated surfaces with flushing oil. Provide best quality and grade of lubricant specified by Equipment Manufacturer.

C. Replace filters in equipment for moving air with new filters of specified type no more than one week before Final Inspection.

3.8 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
   1. Instruct building maintenance personnel and Stake Physical Facilities Representative in operation and maintenance of mechanical systems utilizing Operation And Maintenance Manual when so doing:
      a. Minimum Instruction Periods:
         1) HVAC: Eight (8) hours.
         2) Temperature Control: Six (6) hours.
         3) Refrigeration: Four (4) hours.
      b. Conduct instruction periods after Substantial Completion inspection when systems are properly working and before final payment is made. None of these instructional periods shall overlap another.

3.9 PROTECTION

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system. Cap or plug open ends of pipes and equipment to keep dirt and other foreign materials out of system. Do not use plugs of rags, wool, cotton waste, or similar materials.

B. Do not operate pieces of equipment used for moving supply air without proper air filters installed properly in system.

C. After start-up, continue necessary lubrication and be responsible for damage to bearings while equipment is being operated up to Substantial Completion.

END OF SECTION

SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Common hanger and support requirements and procedures for HVAC systems.

B. Related Requirements:
   1. Section 05 0523: 'Metal Fastening' for quality and requirements for welding.
   2. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   3. Slots and openings through floors, walls, ceilings, and roofs provided under other Divisions in their respective materials.

C. Products Installed But Not Furnished Under This Section:
   1. Stencils and band colors of gas piping used in HVAC equipment.

D. Related Requirements:
   1. Section 09 9124: 'Interior Painted Metal' for providing field painting of identification of piping used with HVAC equipment.
   2. Section 23 0553: 'Identification For HVAC Piping And Equipment' for HVAC piping and equipment identification signage requirements.
   3. Sections Under 09 9000 Heading: Painting of mechanical items requiring field painting.

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Manufacturer's catalog data for each manufactured item.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Approved Manufacturers.
      a. Anvil International
      b. Cooper B-Line
      c. Hilti Inc
      d. Thomas & Betts
      e. Unistrut, Wayne

B. Performance:
   1. Design Criteria:
      a. Support rods for single pipe shall be in accordance with following table:

Rod Diameter	Pipe Size
3/8 inch	2 inches and smaller
1/2 inch	2-1/2 to 3-1/2 inches
5/8 inch	4 to 5 inches
3/4 inch	6 inches

7/8 inch	8 to 12 inches

b. Support rods for multiple pipes supported on steel angle trapeze hangers shall be in accordance with following table:

Rods		Number of Pipes per Hanger for Each Pipe Size						
No.	Diameter	2 Inch	2.5 Inch	3 Inch	4 Inch	5 Inch	6 Inch	8 Inch
2	3/8 Inch	Two	0	0	0	0	0	0
2	1/2 Inch	Three	Three	Two	0	0	0	0
2	5/8 Inch	Six	Four	Three	Two	0	0	0
2	5/8 Inch	Nine	Seven	Five	Three	Two	Two	0
2	5/8 Inch	Twelve	Nine	Seven	Five	Three	Two	Two

1) Size trapeze angles so bending stress is less than 10,000 psi

C. Materials:

1. Hangers, Rods, Channels, Attachments, And Inserts:
   a. Galvanized and UL approved for service intended.
   b. Support horizontal piping from clevis hangers or on roller assemblies with channel supports, except where trapeze type hangers are explicitly shown on Drawings. Hangers shall have double nuts.
   c. Quality Standards:
      1) Support insulated pipes with clevis hanger equal to Anvil Fig 260 or roller assembly equal to Anvil Fig 171 with an insulation protection shield equal to Anvil Fig 167. Gauge and length of shield shall be in accordance with Anvil design data.
      2) Except uninsulated copper pipes, support uninsulated pipes from clevis hanger equal to Anvil Fig 260. Support uninsulated copper pipe from hanger equal to Anvil Fig CT-65 copper plated hangers and otherwise fully suitable for use with copper tubing.
   d. Riser Clamps For Vertical Piping:
      1) Quality Standard: Anvil Figure 261.
   e. Furnace Support Channel:
      1) Quality Standard: Unistrut P1000.
      2) Acceptable Manufacturers: Hilti, Thomas & Betts.
   f. Swivel Attachment:
      1) Quality Standard: Unistrut EM3127.
      2) Acceptable Manufacturers: Hilti, Thomas & Betts.
      3) Equal as approved by Architect before installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Piping:

1. Properly support piping and make adequate provisions for expansion, contraction, slope, and anchorage.
   a. Except for underground pipe, suspend piping from roof trusses or clamp to vertical walls using support channels and clamps. Do not hang pipe from other pipe, equipment, or ductwork. Laying of piping on any building element is not allowed.
   b. Supports For Horizontal Piping:
      1) Support metal piping at 96 inches mm on center maximum for pipe 1-1/4 inches or larger and 72 inches on center maximum for pipe 1-1/8 inch or less.
      2) Support thermoplastic pipe at 48 inches on center maximum.
      3) Provide support at each elbow. Install additional support as required.
   c. Supports for Vertical Piping:
      1) Place riser clamps at each floor or ceiling level.
      2) Securely support clamps by structural members, which in turn are supported directly from building structure.
      3) Provide clamps as necessary to brace pipe to wall.
   d. Insulate hangers for copper pipe from piping by means of at least two layers of Scotch 33 plastic tape.
   e. Expansion of Thermoplastic Pipe:

1) Provide for expansion in every 30 feet of straight run.
2) Provide 12 inch offset below roof line in each vent line penetrating roof.

END OF SECTION

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Products Furnished But not Installed Under This Section:
   1. Identification of HVAC piping and equipment as described in Contract Documents including:
      a. Paint identification for gas piping used in HVAC equipment.
      b. Band colors for gas piping used in HVAC equipment.

B. Related Requirements:
   1. Section 09 9124: 'Interior Painted Metal' for providing field painting of identification of piping used with HVAC equipment.
   2. Section 22 0529: 'Hangers And Supports For Plumbing' for field installation of pipe stencils and band colors for identification for piping used with HVAC equipment.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Description:
   1. Abbreviations for Pipe Stencils and Equipment Identification and Band Colors for Pipe Identification:
      a. Apply stenciled symbols and continuous painting as follows:

Pipe Type	Pipe Color	Symbol
Gas	Yellow	GAS

B. Materials:
   1. Approved Products and Manufacturers.
      a. Products listed in edition of MPI Approved Product List current at time of bidding and later are approved, providing they meet VOC requirements in force where Project is located.
   2. Description:
      a. Ferrous Metal:
         1) New Surfaces: Use MPI(a) INT 5.1B Waterborne Light Industrial Finish system.
   3. Performance Requirements:
      a. New Surfaces: MPI Premium Grade finish requirements.
      b. Maintain specified colors, shades, and contrasts.
   4. Paint (one coat):
      a. Primer:
         1) Ferrous Metal:
            a) MPI 107, 'Primer, Rust-Inhibitive, Water Based'.
               (1) Color: white.
      b. Finish Coat (two coats):
         1) Ferrous Metal:
            a) MPI 153, 'Light Industrial Coating, Interior, Water Based, Semi-Gloss (MPI Gloss Level 5)'.
   5. Labels:
      a. Equipment Identification:
         1) Black formica, with white reveal when engraved.
         2) Lettering to be 3/16 inch high minimum.

PART 3 - EXECUTION

3.1 APPLICATION

A. Labels:
   1. Identify following items with specified labels fastened to equipment with screws (unless noted otherwise):
      a. Thermostats and control panels in mechanical spaces (attach label to wall directly above or below thermostats).
      b. Furnaces.
      c. Condensing units.
      d. Rooftop Units.

B. Painting:
   1. New Surfaces:
      a. Remove rust spots by sanding and immediately spot prime. If all traces of rust cannot be removed, apply rust blocker recommended by Paint Manufacturer before applying full primer coat.
   2. Leave equipment in like-new appearance.
   3. Only painted legends, directional arrows, and color bands are acceptable.
   4. Locate identifying legends, directional arrows, and color bands at following points on exposed piping of each piping system:
      a. Adjacent to each item of equipment.
      b. At point of entry and exit where piping goes through wall.
      c. On each riser and junction.
      d. Every 25 feet on long continuous lines.
      e. Stenciled symbols shall be one inch high and black.

END OF SECTION

SECTION 23 0713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install thermal wrap duct insulation as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3114: 'Low-Pressure Metal Ducts'.
   2. Section 23 3300: 'Acoustic Duct Accessories' for duct liner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer List:
   1. Certainteed
   2. Johns-Manville
   3. Knauf Fiber Glass
   4. Manson Insulation Inc
   5. Owens-Corning

2.2 MATERIALS

A. Thermal Wrap Duct Insulation:
   1. 1-1/2 inch or 3 inch thick fiberglass with factory-laminated, reinforced aluminum foil scrim kraft facing and density of 0.75 lb / per cu ft .
   2. Thermal Conductivity: 0.27 BTU in/HR SF deg F at 75 deg F maximum.
   3. Acceptable Products:
      a. Type 75 standard duct insulation by Certainteed
      b. Microlite FSK by Johns-Manville.
      c. Duct Wrap FSK by Knauf Fiber Glass.
      d. Alley Wrap FSK by Manson Insulation Inc.
      e. FRK by Owens-Corning.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All supply, return, and exhaust air duct work shall be interior lined per specification section 23 3353.

B. Thermal Wrap Duct Insulation:
   1. Install insulation as follows:
      a. Within Building Insulation Envelope:
         1) 1-1/2 inches thick on rectangular outside air ducts and combustion air ducts.
         2) 1-1/2 inches thick on all round ducts.

b. Outside Building Insulation Envelope:
    1) 3 inch thick on round supply and return air ducts.
    2) 1-1/2 inch thick on rectangular, acoustically lined, supply and return air ducts.

2. Wrap insulation tightly on ductwork with circumferential joints butted and longitudinal joints overlapped minimum 2 inches
    a. Do not compress insulation except in areas of structural interference. Minimum thickness at corners shall be one inch thick.
    b. Remove insulation from lap before stapling.
    c. Staple seams at approximately 16 inches on center with outward clenching staples.
    d. Seal seams with foil vapor barrier tape or vapor barrier mastic. Seal penetrations of facing to provide vapor tight system.

C. Insulate outside of ceiling diffusers, diffuser drops, and duct silencers same as ductwork.

END OF SECTION

SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install insulation on above ground refrigerant piping and fittings as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'General HVAC Requirements'.
   2. Section 23 2300: 'Refrigerant Piping'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer List:
      a. Armacell
      b. Childers Products Co
      c. Johns-Manville
      d. Knauf
      e. Manson
      f. Owens-Corning
      g. Speedline Corp

B. Materials:
   1. Refrigeration Piping System:

Pipe Size, Outside Diameter	Insulation Thickness
One inch and smaller	1/2 Inch
1-1/8 to 2 inch	3/4 Inch

      1) One inch sheet for fittings as recommended by Manufacturer.
      2) Approved Products.
         a) AP Armaflex 25/50 by Armacell.
      b. Joint Sealer:
         1) Approved Products.
            a) Armacell 520 by Armacell.
      c. Insulation Tape:
         1) Approved Products.
            a) Armaflex AP Insul Tape by Armacell.
      d. Exterior Finish:
         1) For application to non-white, exterior insulation.
         2) Approved Products.
            a) WB Armaflex Finish by Armacell.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before application of insulating materials, brush clean surfaces to be insulated and make free from rust, scale, grease, dirt, moisture, and any other deleterious materials.

B. Use drop cloths over equipment and structure to prevent adhesives and other materials spotting the work.

3.2 INSTALLATION

A. Refrigeration System Piping System:
   1. General:
      a. Install insulation in snug contact with pipe.
         1) Insulate flexible pipe connectors.
         2) Insulate thermal expansion valves with insulating tape.
         3) Insulate fittings with sheet insulation and as recommended by Manufacturer.
      b. Slip insulation on tubing before tubing sections and fittings are assembled keeping slitting of insulation to a minimum.
      c. Do not install insulation on lines through clamp assembly of pipe support. Butt insulation up against sides of clamp assembly.
      d. Stagger joints on layered insulation. Seal joints in insulation.
      e. Install insulation exposed outside building so 'slit' joint seams are placed on bottom of pipe.
      f. Paint exterior exposed, non-white insulation with two coats of specified exterior finish.
   2. System Requirements:
      a. Condensing Units: Install insulation on above ground refrigerant suction piping and fittings, including thermal bulb, from thermal expansion valve.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work:
   1. Method of installing insulation shall be subject to approval of Architect. Sloppy or unworkmanlike installations are not acceptable.

3.4 CLEANING

A. Leave premises thoroughly clean and free from insulating debris.

3.5 PROTECTION

A. Protect insulation wherever leak from valve stem or other source might drip on insulated surface, with aluminum cover or shield rolled up at edges and sufficiently large in area and of shape that dripping will not splash on surrounding insulation.

END OF SECTION

SECTION 23 0933 - ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install LCBS automatic temperature control system as described in Contract Documents.
   2. Furnish and install conductors and make connections to control devices, motors, and associated equipment.
   3. Assist in air test and balance procedure.

B. Related Requirements:
   1. Section 01 4546: Duct testing, adjusting, and balancing of ductwork.
   2. Section 23 0501: Common HVAC Requirements.
   3. Section 23 3300: Furnishing and installing of temperature control dampers.
   4. Division 26:
      a. Furnishing and installing of raceway, conduit, and junction boxes, including pull wires, for temperature control system except as noted above.
      b. Power wiring to magnetic starters, disconnect switches, and motors.
      c. Motor starters and disconnect switches, unless integral with packaged equipment.

1.2 SUBMITTALS

C. Action Submittals:
   1. Product Data:
      a. Installer to provide product literature or cut sheets for all products specified in Project.
      b. Installer to provide questions of control equipment locations to Mechanical Engineer prior to installation.

D. Informational Submittals:
   1. Certificates:
      a. Installer must provide 'Certificate of Sponsorship' signed from Approved Distributor with bid confirming Installer sponsorship.

E. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Leave with O&M Manual specified in Section 23 0501.
      b. Record Documentation:
         1) Installer's 'Certificate of Sponsorship'.

1.3 QUALITY ASSURANCE

F. Qualifications: Requirements of Section 01 4301 applies, but is not limited to the following:
   1. Installer:
      a. Before bidding, obtain sponsorship from a local, Approved Distributor specified under PART 2 PRODUCTS of this specification. Initial requirements for sponsorship are:
         1) Receive LCBS Connect product training from Approved Distributor.
         2) Installer to provide Distributor sponsorship by submitting 'Certificate of Sponsorship' as Informational Submittal with bid. Certificate available as Attachment in this Specification.

PART 2 - PRODUCTS

2.1 SYSTEMS

G. Manufacturers:
1. Manufacturer List:
   a. Air Products & Controls Ltd
   b. Fire-Lite Alarms
   c. Honeywell Inc
      1) Primary Contact: Chris Brinkerhoff, (801) 550-3344, chris.brinkerhoff@honeywell.com.
   d. ICCA Firex
   e. Insul_Guard
      1) Primary Contact: Dan Craner, (801) 518-3733, insul_guard@comcast.net.
   f. System Sensor
   g. Zimmerman Technologies, Renton, WA:
      1) Primary Contact: Tracy Zimmerman, (425) 255-1906, zimmtech@yahoo.com.

H. Distributors: Obtain LCBS Connect control devices, RP panels, sensors, actuators and other control equipment from following Sponsoring Approved Distributors. See Section 01 4301:
1. Idaho:
   a. MI Controls: (503) 233-5501 dave@micontrols.com Dave Innocenti.
   b. Building Controls & Solutions (801) 214-3313 Kathy.Wright@Building-Controls.com Kathy Wright .
2. Nevada:
   a. Building Controls & Solutions (801) 214-3313 Kathy.Wright@Building-Controls.com Kathy Wright
3. Utah:
   a. Control Equipment Co: (800) 452-1457 rhowe@controlequiputah.com Ray Howe.
   b. Building Controls & Solutions (801) 214-3313 Kathy.Wright@Building-Controls.com Kathy Wright.

I. Performance:
1. Design Criteria:
   a. Honeywell LCBS Connect control system with cloud based gateway:
      1) General Requirements:
         a) Controls multistage equipment, dehumidification and ventilation with 2 wire connection to controller interface location in occupied space.
         b) Adjustable backlight to controller interface module from 15%-100%en after 30 seconds of setting adjustments.
         c) System controllers can be programmed from the interface module or from the cloud service.
         d) LCBS Connect controller utilizes echelon communication network with the controller located near the mechanical equipment and the system interface located in the occupied space.
         e) System shall control outdoor ventilation air based upon system occupancy of electric / electronic actuation of dampers.
         f) CO2 (Carbon Dioxide) sensors will open ventilation dampers only when CO2 exceeds 1000 ppm.
         g) LCBS Connect devices access via internet Chrome browser via gateway.
         h) Wired room temperature sensors may be added as specified.
      2) System Requirements:
         a) Up to 3 Heat/2 Cool Conventional Systems.
         b) Tri-Lingual display (Selectable for English, Spanish, or French).
         c) 18 to 30 Vac.
         d) 50 Hz; 60 Hz.
         e) System switch to include Auto changeover for Heat-Cool.
         f) 7-Day Programming.
         g) 365-Day Event Scheduling.
         h) Display Security Lockout options.
         i) Minimum/ Maximum Temperature Range Stops.

j) Configurable over-ride option.
k) Remote Access via internet.
l) Dehumidification setting range 40 to 80% RH.

b. Honeywell TrueZone panel enabled device(s):
1) General Requirements: Zone Panel:
a) Work in conjunction with LCBS Connect.
b) Control multiple zones on single fan coil unit (gas fired furnace with air conditioning or roof top unit)
c) Keypad programming & checkout.
d) Work with conventional, dual fuel applications.
e) Push wire terminals.
f) Add-a-zone panel expandable.
2) Dampers:
a) Bypass damper installs in any orientation at any angle.
b) Bypass damper provides constant pressure relief regardless of blower speed.
c) Bypass damper provides visual damper percentage open.
d) Zone damper powered by 24VAC circuit from zone panel.
e) Zone damper adjustable range stops for consistent bleed setting.
f) Zone damper LED indicator lights (red closed, green open/ 3 wire applications).
g) Zone damper terminals have push terminals.

J. Components:
1. Controller, Wall Module:
a. Controller and Display Kit:
1) Approved Product.
a) Part Number Honeywell YCRL6438SR1000 consisting of following:
(1) Unitary Controller: Honeywell CRL6438SR1000
(2) Wall Module: Honeywell TS120
b) Wall Cover Plate: Honeywell. 50002883-001.
c) Discharge Air / Return Air Sensors: Honeywell C7041B2005 20k ohms.
d) Outdoor Air Sensor: Honeywell C7041F2006.
e) Indoor Air Sensor: Sylk bus network; Honeywell TR40
f) Averaging sensor: Sylk bus network; Honeywell TR40
b. Internet Gateway Module(s): One (1) module per thirty (30) controllers.
1) Approved Product.
a) LCBS Connect Gateway Module: Honeywell LGW1000.
2. Zone panel and Components:
a. Zone Panel: Honeywell TrueZone HZ322.
b. Zone Panel: Honeywell TrueZone HZ432.
c. Zone Expansion Controller X4, where required: Honeywell TAZ-4.
d. Zone Panel Transformer: AT175F1023.
e. Zone Discharge Air Temperature Sensor: Honeywell C7735A1000.
f. Zone Damper(s): Honeywell ARD (damper size) TZ round damper.
g. Zone Damper(s): Honeywell ZD (damper size) TZ rectangular damper.
h. Zone Bypass Damper: Honeywell CPRD (damper size).
3. Sealant Compound:
a. Description:
1) Non hardening waterproof, vapor proof, self-adhesive for hot or cold application for sealing conduit openings against drafts, dust moisture and noise.
b. Category Four Approved Product. See Section 01 6200 for definitions of Categories:
1) Duct Seal Compound No. DS-130 by Gardner Bender
2) Thumb-Tite Sealing Compound No. 4216-92 by Nu-Calgon
4. Duct Smoke Detectors:
a. Duct mounted smoke detector in systems with airflow greater than 2000 CFM.
b. Intelligent low flow photoelectric duct smoke detector with flash scan.
c. Approved Product.

1) System Sensor Model D4120.

5. Transformer:
   a. 120 / 24 V, 50VA Honeywell AT150F.
   b. 120 / 24 V, 75VA Honeywell AT175F.
6. Damper Actuators:
   a. Electric type equipped for Class I wiring.
   b. Shall not consume power during Unoccupied cycle or use chemicals or expandable media.
   c. Have built in spring return.
   d. Approved Product.
      1) Honeywell MS8105A1030/U.
      2) Honeywell MS8105A1130 w/ End switch.
7. Conductors:
   a. Color-coded and No. 16 and No. 12 AWG Type TWN, TFN, or THHN, stranded.
   b. Controller Cable: 12, 8, or 4 conductor, 18AWG solid copper wire, insulated with high-density polyethylene. Conductors parallel enclosed in brown PVC jacket (22 AWG cable not allowed).
   c. Echelon Network Ebus Communicating Cable:
      1) Class Two Quality Standard. See Section 01 6200:
         a)CAT 4, 22 gauge 0.025 in twisted pair, non-plenum and non-shielded cable.
      2) Standard: LDS Model RP-6.
8. CO_2 (Carbon Dioxide) Return Air Sensor:
   a. Duct mount with display.
   b. Approved Product.
      1) Honeywell: C7232B1006.
9. Control for Electric Ceiling Panel:
   a. Electric Heater Control:
      1) Approved Product.
         a)Switching Relay: Part Number Functional Devices: Relay RIB2401B 20 amp rating.
         b)Disconnect Heater Overload: FMS-TAX5, 2-Pole 1 HP starter switch.
10. Combination Equipment and Thermal Overload Switch Panel:
    a. CEO panel must be provided by approved panel builder.

K. Operation Sequences:
1. Programmable controller shall control Unoccupied and Occupied status of roof top unit and furnace fan systems based on adjustable seven-day program. Roof top unit and furnace supply air fans shall run continuously in Occupied Mode and cycle in Unoccupied Mode.
2. Adjustable heating and cooling set points shall control space temperature by activating either heating or cooling equipment. Programmable controller provides automatic change over between heating and cooling.
3. Controller provides optional override by allowing timed override of program by pushing override on controller touch screen. This shall activate controller to Occupied Mode and system shall control to Occupied set point.
4. Minimum outdoor ventilation air damper, spring return type, shall open in controller Occupied Mode and remain closed in Unoccupied Mode.
5. Systems with CO_2 (Carbon Dioxide) sensor to control minimum, spring return type, outdoor ventilation air damper:
   a. Damper shall open in controller Occupied Mode only when CO_2 sensor setpoint of 1000 ppm is reached. Damper shall close if CO_2 level drops below 900 ppm.
   b. Damper shall remain closed in controller Unoccupied Mode.

PART 3 - EXECUTION

3.1 INSTALLERS

A.
1. Acceptable Installers. See Section 01 4301:
2. Approved HVAC Sub-Contractors shall be pre-approved and included in Construction Documents by Addendum.

3.2 INSTALLATION

A. Interface With Other Work:
1. Calibrate room controllers as required during air test and balance. Insulate sensor J-box with fiberglass insulation; expandable/ foam insulation is NOT acceptable.
2. Instruct air test and balance personnel in proper use and setting of control system components.
3. Install low voltage electrical wiring in accordance with Division 26 of these Specifications.

B. Echelon Communication: Ebus
1. Ebus cable needs to be installed at least 12 inches from lighting, motors, or low voltage switching cables

C. Zone Panel:
1. Zone panel shall be mounted by mechanical equipment with associated LCBS module in close proximity but mounted 24 inches apart.
2. Zone panel shall be mounted at eye level and accessible for visual inspection.
3. Install discharge air sensor 6 feet downstream from a/c coil.
4. Install OA sensor in fresh air duct.
5. TOD relay for fresh air damper which is not part of zone panel shall be mounted in close proximity to panel and clearly labeled such.
6. Zone panel shall be programmed for appropriate amount of zones and control.
7. Zone dampers shall use three (3) wires for LED damper display.
8. Power for zone transformer shall come from mechanical equipment for service switch disconnect.
9. Zone and bypass dampers shall have actuation component positioned such as for visual damper position inspection.
10. Set minimum zone damper position to 16 percent or setting number 1.

D. Control for Electric Ceiling Panel.
1. Install according to local code the electric heater RIB with overload disconnect into electric heater unit.
2. Commission controller to be seen by gateway and webpage.

E. Safety Controls: Interlock duct smoke detectors to keep heating, cooling, and system fan from operating when detector is energized.

F. Mount damper actuators and actuator linkages external of airflow. Make certain dampers operate freely without binding or with actuator housing moving.

G. Paste copy of record control wiring diagram on back of relay panel door cover for each multiple furnace system.

3.3 FIELD QUALITY CONTROL

H. Field Tests:
1. Calibrate, adjust, and set controls for proper operation, operate systems, and be prepared to prove operation of any part of control system. This work is to be completed before pre-substantial completion inspection.
2. Test each individual heating, cooling, and damper control for proper operation using control system.

3.4 SYSTEM STARTUP

I. LCBS Controller.
1. Contractor is responsible for a fully functioning control system accessible via internet web browser. Contractor is responsible to coordinate Network start up with assistance from local IT technician. Local IT technician shall provide available ports on network switch for LCBS gateway.
2. Contractor is responsible configuring all controllers with proper zone names, zone scheduling, proper Church conference / holiday scheduling, all to be coordinated with local FM manager. Set proper clock setting including day/month/year.
3. Set Heating / Cooling to proper stages

4. Set heat cycle rates to 9 cph and cooling to 4 cph.
5. Set DO1 relay to "Occupancy".
6. Set System switch operation to "Automatic" changeover.
7. Set fan switch operation to "ON".
8. Set minimum UnOcc start time for all days. No days shall be scheduled Unconfigured.
9. Set Occupied start times to match meeting start times; provided by local FM manager.
10. Place all zone over-ride durations to one (1) hour except for Office areas which shall be set to two (2) hours.
11. Set Occupied default heating setpoints to 70 degrees, cooling setpoints to 74 degrees.
12. Set Unoccupied default heating setpoint to 60 degrees, cooling setpoints to 90 degrees.
13. Set each zone to applicable Holiday scheduling for General & Stake Conferences.

J. TrueZONE Zone Panel:
1. Contractor responsible for fully functioning zoning system connected to LCBS controller system.
2. Contractor responsible to configuring of zone panel.
3. Contractor responsible to coordinate Network start up with assistance from air balancer.

3.5 ADJUSTING

K. LCBS controller configuration settings; the following are configuration guidelines for consistent installations:
1. Temperature Units — Fahrenheit/ Celsius
2. Equipment Type — Conventional/heat pump.
   a. Stages of Heat — 1,2
   b. Stages of Cool — 1,2
   c. Fan operation in heat mode — Enable Fan w/ Heat
3. Equipment Options
   a. Leave at Default
   b. Heating Cycles per Hour — 6-9 cph
   c. Cooling Cycles per Hour — 3-4 cph
4. Recovery
   a. Leave at Default
5. Economizer / DLC
   a. Configure as required by control equipment.
6. Sensor Selection
   a. Set according to averaging sensors
   b. Set to multi sensor "Smart" when averaging.
   c. Set Occupancy Sensor to "Disable".
7. Terminal Assignment
   a. Set according to equipment
   b. Set Terminal DO1 to Occupancy to control fresh air damper based upon scheduled occupancy or over-ride.
8. Miscellaneous
   a. Leave at default
9. Sensor setting
   a. Leave at default
   b. Set as Required
10. Configure Zone Name (display on Home Screen).
11. Set Password to ABCD.
12. Set Occupied Setpoint
13. Set Unoccupied Setpoint
14. Set Schedule
15. MENU/ Holiday-Event Scheduler / Custom Events/ Create new event.
    a. Mountain Time Zone:
       1) First Sunday in April: Unoccupied all zones for all day / every year.
       2) First Sunday in April: Unoccupied all zones for all day / every year.
       3) First Sunday in October: Unoccupied all zones for all day / every year.

4) First Sunday in October: Unoccupied all zones for all day / every year.

L. Zone Panel Configuration:
1. Configuration:
   a. Conventional Roof Top Unit or Furnace
   b. Cooling stages: (match equipment).
   c. Heat stages: (match equipment).
   d. RF enabled: (NO).
   e. Zones Installed: (match number of zones).
   f. Heat Staging Control: (percent Zones).
2. Advanced Configuration:
   a. Heat Fan Control (HVAC).
   b. Purge Time: (2 minutes).
   c. Fan in Purge (HVAC):
   d. Purge Dampers: (Unchanged).
   e. Changeover delay: (15 minutes).
   f. DA temperature Sensor: (Yes).
   g. DA temperature High Limit (140 degree).
   h. DA Low Limit: (35 degree).
   i. DAT MSTG Inhibit (Yes).
   j. MSTG OT Lockout (No).
3. Save Changes.

3.6 CLOSEOUT ACTIVITIES

M. Instruction Of Owner:
1. Include as part of training required in Section 23 0501, following training:
   a. Training shall be by personnel of installing company and utilize operator's manuals and as-built documentation.
   b. Provide training in (2) two sessions including LCBS Connect sight & smart Apps for up to six (6) hours total:
      1) First session will occur between system completion and Substantial Completion.
      2) Second session will occur within forty-five (45) days of Substantial Completion when agreed upon by Owner.
   c. Training shall include sequence of operation review, selection of displays, modification of schedules and setpoints, troubleshooting of sensors, etc, as follows:
      1) Control System Overview:
         a)Show access to system through both individual controllers and Internet browser and how network works. Scheduling building at minimum for Stake and General Conference, special events.
      2) Controller Programming from Keypad: Instructions on developing setpoints and schedules and adjusting local zone temperatures.
      3) Web Internet training with local Facilities Manager during two (2) sessions.
         a)Review all features accessible from the 'Settings' tab including Alarm points, user access, scheduling and humidity setpoints (where applied).

END OF SECTION

ATTACHMENTS

CERTIFICATE OF SPONSORSHIP
Electric and Electronic Control System for HVAC Installer

PROJECT INFORMATION (To be filled out by Installer - available from project specification):

Project Name: _____

Project Number: _____

Project Address: _____

INSTALLER INFORMATION (To be filled out by Installer):

Installer Name: _____

Installer Firm: _____

Installer Address: _____

I acknowledge and confirm the above listed Installer has received training and exhibit LCBS Connect System skills and is qualified to install the automation control system as specified for Project identified above. Our company will stand behind the Installer meeting the legal specified performance requirements.

Sponsoring Approved Honeywell Distributor Name: _____

Signature: _____ Printed Signature: _____

Date: _____

SECTION 23 1123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavation and backfill required for work of this Section.
   2. Furnish and install gas piping and fittings within building and from building to meter including connection to meter as described in Contract Documents.

B. Related Requirements:
   1. Sections Under 09 9000 Heading: 'Paints And Coatings' for painting of exterior piping.
   2. Section 23 0501: 'Common HVAC Requirements'.
   3. Section 23 0553: 'Identification for HVAC Piping and Equipment'.
   4. Section 31 2316: 'Excavation' for procedure and quality of excavation.
   5. Section 31 2323: 'Fill" for procedure and quality of backfill and compaction.
   6. Section 33 5100: 'Natural-Gas Distribution' for gas line from meter to main.

1.2 REFERENCES

A. Reference Standards:
   1. American National Standards Institute / CSA Group:
      a. ANSI LC 4-2012 (2017) / CSA 6.32-2012 (R2016), 'Press-Connect Metallic Fittings for Use in Fuel Gas Distribution Systems'.
   2. ASTM International:
      a. ASTM A53/A53M-12, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
      b. ASTM A234/A234M-16, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
      c. ASTM D2513-16a, 'Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings'.
   3. International Code Council (ICC):
      a. ICC IFGC-2015: 'International Fuel Gas Code'.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Conform to requirements of requirements of IFGC International Fuel Gas Code.

B. Qualifications:
   1. Welders:
      a. Welders shall be certified and bear evidence of certification thirty (30) days before commencing work on project.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer List:

a. BrassCraft
b. ConBraCo Industries, Inc
c. Jomar International
d. California Valves (formally KOSO) by Pacific Seismic Products Inc
e. Watts Regulator Co

B. Materials:
1. Above-Ground Pipe:
a. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of A53/A53M.
2. Above-Ground Pipe Fittings:
a. Welded forged steel fittings meeting requirements of ASTM A234/A234M.
3. Valves:
a. 125 psi bronze body ball valve, UL listed.
b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Apollo Series 80-100 by ConBraCo.
2) 'Red Cap' R602 by Jenkins NH Canada.
3) Model T-204 by Jomar International.
4) Model B-6000-UL by Watts Regulator.
4. Cocks:
a. Gauge Cocks: Conbraco Series 50-56 bronze gauge cock.
5. Flexible Connector:
a. Type 304 stainless steel corrugated tube coated for corrosion protection.
b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) BrassCraft Procoat.
6. Seismic Valves:
a. Natural gas seismic shut-off valves.
1) Rate at maximum 20 psi pressure with positive seating from minus 40 deg F to plus 150 deg F for exterior mounting near gas meter.
2) UL listed valve, factory set for IBC Seismic Design Category D, E, or F.
3) Size to be determined by total cu ft per hour gas flow requirement of building and following conditions: 0.1 inch water column maximum allowable pressure-drop through valve with available pressure of 4 oz.
4) Approved Product.
a) California Seismic Gas Shutoff Valve (formally KOSO):
(1) Horizontal installation: Model 314F or 315F.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel pipe installed through air plenums, in walls:
1. Pipes 2 inches and smaller shall have screwed or welded fittings.
2. Other steel pipe, exposed, may have screwed or welded fittings.

B. After gas meter, valves, seismic valve and etc, gas piping should rise inside outside wall and not be visible to public.

C. On lines serving gas-fired equipment, install pressure regulator, (lb/oz), gas cocks adjacent to equipment outside of equipment cabinet and easily accessible.

D. Install 6 inch long minimum dirt leg, with pipe cap, on vertical gas drop serving each gas-fired equipment unit.

E. Use fittings for changes of direction in pipe and for branch runouts.

F. Visible gas piping in mechanical mezzanine exposed to view inside building shall be painted yellow and labeled.

G. Install seismic valve in 24 inch long pipe section anchored to building wall at each end.

3.2 FIELD QUALITY CONTROL

A. Field tests:
   1. Subject all portions of gas piping system, in sections or in entirety, to air pressure of 75 psig and prove airtight for four (4) hours.
   2. Disconnect equipment not suitable for 75 psig pressure from piping system during test period.

END OF SECTION

SECTION 23 2300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install piping and specialties for refrigeration systems as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 0719: 'Refrigerant Piping Insulation'.
   3. Section 23 6216: 'Compressor Units: Heat Pumps (5 Ton or less)'.
   4. Section 23 8216.01: 'Air Coils: DX'.

1.2 REFERENCES

A. Definitions:
   1. Refrigerant: Absorbs heat by a change of state (evaporation) from liquid to a gas, and releases heat by a change of state (condenses) from gas back to a liquid.
   2. Vibration Isolation: Vibration reduction in which an isolation system is placed between the source of unwanted vibration and an item which needs to be shielded from the vibration.

B. Reference Standards:
   1. American National Standards Institute (ANSI) / American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. ANSI/ASHRAE 15-2016 and 34-2016, 'Safety Standard and Designation and Classification of Refrigerants'.
   2. American National Standards Institute / American Welding Society:
      a. ANSI/AWS A5.8M/A5.8-2011, 'Specification for Filler Metals for Brazing and Braze Welding'.
   3. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
      a. 2011 ASHRAE Handbook - HVAC Applications.
         1) Chapter 48, 'Noise and Vibration Control'.
   4. ASTM International:
      a. ASTM A36/A36M-14, 'Standard Specification for Carbon Structural Steel'.
      b. ASTM B280-18, 'Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings: Show each individual equipment and piping support.

B. Informational Submittals:
   1. Qualification Statements: Technician certificate for use of HFC and HCFC refrigerants.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Refrigerants:
      a. Underwriters Laboratories / Underwriters Laboratories of Canada:
         1) Comply with requirements of UL 2182.

B. Qualifications. Section 01 4301 applies, but is not limited to the following:
   1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Materials:
   1. Refrigerant Piping:
      a. Meet requirements of ASTM B280, hard drawn straight lengths. Soft copper tubing not permitted.
      b. Do not use pre-charged refrigerant lines.
   2. Refrigerant Fittings:
      a. Wrought copper with long radius elbows.
      b. Approved Manufacturers.
         1) Mueller Streamline.
         2) Nibco Inc.
         3) Elkhart.
         4) Sporlan - ZoomLock
   3. Suction Line Traps:
      a. Manufactured standard one-piece traps.
      b. Approved Manufacturers.
         1) Mueller Streamline.
         2) Nibco Inc.
         3) Elkhart.
         4) Sporlan - ZoomLock [Flame-Free Refrigerant Fittings]
   4. Tee Access:
      a. Brass:
         1) Approved Manufacturers.
            a) JB Industries: Part #A3 Series with Factory Cap and Valve Core.
   5. Connection Material:
      a. Sporlan - ZoomLock Flame-Free Refrigerant Fittings with factory approved tools
      b. Brazing Rods in accordance with ANSI/AWS A5.8M/A5.8:
         1) Copper to Copper Connections:
            a) Classification BCuP-4 Copper Phosphorus (6 percent silver).
            b) Classification BCuP-5 Copper Phosphorus (15 percent silver).
         2) Copper to Brass or Copper to Steel Connections: Classification BAg-5 Silver (45 percent silver).
         3) Do not use rods containing Cadmium.
      c. Flux:
         1) Type Two Acceptable Products:
            a) Stay-Silv White Brazing Flux by Harris Products Group.
            b) High quality silver solder flux by Handy & Harmon.
   6. Valves:
      a. Manual Refrigerant Shut-Off Valves:
         1) Ball valves designed for refrigeration service and full line size.
         2) Valve shall have cap seals.
         3) Valves with hand wheels are not acceptable.
         4) Provide service valve on each liquid and suction line at compressor.
         5) If service valves come as integral part of condensing unit, additional service valves shall not be required.
         6) Approved Manufacturers.
            a) Henry.
            b) Mueller.
            c) Sherwood.
            d) Virginia.

7. Filter-Drier:
    a. On lines 3/4 inch outside diameter and larger, filter-drier shall be replaceable core type with Schrader type valve.
    b. On lines smaller than 3/4 inch outside diameter, filter-drier shall be sealed type with brazed end connections.
    c. Size shall be full line size.
    d. Approved Manufacturers.
        1) Emerson Climate Technologies.
        2) Mueller.
        3) Parker.
        4) Sporlan.
        5) Virginia.
8. Sight Glass:
    a. Combination moisture and liquid indicator with protection cap.
    b. Sight glass shall be full line size.
    c. Sight glass connections and sight glass body shall be solid copper or brass, no copper-coated steel sight glasses allowed.
    d. Approved Product.
        1) HMI by Emerson Climate Technologies.
9. Flexible Connectors:
    a. Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.
    b. Approved Products.
        1) Vibration Absorber Model VAF by Packless Industries.
        2) Vibration Absorbers by Virginia KMP Corp.
        3) Anaconda 'Vibration Eliminators' by Universal Metal Hose.
        4) Style 'BF' Spring-flex freon connectors by Vibration Mountings.
        5) ULCPS by Mason
10. Refrigerant Piping Supports:
    a. Base, Angles, And Uprights: Steel meeting requirements of ASTM A36.
    b. Securing Channels:
        1) At Free-Standing Pipe Support:
            a)Quality Standard: P-1000 channels by Unistrut.
            b)Acceptable Manufacturers: Hilti, Thomas & Betts.
        2) At Wall Support:
            a)Quality Standard: P-3300 channels by Unistrut.
            b)Acceptable Manufacturers: Hilti, Thomas & Betts.
        3) At Suspended Support:
            a)Quality Standard: P-1001 channels by Unistrut.
            b)Acceptable Manufacturers: Hilti, Thomas & Betts.
        4) Angle Fittings:
            a)Quality Standard: P-2626 90 degree angle by Unistrut.
            b)Acceptable Manufacturers: Hilti, Thomas & Betts.
        5) Low-Slope Roof Base Support:
            a)Quality Standard: Dura-Blok DBE or DB-DS by Cooper B-Line.
            b)Acceptable Manufacturers: Unistrut, Mirror, and Mifab.
    c. Pipe Clamps:
        1) Acceptable Manufacturers:
            a)Hydra-Zorb.
            b)ZSI Cush-A-Clamp.
            c)Hilti Cush-A-Clamp.
    d. Protective Cover: 18 ga steel, hot-dipped galvanized.
11. Locking Refrigerant Cap:
    a. Provide and install on charging valves:
        1) Quality Standard: 'No Vent' locking refrigerant cap.
        2) Acceptable Manufacturers: Airtec.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refrigerant Lines:
   1. Install as high in upper mechanical areas as possible. Do not install underground or in tunnels.
   2. Slope suction lines down toward compressor one inch/10 feet. Locate traps at vertical rises against flow in suction lines.

B. Connections:
   1. Refrigeration system connections shall be copper-to-copper, copper-to-brass, or copper-to-steel type properly cleaned and brazed with specified rods. Use flux only where necessary. No soft solder (tin, lead, antimony) connections will be allowed in system.
   2. Braze manual refrigerant shut-off valve, sight glass, and flexible connections.
   3. Circulate dry nitrogen through tubes being brazed to eliminate formation of copper oxide during brazing operation.

C. Specialties:
   1. Install valves and specialties in accessible locations. Install refrigeration distributors and suction outlet at same end of coil.
   2. Install thermostatic bulb as close to cooling coil as possible. Do not install on vertical lines.
   3. Install equalizing line in straight section of suction line, downstream of and reasonably close to thermostatic bulb. Do not install on vertical lines.
   4. Provide flexible connectors in each liquid line and suction line at both condensing unit and evaporator on systems larger than five tons. Anchor pipe near each flexible connector.

D. Refrigerant Supports:
   1. Support Spacing:
      a. Piping 1-1/4 inch And Larger: 8 feet on center maximum.
      b. Piping 1-1/8 inch And Smaller: 6 feet on center maximum.
      c. Support each elbow.
   2. Isolate pipe from supports and clamps with Hydrozorb or Cush-A-Clamp systems.
   3. Run protective cover continuous from condensing units to risers or penetrations at building wall.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Make evacuation and leak tests in presence of Architect's Engineer after completing refrigeration piping systems. Positive pressure test will not suffice for procedure outlined below.
      a. Draw vacuum on each entire system with two stage vacuum pump. Draw vacuum to 300 microns using micron vacuum gauge capable of reading from atmosphere to 10 microns. Do not use cooling compressor to evacuate system nor operate it while system is under high vacuum.
      b. Break vacuum with nitrogen and re-establish vacuum test. Vacuum shall hold for 30 minutes at 300 microns without vacuum pump running.
      c. Conduct tests at 70 deg F ambient temperature minimum.
      d. Do not run systems until above tests have been made and systems started up as specified. Inform Owner's Representative of status of systems at time of final inspection and schedule start-up and testing if prevented by outdoor conditions before this time.
      e. After testing, fully charge system with refrigerant and conduct test with Halide Leak Detector.
      f. Recover all refrigerant in accordance with applicable codes. Do not allow any refrigerant to escape to atmosphere.

B. Non-Conforming Work:
   1. If it is observed that refrigerant lines are being or have been brazed without proper circulation of nitrogen through lines, all refrigerant lines installed up to that point in time shall be removed and replaced at no additional cost to Owner.

END OF SECTION

SECTION 23 2600 - CONDENSATE DRAIN PIPING GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Coordinate installation of condensate drain piping with Section 22 0501 as described in Contract Documents.

B. Related Requirements:
   1. Section 22 0501: 'Common Plumbing Requirements'.
   2. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Materials:
   1. Condensate Drains:
      a. Schedule 40 PVC for condensate drains from furnace combustion chambers and furnace cooling coils.
   2. Solvent Cement and Adhesive Primer:
      a. Use PVC solvent cement that has a VOC content of 510 g/L or less if required by local AHJ if required.
      b. Use adhesive primer that has a VOC content of 550 g/L or less if required by local AHJ if required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Condensate Drains:
   1. Support piping and protect from damage.
   2. Pipe condensate drains from roof top units to roof. Provide 3 inch deep P-trap.
   3. Do not combine PVC condensate drain piping from furnace combustion chamber with copper condensate drain piping from cooling coil.
   4. Pipe auxiliary condensate drains from cooling coil and furnace separately to floor drain.

END OF SECTION

SECTION 23 3001 - COMMON DUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. General procedures and requirements for ductwork.
   2. Repair leaks in ductwork, as identified by duct testing, at no additional cost to Owner.

B. Related Requirements:
   1. Section 01 4546: 'Duct Testing, Adjusting, and Balancing' for ductwork.
   2. Section 07 9219: 'Acoustical Joint Sealants' for quality of acoustic sealant.
   3. Section 23 0501: 'Common HVAC Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
      a. SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible' (4th Edition).

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data: Specification data on sealer and gauze proposed for sealing ductwork.
   2. Samples: Sealer and gauze proposed for sealing ductwork.

B. Informational Submittals:
   1. Manufacturer Instructions:
      a. Installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Performance:
   1. Design Criteria:
      a. Standard Ducts: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA, 'HVAC Duct Construction Standards Metal and Flexible'.

B. Materials:
   1. Duct Hangers:
      a. One inch by 18 ga galvanized steel straps or steel rods as shown on Drawings, and spaced not more than 96 inches apart. Do not use wire hangers.
      b. Attaching screws at trusses shall be 2 inch No. 10 round head wood screws. Nails not allowed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.

B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.

C. Hangers And Supports:
   1. Install pair of hangers as required by spacing indicated in table on Drawings.
   2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
   3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
   4. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

3.2 CLEANING

A. Clean interior of duct systems before final completion.

END OF SECTION

SECTION 23 3114 - LOW-PRESSURE METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install above-grade low-pressure steel ducts and related items as described in Contract Documents.

B. Products Installed But Not Furnished Under This Section:
   1. Duct smoke detectors.

C. Related Requirements:
   1. Section 01 4546: 'Duct Testing, Adjusting, And Balancing' for duct test, balance, and adjust air duct systems services provided by Owner.
   2. Section 23 0713: 'Duct Insulation' for thermal Insulation for ducts, plenum chambers, and casings.
   3. Section 23 3001: 'Common Duct Requirements'.
   4. Section 23 0933: 'Electric And Electronic Control System For HVAC':
      a. Temperature control damper actuators and actuator linkages.
      b. Furnishing of duct smoke detectors.

1.2 REFERENCES

A. Association Publications:
   1. Sheet Metal And Air Conditioning Contractors' National Association / American National Standards Institute:
   2. SMACNA, 'HVAC Duct Construction Standards - Metal and Flexible' (4th edition).

B. Reference Standards:
   1. ASTM International:
      a. ASTM A653/A653M-18, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
      b. ASTM E84-18b, 'Standard Test Method for Surface Burning Characteristics of Building Materials'.
   2. Underwriters Laboratories, Inc.:
      a. UL 723: 'Standard for Safety Test for Surface Burning Characteristics of Building Materials'; (11th Edition - 2018).

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Duct Sealer:
      a. Meet Class A flame spread rating in accordance with ASTM E84 or UL 723.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Duct Sealer:
      a. Handle, store, and apply materials in compliance with applicable regulations and material safety data sheets (MSDS).
      b. Handle to prevent inclusion of foreign matter, damage by water, or breakage.
      c. Store in a cool dry location, but never under 35 deg F or subjected to sustained temperatures exceeding 110 deg F or as per Manufacturer's written recommendations.
      d. Do use sealants that have exceeded shelf life of product.

1.5 FIELD CONDITIONS

A. Ambient Conditions:
   1. Duct Sealer:
      a. Do not apply under 35 deg F or subjected to sustained temperatures exceeding 110 deg F or as per Manufacturer's written recommendations.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Sheet Metal:
      a. Fabricate ducts, plenum chambers and casings of zinc-coated, lock-forming quality steel sheets meeting requirements A653/A653M, with G 60 coating.
   2. Duct Sealer For Interior Ducts:
      a. Approved Products.
         1) Duct Butter or ButterTak by Cain Manufacturing Co Inc
         2) DP 1010, DP 1030 or DP 1015
         3) PROseal, FIBERseal, EVERseal, or EZ-seal by Ductmate Industries, Inc.
         4) SAS by Duro Dyne
         5) Iron Grip 601 by Hardcast Inc
         6) MTS100 or MTS 200 by Hercules Mighty Tough
         7) 15-325 by Miracle / Kingco
         8) 44-39 by Mon-Eco Industries Inc
         9) Airseal Zero by Polymer Adhesive Sealant Systems Inc
         10) Airseal #22 Water Base Duct Sealer
   3. Duct Sealer For Exterior Ducts:
      a. Approved Products.
         1) Two Part II Sealing System including RTA-50 liquid adhesive and DT-5300 for 3 inch and DT 5400 for 4 inch tape by Hardcast Inc

B. Fabrication:
   1. General:
      a. Straight and smooth on inside with joints neatly finished.
      b. Duct drops to diffusers shall be round, square, or rectangular to accommodate diffuser neck. Drops shall be same gauge as branch duct. Seal joints air tight.
   2. Standard Ducts:
      a. General:
         1) Ducts shall be large enough to accommodate inside acoustic duct liner. Dimensions shown on Drawings are net clear inside dimensions after duct liner has been installed.
      b. Rectangular Duct:
         1) Duct panels through 48 inch dimension having acoustic duct liner need not be cross-broken or beaded. Cross-break unlined ducts, duct panels larger than 48 inch vertical and horizontal sheet metal barriers, duct offsets, and elbows, or bead 12 inches on center.
      c. Round Duct:
         1) Spiral Seam:
            a) 28 ga minimum for ducts up to and including 14 inches in diameter.
            b) 26 ga minimum for ducts over 14 inches and up to and including 26 inches in diameter.
         2) Longitudinal Seam:
            a) 28 ga minimum for ducts up to and including 8 inches in diameter.
            b) 26 ga minimum for ducts over 8 inches and up to 14 inches in diameter.
            c) 24 ga minimum for ducts over 14 inches up to and including 26 inches in diameter.

PART 3 - EXECUTION

3.1 PREPARATION

A. Metal duct surface must be clean and free of moisture, contamination and foreign matter before applying duct sealer for interior and exterior ducts.

3.2 INSTALLATION

A. Install ducts where indicated. Make required connections to roof top units and furnaces.

B. Coordinate location of all ductwork with structural, mechanical, plumbing, electrical trades. Make required offsets and changes in direction of ductwork were required to avoid conflicts.

C. Field verify location of ductwork and routing prior to fabrication.

D. Install internal ends of slip joints in direction of flow. Seal transverse and longitudinal joints air tight using specified duct sealer as per Manufacturer's written instructions. Cover horizontal and longitudinal joints on exterior ducts with two layers of specified tape installed with specified adhesive.

E. Securely anchor ducts and plenums to building structure with specified duct hangers attached with screws. Do not hang more than one duct from a duct hanger. Brace and install ducts so they shall be free of vibration under all conditions of operation.

F. Ducts shall not bear on top of structural members.

G. Paint ductwork visible through registers, grilles, and diffusers flat black.

H. Properly flash where ducts protrude above roof.

I. Under no conditions will pipes, rods, or wires be allowed to penetrate ducts.

3.3 FIELD QUALITY CONTROL

A. Field Tests:
   1. Air Test and Balance Testing as specified in Section 01 4546: 'Duct Testing, Adjusting, and Balancing'.

B. Non-Conforming Work:
   1. Reseal transverse joint duct leaks and seal longitudinal duct joint leaks discovered during air test and balance procedures at no additional cost to Owner.

END OF SECTION

SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install duct accessories in specified ductwork as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0933: 'Electric And Electronic Control System For HVAC' for temperature control damper actuators and actuator linkages.
   2. Section 23 3001: 'Common Duct Requirements'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A653/A653M-18, 'Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process'.
      b. ASTM C1071-16, 'Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)'.
      c. ASTM C1338-14, 'Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings'.

PART 2 - PRODUCTS

A. Materials:
   1. Acoustical Liner System:
      a. Duct Liner:
         1) One inch thick, 1-1/2 lb density fiberglass conforming to requirements of ASTM C1071. Liner will not support microbial growth when tested in accordance with ASTM C1338.
         2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            a) ToughGard by CertainTeed.
            b) Duct Liner E-M by Knauf Fiber Glass.
            c) Akousti-Liner by Manson Insulation.
            d) Quiet R by Owens Corning.
            e) Linacoustic RC by Johns-Manville.
      b. Adhesive:
         1) Approved Water-Based Products.
            a) Cain: Hydrotak.
            b) Design Polymerics: DP2501 or DP2502 (CMCL-2501).
            c) Duro Dyne: WSA.
            d) Elgen: A-410-WB.
            e) Hardcast: Coil-Tack.
            f) Hercules: Mighty Tough Adhesives MTA500 or MTA600.
            g) Miracle / Kingco: PF-101.
            h) Mon-Eco: 22-67 or 22-76.
            i) Polymer Adhesive: Glasstack #35.
            j) Techno Adhesive: 133.
            k) McGill AirSeal: Uni-tack.

2) Approved Solvent-Based (non-flammable) Products.
   a) Cain: Safetak.
   b) Duro Dyne: FPG.
   c) Hardcast: Glas-Grip 648-NFSE.
   d) Miracle / Kingco: PF-91.
   e) Mon-Eco: 22-24.
   f) Polymer Adhesive: Q-Tack.
   g) Techno Adhesive: 'Non-Flam' 106.
3) Approved Solvent-Based (flammable) Products.
   a) Cain: HV200.
   b) Duro Dyne: MPG.
   c) Hardcast: Glas-Grip 636-SE.
   d) Miracle / Kingco: PF-96.
   e) Mon-Eco: 22-22.
   f) Polymer Adhesive: R-Tack.
   g) Techno Adhesive: 'Flammable' 106.

c. Fasteners:
1) Adhesively secured fasteners not allowed.
2) Approved Products.
   a) AGM Industries: 'DynaPoint' Series RP-9 pin.
   b) Cain.
   c) Duro Dyne.
   d) Gripnail: May be used if each nail is installed by 'Grip Nail Air Hammer' or by 'Automatic Fastener Equipment' in accordance with Manufacturer's recommendations.

2. Flexible Equipment Connections:
a. 30 oz closely woven UL approved glass fabric double coated with neoprene.
b. Fire retardant, waterproof, air-tight, resistant to acids and grease, and withstand constant temperatures of 200 deg F
c. Approved Products.
1) Cain: N-100.
2) Duro Dyne: MFN.
3) Dyn Air: CPN with G-90 galvanized off-set seam.
4) Elgen: ZLN / SDN.
5) Ventfabrics: Ventglas.
6) Ductmate: ProFlex.

3. Duct Access Doors:
a. General:
1) Factory built insulated access door with hinges and sash locks, as necessary. Construction shall be galvanized sheet metal, 24 ga minimum.
2) Fire and smoke damper access doors shall have minimum clear opening of 12 inches square or larger as shown on Drawings.
b. Rectangular Ducts:
1) Approved Products.
   a) Air Balance: Fire/Seal FSA 100.
   b) Air-Rite: Model HAD-2.
   c) Cesco: HDD.
   d) Elgen: TAB Type / Hinge and Cam.
   e) Flexmaster: Spin Door.
   f) Kees: ADH-D.
   g) Nailor: 08SH.
   h) Pottorff: 60-HAD.
   i) Ruskin: ADH-24.
   j) United Enertech: L-95.
c. Round Ducts:
1) Approved Products.
   a) Ductmate: 'Sandwich' Access Door.

b) Elgen: Sandwich Access Door.
c) Kees: ADL-R.
d) Nailor: 0809.
e) Pottorff: RAD.
f) Ruskin: ADR.
g) Ward: DSA.

4. Dampers And Damper Accessories:
   a. Locking Quadrant Damper Regulators:
      1) Approved Products.
         a) Duro Dyne: KS-385.
         b) Dyn Air: QPS-385.
         c) Elgen: EQR-4.
         d) Ventfabrics: Ventline 555.
         e) Young: No. 1.
   b. Concealed Ceiling Damper Regulators:
      1) Approved Products.
         a) Cain.
         b) Duro Dyne.
         c) Elgen.
         d) Metco Inc.
         e) Ventfabrics: 666 Ventlok.
         f) Young: 301.
   c. Volume Dampers:
      1) Rectangular Duct:
         a) Factory-manufactured 16 ga galvanized steel, single blade and opposed blade type with 3/8 inch axles and end bearings. Blade width 8 inches maximum. Blades shall have 1/8 inch clearance all around.
         b) Damper shall operate within acoustical duct liner.
         c) Provide channel spacer equal to thickness of duct liner.
         d) Dampers above removable ceiling and in Mechanical Rooms shall have locking quadrant on bottom or side of duct. Otherwise, furnish with concealed ceiling damper regulator and cover plate.
         e) Approved Products. :
            (1) Air-Rite: Model CD-2.
            (2) American Warming: VC-2-AA.
            (3) Arrow: OBDAF-207.
            (4) C & S: AC40.
            (5) Cesco: AGO.
            (6) Daniel: CD-OB.
            (7) Greenheck: VCD-20.
            (8) Nailor: 1810 or 1820.
            (9) Pottorff: CD-42.
            (10) Ruskin: MD-35.
            (11) United Enertech: MD-115.
            (12) Utemp: CD-OB.
      2) Round Duct:
         a) Factory-manufactured 20 ga galvanized steel, single blade with 3/8 inch axles and end bearings.
         b) For use in outside air ducts.
         c) Approved Products.
            (1) Air Balance: Model AC-22.
            (2) Air-Rite: Model CD-8.
            (3) American Warming: V-22.
            (4) Arrow: Type-70.
            (5) C & S: AC21R.
            (6) Cesco: MGG.
            (7) Nailor: 1890.
            (8) Pottorff: CD-21R.

(9) Ruskin: MDRS-25.
(10) United Enertech: RD.

d. Motorized Outside Air Dampers:
1) General:
a) Low leakage type. AMCA certified.
b) Make provision for damper actuators and actuator linkages to be mounted external of air flow.
2) Rectangular Ducts:
a) Damper Blades:
(1) Steel or aluminum airfoil type with mechanically locked blade seals, 8 inch (200 mm) blade width maximum measured perpendicular to axis of damper.
(2) Jamb seals shall be flexible metal compression type.
(3) Opposed or single blade type.
b) Approved Products.
(1) Air Balance: AC 526.
(2) American Warming: AC526.
(3) Arrow: AFD-20.
(4) C & S: AC50.
(5) Cesco: AGO3.
(6) Nailor: 2020.
(7) Pottorff: CD-52.
(8) Ruskin: CD-60.
(9) Tamco: Series 1000.
(10) United Enertech: CD-150 or CD-160.
3) Round Ducts:
a) Damper Blades:
(1) Steel with mechanically locked blade seals.
(2) Blade seals shall be neoprene or polyethylene.
(3) Single blade type.
b) Approved Products.
(1) Air Balance: AC 25.
(2) American Warming: VC25.
(3) Arrow: Type 70 or 75.
(4) C & S: AC25R.
(5) Cesco: AGG.
(6) Nailor: 1090.
(7) Pottorff: CD-25R.
(8) Ruskin: CD25.
(9) Tamco: Square-to-Round Series 1000.
(10) United Enertech: RI.

e. Backdraft Dampers:
1) Backdraft blades shall be nonmetallic neoprene coated fiberglass type.
2) Stop shall be galvanized steel screen or expanded metal, 1/2 inch mesh.
3) Frame shall be galvanized steel or extruded aluminum alloy.
4) Approved Products.
a) Air-Rite: Model BDD-3.
b) American Warming: BD-15.
c) C & S: BD30.
d) Pottorff: BD-51.
e) Ruskin: NMS2.
f) Utemp: BFEA.

5. Air Turns:
a. Single thickness vanes. Double thickness vanes not acceptable.
b. 4-1/2 inch wide vane rail. Junior vane rail not acceptable.

6. Branch Tap for Flexible Ductwork:

a. Factory-manufactured rectangular-to-round 45 degree leading tap fabricated of 24 ga zinc-coated lock-forming quality steel sheets meeting requirements of ASTM A653, with G-90 coating.
b. One inch wide mounting flange with die formed corner clips, pre-punched mounting holes, and adhesive coated gasket.
c. Manual Volume Damper:
1) Single blade, 22 ga minimum
2) 3/8 inch minimum square rod with brass damper bearings at each end.
3) Heavy-duty locking quadrant on 1-1/2 inch high stand-off mounting bracket attached to side of round duct.
d. Approved Products.
1) ST-1HD by Air-Rite:
a) Nylon damper bearings approved for Air-Rite.
2) STO by Flexmaster.
3) HET by Sheet Metal Connectors.

B. Fabrication:
1. Duct Liner:
a. Install mat finish surface on airstream side. Secure insulation to cleaned sheet metal duct with continuous 100 percent coat of adhesive and with 3/4 inch long mechanical fasteners 12 inches on center maximum unless detailed otherwise on Drawings. Pin all duct liner.
b. Accurately cut liner and thoroughly coat ends with adhesive. Butt joints tightly. Top and bottom sections of insulation shall overlap sides. If liner is all one piece, folded corners shall be tight against metal. Ends shall butt tightly together.
c. Coat longitudinal and transverse edges of liner with adhesive.
2. Air Turns:
a. Permanently install vanes arranged to permit air to make abrupt turn without appreciable turbulence, in 90 degree elbows of above ground supply and return ductwork.
b. Quiet and free from vibration when system is in operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Duct Liner:
1. Furnish and install acoustic lining in following types of rectangular ducts unless noted otherwise on Contract Documents:
a. Supply air.
b. Return air.
c. Mixed air.
d. Transfer air.
e. Relief air.
f. Exhaust air.
g. Elbows, fittings, and diffuser drops greater than 12 inches in length.
2. Do not install acoustic lining in round ducts.

B. Flexible Connections: Install flexible inlet and outlet duct connections to each furnace and roof top unit supply and return air duct.

C. Access Doors In Ducts:
1. Install at each manual outside air damper and at each motorized damper. Locate doors within 6 inches of installed dampers.

D. Dampers And Damper Accessories:
1. Install concealed ceiling damper regulators.
a. Paint cover plates to match ceiling tile.
b. Do not install damper regulators for dampers located directly above removable ceilings or in Mechanical Rooms.

2. Provide each take-off with an adjustable volume damper to balance that branch.
    a. Anchor dampers securely to duct.
    b. Install dampers in main ducts within insulation.
    c. Dampers in branch ducts shall fit against sheet metal walls, bottom and top of duct, and be securely fastened. Cut duct liner to allow damper to fit against sheet metal.
    d. Where concealed ceiling damper regulators are installed, provide cover plate.
3. Install motorized dampers on each furnace outside air intake duct.

END OF SECTION

SECTION 23 3346 - FLEXIBLE DUCTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install supply air branch duct runouts to diffusers as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: Common Duct Requirements.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association / American National Standards Institute:
      a. NFPA 90A: 'Installation of Air-Conditioning and Ventilating Systems' (2018 or most recent edition adopted by AHJ).
   2. Underwriters Laboratories:
      a. UL 181, 'Factory-Made Ducts and Air Connectors' (11th Edition).
      b. UL 181B, 'Closure Systems for Use With Flexible Air Ducts and Air Connectors' (3rd Edition).

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Ducts:
      a. Formable, flexible, circular duct which shall retain its cross-section, shape, rigidity, and shall not restrict airflow after bending.
      b. Insulation:
         1) Nominal 1-1/2 inches, 3/4 lb per cu ft density fiberglass insulation with air-tight, polyethylene or polyester core, sheathed in seamless vapor barrier jacket factory installed over flexible assembly.
      c. Assembly, including insulation and vapor barrier, shall meet Class I requirement of NFPA 90A and be UL 181 rated, with flame spread of 25 or less and smoke developed rating of 50 or under.
      d. Approved Products.
         1) PR-25 by JP Lambornes.
         2) Flex-Vent KP by Thermaflex by Flexible Technologies.
         3) Type 1B Insulated by Flexmaster.
   2. Cinch Bands: Nylon, 3/8 inch removable and reusable type.
      a. Listed and labeled in accordance with Standard UL 181B and labeled 'UL 181 B-C'.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct in fully extended condition free of sags and kinks, using 72 inch maximum lengths.

B. Make duct connections by coating exterior of duct collar for 3 inches with duct sealer and securing duct in place over sheet metal collar with specified cinch bands.

END OF SECTION

SECTION 23 3401 - EXHAUST FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install ceiling mounted exhaust fans as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.
   2. Division 26: Control device and electrical connection.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Bear AMCA seal and UL label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Acme Engineering & Manufacturing Corp,
   2. Broan-Nu Tone LLC
   3. Carnes Co
   4. Loren Cook Co
   5. Soler & Palau

2.2 MANUFACTURED UNITS

A. Ceiling Mounted Exhaust Fans:
   1. Acoustically insulated housings. Sound level rating of 5.0 sones maximum for CFM and static pressure listed on Contract Drawings.
   2. Include chatterproof integral back-draft damper with no metal-to-metal contact.
   3. Include factory mounted integral fan speed controller located inside the fan housing behind the ceiling grill.
   4. Integrate exhaust fan control with building systems control and occupancy sensor control.
   5. Include vibration kit.
   6. True centrifugal wheels.
   7. Entire fan, motor, and wheel assembly shall be easily removable without disturbing housing.
   8. Suitably ground motors and mount on rubber-in shear vibration isolators.
   9. Provide wall or roof cap, as required.
   10. Approved Products.
      a. Acme: VQ.
      b. Broan: LoSone.
      c. Carnes: VCD.
      d. Cook: Gemini.
      e. Soler & Palau: FF.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install ceiling exhaust fans where indicated.

B. Anchor fan units securely to roof structure.

C. Balance exhaust fans to CFM indicated using the integral fan speed controller furnished with each exhaust fan.

D. Exhaust fan shall operate whenever occupancy inside the restroom is detected. The exhaust fan shall continue to operate for 10 minutes (adjustable) after occupancy is no longer detected

END OF SECTION

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install diffusers, registers, and grilles connected to ductwork as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'General Duct Requirements'.

1.2 SUBMITTALS

A. Submittals:
   1. Manufacturers information sheet indicating type, materials and accessories associated with each diffuser, register or grille.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Contact List:
   1. Carnes Co
   2. J & J Register
   3. Krueger Air System Components
   4. Metal*Aire by Metal Industries Inc
   5. Nailor Industries Inc
   6. Price Industries Inc
   7. Titus
   8. Tuttle & Bailey

2.2 MANUFACTURED UNITS

A. Ceiling Return And Transfer Grilles:
   1. Finish: Bright-white baked enamel.
   2. 1/2 inch spacing.
   3. See Contract Documents for location of grilles.
   4. Quality Standard.
      a. Price: 535.

B. Classroom and Foyer Side Wall Return Grilles:
   1. Finish: Anodized aluminum as indicated in the contract documents.
   2. Quality Standard.
      a. Price: RCG.

C. Ceiling and Side Wall Linear Slot Diffusers:
   1. Finish: Anodized Aluminum
   2. Double deflection.
   3. Quality Standard.

a. Price: SDBI100-3 Slot

D. Ceiling Linear Slot Diffusers:
1. Finish: Bright-white baked enamel.
2. Double deflection.
3. Quality Standard.
a. Price: TBD4-2 Slot

E. Low Sidewall Return Grilles- Office Areas:
1. Finish: Off-white baked enamel.
2. 38 or 45 degree deflection.
3. Quality Standard.
a. Price: RCG

F. Ceiling Diffusers:
1. Finish: Bright-white baked enamel.
2. Quality Standard.
a. Price: SPD

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings. Secure frames to ductwork by using four sheet metal screws, one per side. Level floor registers and anchor securely into floor.

3.2 ADJUSTING

A. Set sidewall supply register blades at 15 degrees upward deflection.

END OF SECTION

SECTION 23 3714 - LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install louvers connected to ductwork as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Architectural louvers not connected to ductwork.

C. Related Requirements:

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Louvers:
   1. General:
      a. Extruded aluminum, with blades welded or screwed into frames.
      b. Frames shall have mitered corners.
      c. Louvers shall be recessed, flanged, stationary, or removable as noted on Contract Documents.
      d. Finish:
         1) Polyvinyledene Fluoride (PVF_2) Resin-base finish (Kynar 500 or Hylar 5000) containing 70 percent minimum PVF_2 in resin portion of formula. Thermo-cured two coat system consisting of corrosion inhibiting epoxy primer and top coat factory applied over properly pre-treated metal.
         2) Color as selected by Architect from Manufacturer's standard colors.
   2. Louvers Connected To Ductwork:
      a. 1/2 inch mesh 16 ga aluminum bird screen.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) K638 by Airolite.
         2) LE-1 by Air-Rite Manufacturing.
         3) LE48 by American Warming & Ventilating.
         4) EA-405 by Arrow United Industries.
         5) FKDA by Carnes.
         6) 455-XP by Industrial Louvers.
         7) EFK-445 by Pottorff.
         8) ELF81S30 by Ruskin.
         9) EL-4 by United Enertech.
         10) 2740-31 by Vent Products.
         11) EX by Wonder Metals.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Anchor securely into openings.

B. Where louvers touch masonry or dissimilar metals, protect with heavy coat of asphaltum paint.

END OF SECTION

SECTION 23 3723 - HVAC GRAVITY VENTILATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install penthouse roof vents as described in Contract Documents.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer List:
   1. Air-Rite Manufacturing
   2. Breidert Air Products
   3. Carnes Company
   4. Greenheck Fan Corporation
   5. Loren Cook Co
   6. United Enertech Corporation
   7. Vent Products Co, Inc

2.2 MANUFACTURED UNITS

A. Louvered Penthouses:
   1. Fabricated from 0.081 inch extruded aluminum.
      a. All welded construction.
      b. Screws or rivets will not be allowed.
   2. Blades:
      a. Horizontal at 45 degree angle with return bends at upper edges.
      b. Welded, mitered corners for continuous blade effect.
   3. Bird Screens: 1/2 inch square mesh 16 ga aluminum in extruded aluminum, rewirable frames on interior of louvers.
   4. Penthouse Finish: Clear anodized aluminum.
   5. Curbs:
      a. Galvanized steel, insulated, factory-fabricated curb.
      b. Insulation: Minimum 1-1/2 inches thick, 3 lb density fiber glass.
      c. Curb Extension: 8 inches above finished roof level.
   6. Provide automatic back draft damper on Relief Air Penthouses. Provide motorized damper where indicated on Drawings.
   7. Approved Products.
      a. Air-Rite Manufacturing: Model LPE-1.
      b. Breidert: Model RLX.
      c. Carnes: GLAB.
      d. Cook: Type TRE.
      e. Greenheck: WIH/WRH.
      f. United Enertech: Model PEL-4.
      g. Vent Products: Model 7100.

PART 3 - EXECUTION:

A. INSTALLATION:

1. Install penthouses for outside air intake and exhaust air were indicated on the contract documents.
2. Install pet houses securely anchored 214 inch high insulated factory fabricated roof curbs.
3. Install penthouses level and plumb.
4. Make all required connections to exhaust ducts and outside air ducts as indicated on the drawings.

END OF SECTION

SECTION 23 4100 - AIR FILTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install filters used in mechanical equipment.

B. Related Requirements:
   1. Section 23 3001: 'Common Duct Requirements'.
   2. Section 23 5417: ' Gas-Fred Furnaces
   3. Section 23 7413: 'Packaged Roof Top Units.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Furnace Filters: One inch thick throw-away type as recommended by Furnace Manufacturer.

B. Roof Top Unit Filters: One inch thick throw-away type as recommended by Roof Top Unit Manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide ample access for filter removal.

3.2 FIELD QUALITY CONTROL

A. Inspection: At date of Substantial Completion, air filters shall be new, clean, and approved by Owner's representative.

END OF SECTION

SECTION 23 5135 - AIR PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install heating equipment exhaust piping and combustion air intake piping for furnaces and condensing type water heaters as described in Contract Documents.

B. Related Requirements:
   1. Section 22 3423: 'Gas Domestic Water Heaters'.
   2. Section 23 0501: 'Common HVAC Requirements'.
   3. Section 23 5417: 'Gas-Fired Furnaces'.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D1785-12, 'Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120'.
      b. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Materials:
   1. Air Piping: Schedule 40 pipe and fittings meeting requirements of ASTM D1785, ASTM D2661, or ASTM D2665.
   2. Solvent Cement and Adhesive Primer:
      a. Use PVC solvent cement that has a VOC content of 510 g/L or less if required by local AHJ if required.
      b. Use adhesive primer that has a VOC content of 550 g/IL or less if required by local AHJ if required.
      c. Meet requirements of ASTM F656 for cement primer and ASTM D2564 for pipe cement.
   3. Flexible Foamed Pipe Insulation:
      a. Thickness:
         1) 1/2 inch for 2 through 3 inch outside diameter pipe.
         2) 1/2 inch sheet for fittings as recommended by Manufacturer.
      b. Approved Products.
         1) Tubolit by Armaflex.
         2) ImcoLock or Therma-Cel by Nomaco K-Flex.
   4. Insulation Joint Sealer:
      a. Approved Products.
         1) 520 by Armaflex.
         2) R-320 by Nomaco K-Flex.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation For Condensing Furnaces:
   1. Run individual vent and individual combustion intake piping from each furnace to concentric roof termination kit provided by Furnace Manufacturer. Slope lines downward toward furnace.
   2. Slope combustion chamber drain downward to funnel drain. Anchor to wall with wall clamps, allowing free movement through clamp for expansion.
   3. Use concentric roof termination kit provided by Furnace Manufacturer. Install vent and combustion air intake piping at clearance and distances required by Furnace Manufacturer.
   4. Attach factory-supplied neoprene coupling to combustion-air inlet connection and secure with clamp.
   5. Ensure that factory-supplied perforated metal disc is installed in flexible coupling, unless its removal is required.
   6. York Furnaces: Install air piping on side of furnace in horizontal or vertical installation.

B. Installation For Condensing Water Heaters:
   1. Run individual vent and individual combustion intake piping from each water heater to roof termination as recommended by Water Heater Manufacturer. Concentric roof termination kit may be used if approved by and provided by Water Heater Manufacturer. Slope lines downward toward water heater.
   2. Slope combustion chamber exhaust drain downward to floor drain.

C. Support:
   1. Support concentric roof termination kit at ceiling or roof line with 20 ga sheet metal straps as detailed on Drawings.
   2. Support horizontal and sloping sections of pipe with 1 inch wide 20 ga galvanized steel straps. Anchor securely to structure, not allowing pipe to sway.

D. Insulation:
   1. General:
      a. Install insulation in snug contact with pipe and in accordance with Manufacturer's recommendations.
      b. Slip insulation on piping before piping sections and fittings are assembled keeping slitting of insulation to a minimum.
      c. Joints:
         1) Place 'slit' joint seams of insulation exposed outside building on bottom of pipe.
         2) Stagger joints on layered insulation.
         3) Seal joints in insulation.
      d. Paint exterior exposed insulation with two coats of finish recommended by Insulation Manufacturer, color selected by Architect.
   2. Install specified insulation on PVC air piping serving mechanical equipment as follows
      a. Combustion air PVC piping in truss space and in attic.
      b. Combustion vent PVC piping in attic, in truss space, and above roof.
      c. Insulate fittings with sheet insulation and as recommended by Manufacturer.

END OF SECTION

SECTION 23 5414 - ELECTRIC-RESISTANCE CEILING PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install ceiling mounted electric resistance heating panels as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0501: Common HVAC Requirements.

1.2 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Panels to conform to UL, NEC, and NFPA requirements.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Manufacturers:
   1. Approved Manufacturers.
      a. Brasch Manufacturing Co Inc
      b. Marley Berko

B. Manufactured Units:
   1. Quality Standard
      a. Ceiling Panels:
         1) Marley Berko501F
         2) Panels shall be listed by UL for zero clearance to combustible surfaces.
         3) Furnish complete with ceiling tile flanged kit for ceiling system indicated.
         4) Furnish with wall control thermostat, line voltage for control.
         5) Panel casings shall be of flanged type for attachment to systems as specified.

      b. Voltage and phase, to be furnished as shown on Drawings

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install electric ceiling panels where indicated on the contract documents.

B. Make all required electrical power and control connections for a complete and functional heating system.

END OF SECTION

SECTION 23 5417 - GAS-FIRED FURNACES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install multi position gas-fired condensing furnaces as described in Contract Documents.

B. Related Sections:
   1. Section 23 0501: 'Common HVAC Requirements'.
   2. Section 23 1123: 'Facility Natural Gas Piping'.
   3. Section 23 2300: 'Refrigerant Piping'.
   4. Section 23 4100: 'Air Filters'.
   5. Section 23 5135: 'Air Piping'.
   6. Section 23 6214: 'Compressor Units: Air Conditioning (5 Ton or less)' for DX Cooling.

1.2 SUBMITTALS

A. Informational Submittals:
   1. Manufacturer Reports: Equipment check-out sheets.

B. Special Procedure Submittals:
   1. Installer must register with Manufacturer before submitting Manufacturer Warranty:
      a. Installer to contact Owner's Representative (FM Group or Project Manager) for following MANDATORY information to be given to Manufacturer before Manufacturer will issue Manufacturer's 'Special LDS Warranty' included with Closing Submittal:
         1) This must be given to Manufacturer:
            a) Name of Owner (name of FM Group) _____
            b) Mailing Address (FM office address) _____
            c) Building Property ID (unique 7-digit identifier) _____
            d) Project site address: _____
            e) Model Number of each Unit _____
            f) Serial Number of each Unit _____
            g) Date of Installation / Startup _____
      b. Product Data for Prerequisite EQ 1:
         1) Documentation indicating that units comply with ANSI/ASHRAE 62.1, Section 5 - 'Systems and Equipment'.
      c. Product Data for Credit EQ 4.1:
         1) For solvent cements and adhesive primers, including printed statement of VOC content.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Final, executed copy of Manufacturer's 'Special LDS Warranty' including required Owner / Manufacturer mandatory information.
      b. Record Documentation:
         1) Manufacturers Documentation:
            a) Equipment checkout sheet: Complete and sign all items for each unit.

1.3 WARRANTY

A. Manufacturer's Warranty:
   1. Provide Manufacturer's 'Special LDS Warranty' for the following:
      a. Provide fifteen (15) year minimum limited warranty of heat exchanger.
      b. Provide five (5) year limited warranty on parts.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Carrier Corporation:
         1) Carrier National: Bradley Brunner (270) 282-1241 Bradley.M.Brunner@Carrier.com.
         2) Carrier Utah: Bret Adams (Contractors Heating/Cooling Supply) (801) 224-1020 ext. 2527 bret.adams@mc.supply
      b. Lennox Industries:
         1) For pricing and information contact: Lennox Mountain Commercial @ 1-800-972-3283.
         2) Lennox National Contact: Jeff Barrett (801) 556-6114 jeff.barrett@lennoxind.com
      c. York (US Air Conditioning Distributors):
         1) Nick Filimoehala (801) 463-5323 n.filimoehala@us-ac.com.

B. Design Criteria:
   1. Rated at 92 percent minimum AFUE (Annual Fuel Utilization Efficiency) calculated in accordance with DOE test procedures.

C. Manufactured Units:
   1. Furnaces:
      a. Factory assembled units certified by AGA complete with blower section, furnace section, steel casing, piped, and wired.
      b. Blower section shall consist of cabinet, blower, and motor.
         1) Cabinet shall be of 22 ga minimum cold rolled steel and have finish coat of baked-on enamel.
         2) Blower shall be Class 1, full DIDW, statically and dynamically balanced.
      c. Automatic controls shall consist of:
         1) Manual gas shut-off valve.
         2) Operating automatic gas valve.
         3) Solid-state type fan and thermal limit controls.
         4) 24-volt transformer.
         5) Hot surface ignition system.
      d. Blower shall be driven by multi-speed direct driven motor.
      e. Furnace section shall be enclosed in 22 ga minimum enameled steel casing lined with foil covered insulation.
      f. Heat Exchanger: Aluminized steel.
      g. Gas Burners: Aluminized steel.
      h. PVC intake of outside air and PVC combustion product exhaust, with sealed combustion, direct vent system.
      i. Concentric roof termination kit for roof mounting.
      j. Approved Products.
         1) Standard Furnaces:
            a) Carrier: 59SC5B.
            b) Lennox: ML196E
            c) York: TM9E
         2) Two Stage Heat with ECM motor:
            a) Carrier: 59TN6.
            b) Lennox: EL296V.

c) York: TM9V.

2. Cooling Coil:
   a. Cooling coil shall consist of heavy gauge steel cabinet with baked-on enamel finish to match furnace:
      1) Coil shall have aluminum fins bonded to seamless copper or aluminum tubing.
      2) Coil shall be ARI rated. Provide drain pans with connections at one end.
      3) Use thermal expansion valve.
   b. Approved Products.
      1) Horizontal:
         a) Carrier: CNPHP.
         b) Lennox: CHX35
         c) York: CM.

      2) Vertical:
         a) Carrier: CNPVP.
         b) Lennox: CX35.
         c) York: CF.

2.2 ACCESSORIES

A. Filter Frame:
   1. Build filter frame external to furnace as detailed on Contract Drawings.

B. Vibration Isolators:
   1. Horizontal Installation:
      a. Neoprene hanger type with load of 75 lbs maximum.
      b. Approved Products.
         1) RH by Kinetics Noise Control, Dublin, OH www.kineticsnoise.com.
         2) Mason Industries, Hauppage, NY www.mason-ind.com.
         3) RH by Vibration Mounting & Controls, Bloomingdale, NJ www.vmc-kdc.com.
   2. Vertical Installation: 4 inches square by 1/2 inch thick minimum neoprene type vibration isolation pads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vibration Isolators:
   1. Install vibration isolator on each hanger rod supporting horizontal furnace and under each corner of vertical furnace.

3.2 FIELD QUALITY CONTROL

A. Manufacturer Services:
   1. Furnace installer shall:
      a. Install gas fired furnaces complete with all connections to supply return and outside air ductwork.
      b. Install gas fired furnaces were indicated on the contract documents. Make all required electrical and control connections for a complete and functional heating and cooling system.
      c. Make all refrigeration piping connections to rooftop mounted air cooled condensing units as indicated in the contract documents.
      d. Install 12 inch high return air plenum for all vertical upflow furnaces.
      e. Install external filter section for each furnace as indicated in the contract documents.
      f. Verify proper gas orifice size.
      g. Clock gas meter for rated input.
      h. Verify and set gas pressure at furnace.

i. Check and measure temperature rise.
j. Check safety controls for proper operation.
k. Check combustion vent sizes and combustion air sizes.

2. In addition, furnace installer shall start up, check out, and adjust furnaces using equipment check-out sheet provided by Manufacturer. Complete and sign all items on sheet.

END OF SECTION

SECTION 23 6214 - COMPRESSOR UNITS: AIR CONDITIONING (5 TON OR LESS)

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install compressor units as described in contract documents.

B. Related Sections:
   1. Section 06 2001: 'Common Finish Carpentry Requirements' for blocking at roof mounted compressor unit curb locations.
   2. Sections under Heading 07 5000 Membrane Roofing.
   3. Section 23 0501: 'Common HVAC Requirements'.
   4. Section 23 2300: 'Refrigerant Piping'.
   5. Section 23 5417: 'Gas-Fired Furnaces'.

C. Reference Standards:
   1. Air-Conditioning, Heating, and Refrigeration Institute:
      a. AHRI Standard 210/240-2017, 'Performance Rating of Unitary Air-Conditioning & Air-Source Heat Pump Equipment' (formerly ARI Standard 210/240).
   2. American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning Engineers:
      a. ANSI/ASHRAE 15-2016 and 34-2016, 'Safety Standard and Designation and Classification of Refrigerants'.
   3. ASTM International:
      a. ASTM A615/A615M-18, 'Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement'.
      b. ASTM C920-18, 'Standard Specification for Elastomeric Joint Sealants'.
   4. CSA Group (Canadian Standards Association):
      a. CSA G30.18-09 (2014), 'Carbon Steel Bars for Concrete Reinforcement'.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sequencing with other trades for installation of roof mounted 'Compressor Unit Curb'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. 'Compressor Unit Curb':
         1) Provide fabrication details and sections with dimensions and materials used including reinforcing showing compliance to Contract Drawings.

B. Informational Submittals:
   1. Tests and Evaluation Reports:
      a. Manufacturer Reports: Equipment check-out sheets.

C. Special Procedure Submittals:
   1. Installer must register with Manufacturer before submitting Manufacturer Warranty:
      a. Installer to contact Owner's Representative (FM Group or Project Manager) for following MANDATORY information to be given to Manufacturer before Manufacturer will issue Manufacturer's 'Special Church Warranty' included with Closing Submittal:

1) This must be given to Manufacturer:
   a) Name of Owner (name of FM Group) _____
   b) Mailing Address (FM office address) _____
   c) Building Property ID (unique 7 digit identifier) _____
   d) Project site address: _____
   e) Model Number of each Unit _____
   f) Serial Number of each Unit _____
   g) Date of Installation / Startup _____

2. Qualification Statements:
   a. Technician certificate for use in HFC and HCFC refrigerants.

D. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Warranty Documentation:
      1) Final, executed copy of Manufacturer's 'Special Church Warranty' including required Owner / Manufacturer mandatory information.
   b. Record Documentation:
      1) Manufacturers Documentation:
         a) Equipment checkout sheet: Complete and sign all items for each unit.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Each unit shall be UL / ULC or ETL labeled.
2. Comply with ANSI/AHRI Standard 210/240.
3. Refrigeration compressor, coils, and specialties shall be designed to operate with CFC-free refrigerants.

B. Qualifications. Section 01 4301 applies, but is not limited to the following:
1. Installer: Refrigerant piping shall be installed by refrigeration contractor licensed by State and by technicians certified in use of HFC and HCFC refrigerants.

1.5 WARRANTY

A. Manufacturer's Warranty:
1. Provide Manufacturer's 'Special Church Warranty' for the following:
   a. Provide ten (10) year limited warranty on compressor.
   b. Provide five (5) year limited warranty on parts from date of 'start-up'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
1. Manufacturer Contact List:
   a. Air-Rite Manufacturing, Bountiful, UT www.air-ritemfg.com.
      1) Blair Halverson (801) 295-2529.
   b. Carrier Corporation:
      1) Carrier National: Bradley Brunner (270) 282-1241 Bradley.M.Brunner@Carrier.com.
      2) Carrier Utah: Bret Adams (Contractors Heating/Cooling Supply) (801) 224-1020 ext. 2527 bret.adams@mc.supply.
   c. Lennox Industries:

1) For pricing and information call Lennox Mountain Commercial at (800) 972-3283.
2) Lennox National Contact: Jeff Barrett (801) 556-6114 jeff.barrett@lennoxind.com.

d. York (US Air Conditioning Distributors):
1) Nick Filimoehala (801) 463-5323 n.filimoehala@us-ac.com.

B. Performance:
1. Capacities: SEER rating as defined by AHRI shall be 13.0 or greater.

C. Manufactured Units:
1. Compressor Units (5 Tons or Less):
a. General:
1) Units shall be operable down to 0 deg F outdoor temperature.
2) Use R-410a refrigerant.
3) Only one liquid line, one suction line, and one power connection shall be made to each compressor. Provide charging valves.
b. Condenser Coils:
1) Aluminum plate fins mechanically bonded to seamless copper tubes or 'Spine Fin' trade mark system which has aluminum fins epoxy bonded to aluminum tubes or micro-channel.
2) Provide stamped louver coil guard for unit.
c. Fans:
1) Direct driven propeller type.
2) Fan motor shall be single or two speed, thermostatically controlled, permanently lubricated, and designed with permanent protection.
3) Motors shall be resiliently mounted.
4) Each fan shall have a safety guard.
d. Compressor:
1) Each condenser unit shall have only one compressor.
2) Design with following features:
a) Externally mounted brass service valves with charging connections.
b) Crankcase heater.
c) Resilient rubber mounts.
d) Compressor motor-overload protection.
e) Single speed.
e. Controls:
1) Factory wired and located in separate enclosure.
2) Following three paragraphs may not be factory installed and will therefore have to be field installed.
3) Safety devices:
a) High and low pressure cutout.
b) Condenser fan motor-overload devices.
4) Anti-cycle timers to prevent units from starting up again for five minutes after any power interruption.
5) Head pressure type low ambient kit.
f. Casing:
1) Fully weatherproof for outdoor installation. Finish shall be weather resistant.
g. Openings shall be provided for power and refrigerant connections.
h. Panels shall be removable for servicing.
i. Approved Products.
1) Southwest Region:
a) Carrier: 24AAA5.
b) Lennox: 14ACX.
c) York: YCS.

2.2 ACCESSORIES

A. Vibration Isolators:

1. 4 inches square by 3/4 inch thick minimum neoprene type vibration isolation pads.

2.3 ACCESSORIES

A. Compressor Unit Curb:
   1. Description: Pre-Fabricated roof mounted compressor unit curb as described in Contract Drawings.
   2. Design Criteria:
      a. Design for roof pitch as shown on Contract Drawings.
      b. Design for 'compressor unit curb' dimensions as shown on Contract Drawings.
   3. Unit Construction pre-fabricated as shown on Contract Drawings:
      a. Galvanized Steel:
         1) Solid curb base: 20 ga (0.0396 in) with 3 inch lip for attachment to roof decking.
         2) Curb body: 18 ga (0.0516 in) curb body with welded corners and 3 inch lip for welding to 'solid curb base.
         3) Curb cap: 18 ga (0.0516 in) sized 1 inch larger than 'curb body' attached to 'plywood curb top'.
      b. Plywood curb top: 3/4 inch thick.
      c. Concrete reinforcement bars:
         1) Grade 60 minimum deformed type conforming to ASTM A615/A615M or CAN/CSA G30.18 and free of heavy rust scales and flakes or other bond-reducing coatings.
         2) Two (2) #4 bars each way spaced as shown on Contract Drawings and welded to 'curb body' and where bars cross each other.
         3) Weld to 'curb body' 2 inches above 'solid curb base' at shallowest dimension as shown on Contract Drawings.
      d. Elastomeric sealant:
         1) Continuous at 'solid curb base' interior perimeter applied after welding to 'curb body'.
         2) Meet following standards for sealant:
            a) ASTM C920: Type S Grade NS, Class 25 (min).
      e. Fasteners as shown on Contract Drawings.
      f. Type One Acceptable Products:
         1) Quality Standard: Model: C-2PLDS by Air-Rite.
         2) Equal as approved by Architect before bidding. See Section 01 6200.
   4. Concrete installed at the project site:
      a. 1,800 psi minimum at twenty eight (28) days.
      b. 4 inch minimum thickness.

B. 'Z' Clip:
   1. 18 ga (0.0516 in) in width and height as shown on Contract Drawings.

C. Vibration Isolators:
   1. 4 inches square by 3/4 inch thick minimum neoprene type vibration isolation pads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Verify blocking installed under roof decking is in correct location to attach 'compressor unit curb'.
   2. Notify Architect of unsuitable conditions in writing
   3. Commencement of Work by Installer is considered acceptance of substrate.

3.2 INSTALLATION

A. General:

1. Set compressor units level on concrete slab on vibration isolation pads located at each corner of unit. This does not apply to compressor units that have composite non-metal bottom.
2. Compressor unit to be anchored solidly to concrete slab.
3. Do not use capillary tube and piston type refrigerant metering devices.

3.3 INSTALLATION

A. General:
   1. Coordinate with other trades affected by the Work of this section.

B. Compressor Unit Curb:
   1. Attach 'compressor unit curb' to roof decking with fasteners.
   2. Attach 'plywood curb top' and sheet metal 'curb cap' to 'curb body' with fasteners.

C. Compressor Units:
   1. Set compressor units level on 'compressor unit curb' on vibration isolation pads located at each corner of unit. This does not apply to compressor units that have composite non-metal bottom.
   2. Attach compressor units to 'compressor unit curb' with 'Z' clips and attachment screws post drilled into concrete inside 'curb body' at all four (4) sides.
   3. Do not use capillary tube and piston type refrigerant metering devices.

3.4 FIELD QUALITY CONTROL

A. Manufacturer Services:
   1. Compressor units shall be started up, checked out, and adjusted by compressor unit Installer.
   2. Use equipment checkout sheet provided by Manufacturer:
      a. Complete and sign all items on sheet.

END OF SECTION

DIVISION 26 – ELECTRICAL

26 0501	Common Electrical Requirements
26 0503	Electrical Utility Services
26 0519	Line-Voltage Electrical Power Conductors and Cables
26 0523	Control-Voltage Electrical Cables
26 0526	Grounding and Bonding for Electrical Systems
26 0533	Raceways and Boxes for Electrical Systems
26 0613	Electrical Equipment Mounting Height Schedule
26 0924	Lighting Control System
26 2417	Circuit-Breaker Panelboards
26 2726	Wiring Devices
26 2816	Enclosed Switches and Circuit Breakers
26 4301	Surge Protective Devices
26 5100	Interior Lighting
26 5121	Interior Lighting: LED Dimming Drivers
26 5200	Emergency Lighting
26 5600	Exterior Lighting

SECTION 26 0501 – COMMON ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. General electrical system requirements and procedures.
   2. Perform excavating and backfilling work required by work of this Division as described in Contract Documents.
   3. Make electrical connections to equipment provided under other Sections.Furnish and install Penetration Firestop Systems at electrical system penetrations as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Anchor bolts and templates for exterior lighting equipment bases.

C. Related Requirements:
   1. Section 07 8400: 'Firestopping' for quality of Penetration Firestop Systems to be used on Project and submittal requirements.
   2. Section 31 2316: 'Excavation' for criteria for performance of excavating.
   3. Section 31 2323: 'Fill' for criteria for performance of backfilling.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association / American National Standards Institute:
      a. NFPA 70, 'National Electrical Code (NEC)' (2017 or most recent edition adopted by AHJ).
   2. National Electrical Manufacturing Association Standards (NEMA):
      a. NEMA 250-2018, 'Enclosure for Electrical Equipment (1000 Volts Maximum)'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Provide following information for each item of equipment:
         1) Catalog Sheets.
         2) Assembly details or dimension drawings.
         3) Installation instructions.
         4) Manufacturer's name and catalog number.
         5) Name of local supplier. Furnish such information for following equipment:
         1) Section 26 2417: 'Circuit-Breaker Panelboards'.
         2) Section 26 2726: 'Wiring Devices' for lighting control equipment.
         3) Section 26 2773: 'Chime systems'.
         4) Section 26 2816: 'Enclosed Switches And Circuit Breakers'.
         5) Section 26 5100: 'Interior Lighting Fixtures'.
         6) Section 26 5200: 'Emergency Lighting' for battery units.
         7) Section 26 5600: 'Exterior Lighting' for fixtures, poles, and associated control equipment.
      c. Do not purchase equipment before approval of product data.
   2. Shop Drawings:
      a. Submit on Panelboards:
      b. Indicate precise equipment to be used, including all options specified. Indicate wording and format of nameplates where applicable. Submit in three-ring binder with hard cover.

B. Informational Submittals:
   1. Test And Evaluation Reports:
      a. Report of site tests, before Substantial Completion.
   2. Qualification Statement:
      a. Electrical Subcontractor:
         1) Provide Qualification documentation if requested by Architect or Owner.
      b. Installer:
         1) Provide Qualification documentation if requested by Architect or Owner.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
      b. Record Documentation:
         1) Manufacturers documentation:
            a) Manufacturer's literature.
            b) Include copy of approved shop drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.
   2. Material and equipment provided shall meet standards of NEMA or UL and bear their label wherever standards have been established and label service is available.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
   1. Electrical Subcontractor:
      a. Company specializing in performing work of this section.
         1) Minimum five (5) years experience in electrical installations.
         2) Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
      b. Upon request, submit documentation.
   2. Installer:
      a. Licensed for area of Project.
      b. Designate one (1) individual as project foremen who shall be on site at all times during installation and experienced with installation procedures required for this project.
      c. Upon request, submit documentation.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Performance:
   1. Design Criteria:
      a. Materials and equipment provided under following Sections shall be by same Manufacturer:
         1) Section 26 2417: Panelboards.
         2) Section 26 2816: Enclosed Switches And Circuit Breakers.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Acceptable Installers. See Section 01 4301:
   1. Meet Quality Assurance Installer Qualifications as specified in Part 1 of this specification.

3.2 EXAMINATION

A. Verification Of Conditions:
   1. Confirm dimensions, ratings, and specifications of equipment to be installed and coordinate these with site dimensions and with other Sections.

3.3 INSTALLATION

A. General:
   1. Locations of electrical equipment shown on Drawings are approximate only. Field verify actual locations for proper installation.
   2. Coordinate electrical equipment locations and conduit runs with those providing equipment to be served before installation or rough in.
      a. Notify Architect of conflicts before beginning work.
      b. Coordinate locations of power and lighting outlets in mechanical rooms and other areas with mechanical equipment, piping, ductwork, cabinets, etc, so they will be readily accessible and functional.
   3. Work related to other trades which is required under this Division, such as cutting and patching, trenching, and backfilling, shall be performed according to standards specified in applicable Sections.

B. Install Penetration Firestop System appropriate for penetration at electrical system penetrations through walls, ceilings, and top plates of walls.

3.4 FIELD QUALITY CONTROL

A. Field Tests:
   1. Test systems and demonstrate equipment as working and operating properly. Notify Architect before test. Rectify defects at no additional cost to Owner.
   2. Measure current for each phase of each motor under actual final load operation, i.e. after air balance is completed for fan units, etc. Record this information along with full-load nameplate current rating and size of thermal overload unit installed for each motor.

3.5 CLOSEOUT ACTIVITIES

A. Training:
   1. Provide competent instructor for three (3) days to train Owner's maintenance personnel in operation and maintenance of electrical equipment and systems. Factory representatives shall assist this instruction as necessary. Schedule instruction period at time of final inspection.

END OF SECTION

SECTION 26 0503 – ELECTRICAL UTILITY SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install service as described in Contract Documents and as required by local serving agency.
   2. Complete cost of service.

B. Related Requirements:
   1. Section 03 3053: Transformer pad.
   2. Section 26 0501: Common Electrical Requirements.
   3. Local utility shall furnish and install primary underground service including transformer, conductors, current transformers, metering conductors, and meter.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: Coordinate with serving agency on all items, especially service entrance fittings, meter sockets, and current transformer (C/T) boxes where required.

END OF SECTION

SECTION 26 0519 - LINE-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of conductors used on Project except as excluded below.

B. Related Requirements:
   1. Section 23 0933: 'Electric and Electronic Control System for HVAC' for conductors and cables for temperature control system.
   2. Section 26 0501: 'Common Electrical Requirements'.

1.2 REFERENCES

A. Definitions:
   1. Line Voltage: Over 70 Volts.

B. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 70, 'National Electric Code (NEC)' (2017 or most recent edition adopted by AHJ including all applicable amendments and supplements).
         1) Article 334, ''Nonmettalic-Sheathed Cable, Types NM, NMC And NMS'.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Line Voltage Conductors:
   1. Copper with AWG sizes as shown:
      a. Minimum size shall be No. 12 except where specified otherwise.
      b. Conductor size No. 8 and larger shall be stranded.
   2. Insulation:
      a. Standard Conductor Size No. 10 And Smaller: 600V type THWN or XHHW (75 deg F (24 deg C)).
      b. Standard Conductor Size No. 8 And Larger: 600V Type THW, THWN, or XHHW (75 deg F (24 deg C)).
      c. Higher temperature insulation as required by NFPA 70 or local codes.
   3. Colors:
      a. 208Y / 120 V System:
         1) Black: Phase A.
         2) Red: Phase B.
         3) Blue: Phase C.
         4) Green: Ground.
         5) White: Neutral.
      b. Conductors size No. 10 and smaller shall be colored full length. Tagging or other methods for coding of conductors size No. 10 and smaller not allowed.
      c. For feeder conductors larger than No. 10 at pull boxes, gutters, and panels, use painted or taped band or color tag color-coded as specified above.

B. Line Voltage Cables:
   1. Non-Metallic Sheathed Cable (NM) and Metal Clad Cable (MC) may be used as restricted below:
      a. Copper conductors.

b. Sizes #12 through #8.
c. Use only in indoor dry locations where:
1) Not subject to damage.
2) Not in contact with earth.
d. Not in concrete.
e. Not where exposed, visible, accessible or not concealed inside a 15 minute fire barrier (such was sheet rocked walls).
f. Not over suspended ceilings.
g. As restricted by NFPA 70 Article 334.

2. Metal Clad Cable (MC) may be used as restricted below:
a. Copper conductors.
b. Sizes #12 through #8.
c. Use only in indoor dry locations where:
1) Not subject to damage.
2) Not in contact with earth.
3) Not in concrete.

C. Cord Sets For Ranges: Three pole, 4 wire grounding, 125/250V, NEMA 14-50P plug, 48 inch (1 200 mm) cord length minimum.

D. Standard Connectors:
1. Conductors No. 8 And Smaller: Steel spring wire connectors.
2. Conductors Larger Than No. 8: Pressure type terminal lugs.
3. Connections Outside Building: Watertight steel spring wire connections with waterproof, non-hardening sealant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Conductors and cables shall be continuous from outlet to outlet.
2. Do not use direct burial cable.

B. Line Voltage Conductors:
1. Install conductors in raceway where indicated on Contract Drawings. Run conductors of different voltage systems in separate conduits.
2. Route circuits at own discretion, however, circuiting shall be as shown in Panel Schedules. Group circuit homeruns to panels as shown on Contract Drawings.
3. Neutrals:
a. On three-phase, 4-wire systems, do not use common neutral for more than three circuits.
b. On single-phase, 3-wire systems, do not use common neutral for more than two circuits.
c. Run separate neutrals for each circuit where specifically noted on Contract Drawings.
d. Where common neutral is run for two or three home run circuits, connect phase conductors to breakers in panel which are attached to separate phase legs:
1) Provide breaker tie so that all circuits that share common neutral are simultaneously disconnected.
2) Neutral conductors shall be of same size as phase conductors unless specifically noted otherwise.
4. Pulling Conductors:
a. Do not pull conductors into conduit until raceway system is complete and cabinets and outlet boxes are free of foreign matter and moisture.
b. Do not use heavy mechanical means for pulling conductors.
c. Use only listed wire pulling lubricants.

C. Line Voltage Cables:
1. Route circuits at own discretion, however, circuiting and numbering shall be as shown in Panel Schedules.
2. Support cables using approved staples, cable ties, straps, hangers, or similar fittings, spaced as required.

3. Where installing in framing, do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width. Holes shall be one inch diameter maximum.
4. Conceal cables within ceilings and walls of finished areas. Cables may be exposed in unfinished areas but not run on floors of mechanical equipment spaces or in such a way that they obstruct access to, operation of, or servicing of equipment.
5. Install exposed cables parallel to or at right angles to building structure lines.
6. Keep cables 6 inches (150 mm) minimum from hot water pipes.
7. Do not support cables from mechanical ducts or duct supports without Architect's written approval.
8. Prohibited procedures:
    a. Boring holes for installation of cables in vertical truss members.
    b. Notching of structural members for installation of cables.

END OF SECTION

SECTION 26 0523 - CONTROL-VOLTAGE ELECTRICAL CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install control-voltage electrical cables as described in Contract Documents.

B. Related Requirements:
   1. Section 23 0933: 'Electric And Electronic Control System For HVAC' for cables for Temperature Control System cables.
   2. Section 26 0501: 'Common Electrical Requirements'.
   3. Section 26 0924: 'Lighting Control System'.
   4. Section 27 1501: 'Communications Horizontal Cabling' for voice and data system cables.
   5. Section 27 4117: 'Video Systems' for cables.
   6. Section 27 5117: 'Audio Systems' for cables.
   7. Section 28 3101: 'Fire Detection And Alarm System' for cables.

1.2 REFERENCES

A. Definitions:
   1. Control Voltage: 70 Volts and under.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Category Four Approved Cable Manufacturers. See Section 01 6200 for definitions of Categories:
      a. Alpha Wire Co, Elizabeth, NJ www.alphawire.com.
      b. Belden Wire & Cable Co, Richmond, IN www.belden.com.
      c. Liberty Wire & Cable, Colorado Springs, CO www.libertycable.com.
      d. West Penn Wire Corp, Washington, PA www.westpenn-cdt.com.

B. Components:
   1. Building Control System Cables.
      a. CAT 5E, 24 AWG, solid bare copper, four pair, UTP, white cable jacket.
      b. Sheath Colors:
         1) Lighting Control: Yellow.
      c. Meet requirements of EIA / TIA 568 Standard.
   2. Lighting Control Cables and Conductors:
      a. Provide cable per Lighting Control Panel Manufacturer's recommendations and requirements.
      b. Lighting Control Cables ran in same raceway as line voltage cables shall have same insulation voltage rating as line voltage conductors.
      c. Cable Jacket shall be yellow.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Cables shall be continuous and without splices from source to outlet.
   2. Run cables in raceway as indicated on Contract Drawings.
   3. Run exposed cables parallel to or at right angles to building structure lines.
   4. Keep cables 6 inch (150 mm) minimum from hot water pipes.
   5. Support cables using approved staples, cable ties, straps, hangers, or similar fittings spaced every 3 feet (900 mm).
   6. Where installing in framing, do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width. Holes shall be 1/2 inch (13 mm) diameter maximum.
   7. Bundle only cables of same systems together.
   8. Do not run cables within 10 inches (255 mm) of line voltage conductors/raceways.
   9. Extend cables 18 inches (450 mm) from wall or ceiling at all outlet locations. Extend cables to twice vertical length of cabinet at each cabinet location.
   10. Pulling cables into conduit:
      a. Do not pull cables until raceway system is complete and cabinets and outlet boxes are free of foreign matter and moisture.
      b. Do not use heavy mechanical means for pulling cables.
      c. Use only listed wire pulling lubricants.
   11. Prohibited procedures:
      a. Boring holes for installation of cables in vertical truss members.
      b. Notching of structural members for installation of cables.

B. Control Cables:
   1. For cables not installed in raceway, do not run cables within 10 inches (255 mm) of line voltage conductors / raceways. Also, maintain 10 inches (255 mm) minimum between following exposed cable groups:
      a. Microphone cables.
      b. CAT-6, sound system control, telephone, video, or ATC cables.
      c. Loudspeaker cables.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install grounding for electrical installation as described in Contract Documents except as excluded below.

B. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete'.
      a. Pre-installation conference held jointly with other concrete related sections.
   2. Section 26 0501: 'Common Electrical Requirements'.
   3. Section 26 4301: 'Surge Protection Devices'.

1.2 REFERENCES

A. Reference Standards:
   1. Institute of Electrical and. Electronics Engineers (IEEE):
      a. IEEE 837-2014, 'Standard for Qualifying Permanent Connections Used in Substation Grounding'.
   2. National Fire Protection Association:
      a. NFPA 70, 'National Electric Code (NEC)' (2017 or most recent edition adopted by AHJ including all applicable amendments and supplements).
      b. NFPA 780, 'Standard for the Installation of Lightning Protection Systems' (2014 or latest approved edition).
   3. Telecommunications Industry Association:
      a. TIA-942 A, 'Telecommunications Infrastructure Standard for Data Centers' (2014).
   4. Section 27 1116: 'Communications Cabinets, Racks, Frames, and Enclosures'.
   5. Section 27 1501: 'Communications Horizontal Cabling' for cables for Telephone and Data Systems.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in pre-installation conference as specified in Section 03 3111.
   2. In addition to agenda items specified in Section 01 3100 and 31 3111, review following:
      a. Review Architect's inspection of grounding conductor installation before placement of concrete.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Requirements of Section 27 1501 applies, but is not limited to following:
      a. Cable assemblies shall be UL / CE Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.
      b. Grounding shall conform to all required Commercial Building Grounding and Bonding Requirements for Telecommunications, Electrical Codes, and Manufacturer's grounding requirements.
   2. Systems shall be installed per NFPA 780 and NFPA 70.
   3. All Bonds shall comply with most current version of IEEE 837 Standard.

B. Qualifications: Requirements of Section 01 4301 applies, but is not limited to following:
   1. Installers Qualifications:
      a. Grounding and Bonding:

1) Licensed electrical contractor shall perform installation and termination of main bonding conductor to building service entrance ground.
2) Licensed in State that Work is to be performed.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
1. Type One Acceptable Products:
a. 'Cadweld' by Erico International, Solon, OH www.erico.com.
b. 'ThermOweld' by Continental Industries, Tulsa, NE www.conind.com.
c. Equal as approved by Architect before bidding. See Section 01 6200.

B. Performance:
1. Design Criteria:
a. Size materials as shown on Drawings and in accordance with applicable codes.
b. Bonding System Workmanship:
1) The ground/earthing system shall be designed for high reliability and shall meet following criteria:
a) Local electrical codes shall be adhered to.
b) All grounding/earthing conductors shall be copper.
c) Regulatory Agency Sustainability Approvals requirements are required.
c. Rack and Cabinet Grounding/Earthing:
1) Equipment and racks shall be bonded in accordance with methods prescribed in TIA-942.
2) All grounding backbone should be #6 AWG copper cable.
3) In telecommunications spaces with small number of racks or cabinets, rack/cabinet grounding/earthing jumper cable directly to telecommunications ground bus is permitted. Large spaces shall utilize mesh Common Bonding network, or overhead grounding backbone.
4) Equipment racks, housings, messenger cables, and raceways:
a) Connect cabinets, racks, frames and terminal boards to single-point ground which is connected to building ground system proper sized, bonded and tested green insulated copper grounding conductor.

C. Materials:
1. Grounding And Bonding Jumper Conductors: Bare copper or with green insulation.
2. Make grounding conductor connections to ground rods and foundation ground loop using approved bolted clamps listed for such use.
3. Service Grounding Connections And Cable Splices: Make by exothermic process.
4. Telecommunications ground bus bar (TGB): copper.
a. Grounding bus bar:
1) Technology Room shall be provided with telecommunications ground bus bar (TGB).
2) Ground loop current potential is minimized between telecommunications equipment and electrical system to which it is attached.
b. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in Technology Room shall be grounded to respective TGB using minimum #6 AWG stranded copper bonding conductor and compression connectors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work: Coordinate with Section 03 3111 in installing grounding conductor and placing concrete. Do not allow placement of concrete before Architect's inspection of grounding conductor installation.

B. Grounding conductors and bonding jumper conductors shall be continuous from terminal to terminal without splice. Provide grounding for following.
   1. Electrical service, its equipment and enclosures.
   2. Conduits and other conductor enclosures.
   3. Neutral or identified conductor of interior wiring system.
   4. Main panelboard, power and lighting panelboards.
   5. Non-current-carrying metal parts of fixed equipment such as motors, starter and controller cabinets, instrument cases, and lighting fixtures.
   6. Lightning protection down conductors.

C. Provide concrete-encased electrode system by embedding 20 feet (6.10 m) minimum of No. 2/0 bare copper conductor in concrete footing that is in direct contact with the earth, 2 inches (50 mm) minimum below concrete surface. Extend No. 2/0 copper conductor to main panel as shown on Drawings.

D. Ground identified common conductor of electrical system at secondary side of main transformer supplying building. Ground identified grounded (neutral) conductor of electrical system on supply side of main service disconnect.

E. Pull grounding conductors in non-metallic raceways, in flexible steel conduit exceeding 72 inches (1 800 mm) in length, and in flexible conduit connecting to mechanical equipment.

F. Provide grounding bushings on all feeder conduit entrances into panelboards and equipment enclosures.

G. Bond conduit grounding bushings to enclosures with minimum #10 AWG conductor.

H. Connect equipment grounds to building system ground.
   1. Use same size equipment grounding conductors as Phased conductors up through #10 AWG.
   2. Use NEC Table 250-95 for others unless noted otherwise in Drawings.

I. Run separate insulated grounding cable from each equipment cabinet to electrical panel. Do not use intermediate connections or splices. Affix directly to cabinet.

J. On motors, connect ground conductors to conduit with approved grounding bushing and to metal frame with bolted solderless lug.

K. Ground cabinet of transformers to conduit and ground wires, if installed. Bond transformer secondary neutral conductor to cabinet.

L. TGB shall be 1/4 inch (6.4 mm) thick x 2 inches (50 mm) high x 12 inches (305 mm) long installed with insulated standoffs at location directed.

M. Ground rack to TGB using #6 copper conductor and compression connector.
   1. Equipment bonding for Baptismal Fonts:
      a. Copper Lug Mechanical Connector:
         1) Connect all metallic elements of baptismal font as shown in Contract Drawings.
      b. Grounding Clamps and Connectors:
         1) Connect to structural reinforcing bars as per NFPA 70 Article 680 and as shown in Contract Drawings.

3.2 FIELD QUALITY CONTROL

A. Field Inspections:
   1. Notify Architect for inspection two (2) days minimum before placing concrete over grounding conductor.
   2. Grounding Well integrity shall be tested separately and together with Lightning Protection System integrity.

END OF SECTION

SECTION 26 0533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Quality of material and installation procedures for raceway, boxes, and fittings used on Project but furnished under other Divisions.
   2. Furnish and install raceway, conduit, and boxes used on Project not specified to be installed under other Divisions.
   3. Furnish and install air-vapor barrier boxes as described in Contract Documents.
   4. Furnish and install main electrical service raceway as described in Contract Documents and comply with electrical utility company requirements.
   5. Furnish and install main telephone service raceway as described in Contract Documents and comply with telephone company requirements.

B. Related Requirements:
   1. See Section 07 8400: 'Firestopping' for raceways penetrating fire rated walls, ceilings, and barriers'.
   2. Section 23 0933: 'Electric and Electronic Control System for HVAC' for concealed raceway and extensions for temperature control system.
   3. Section 26 0501: 'Common Electrical Requirements' for general electrical requirements'.
   4. Section 26 0503: 'Electrical Utility Services' for electrical primary underground service requirements.
   5. Section 27 1501: 'Communications Horizontal Cabling' for raceway for telephone and data systems.
   6. Section 27 4117: 'Video Systems' for system wiring.
   7. Section 27 5117: 'Audio Systems' for sound system wiring.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 70, 'National Electric Code (NEC)' (2017 or most recent edition adopted by AHJ including all applicable amendments and supplements).

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Cooper B-Line, Highland, IL www.b-line.com.
      b. Hubbell Incorporated, Milford, CT www.hubbell-wiring.com or Hubbell Canada Inc, Pickering, ON (905) 839-4332.
      c. Square D, Palatine, IL www.squared.com.
      d. Thomas & Betts, Memphis, TN www.tnb.com or Thomas & Betts Ltd, Iberville, PQ (450) 347-5318.
      e. Walker Systems Inc, Williamstown, WV (800) 240-2601 or Walker Systems Inc / Wiremold Canada Inc, Fergus, ON (519) 843-4332.
      f. Wiremold Co, West Hartford, CT www.wiremold.com.

B. Materials:
   1. Raceway And Conduit:

a. Sizes:
   1) 3/4 inch (19 mm) for exterior use, unless indicated otherwise.
   2) 1/2 inch (13 mm) for interior use, unless indicated otherwise.
b. Types: Usage of each type is restricted as specified below by product.
   1) Galvanized rigid steel or galvanized intermediate metal conduit (IMC) is allowed for use in all areas. Where in contact with earth or concrete, wrap buried galvanized rigid steel and galvanized IMC conduit and fittings completely with vinyl tape.
   2) Galvanized Electrical Metallic Tubing (EMT), Flexible Steel Conduit, and Electrical Non-Metallic Tubing (ENT):
      a) Allowed for use only in indoor dry locations where it is:
         (1) Not subject to damage.
         (2) Not in contact with earth.
         (3) Not in concrete.
      b) For metal conduit systems, flexible steel conduit is required for final connections to indoor mechanical equipment.
   3) Schedule 40 Polyvinyl Chloride (PVC) Conduit:
      a) Allowed for use only underground or below concrete with galvanized rigid steel or IMC elbows and risers.
   4) Listed, Liquid-Tight Flexible Metal Conduit:
      a) Use in outdoor final connections to mechanical equipment, length not to exceed 36 inches (900 mm).
   5) Pre-wired 3/8 Inch (9.5 mm) Flexible Fixture Whips: Allowed only for connection to recessed lighting fixtures, lengths not to exceed 72 inches (1 800 mm).
c. Prohibited Raceway Materials:
   1) Aluminum conduit.
   2) Armored cable type AC (BX) cable.
   3) Armored cable type AC (BX) cable.

2. Raceway And Conduit Fittings:
   a. Rigid Steel Conduit And IMC: Threaded and designed for conduit use.
   b. EMT:
      1) Compression type.
      2) Steel set screw housing type.
   c. PVC Conduit:
      1) PVC type. Use PVC adapters at all boxes.
      2) PVC components, (conduit, fittings, cement) shall be from same Manufacturer.
   d. Flexible Steel Conduit: Screw-in type.
   e. Liquid-tight Flexible Metal Conduit: Sealtite type.
   f. Expansion fittings shall be equal to OZ Type AX sized to raceway and including bonding jumper.
   g. Prohibited Fitting Materials:
      1) Crimp-on, tap-on, indenter type fittings.
      2) Cast set-screw fittings for EMT.
      3) Spray (aerosol) PVC cement.
3. Outlet Boxes:
   a. Galvanized steel of proper size and shape are acceptable for all systems. Where metal boxes are used, provide following:
      1) Provide metal supports and other accessories for installation of each box.
      2) Equip ceiling and bracket fixture boxes with fixture studs where required.
      3) Equip outlets in plastered, paneled, and furred finishes with plaster rings and extensions to bring box flush with finish surface.
   b. Non-metallic boxes may be used only for control voltage wiring systems.
   c. Telephone / data outlet boxes shall be single device outlet boxes.
   d. HVAC Instrumentation And Control:
      1) Junction boxes in mechanical equipment areas shall be 4 inches (100 mm) square.
      2) Boxes for remote temperature sensor devices shall be recessed single device.
      3) Boxes for thermostats shall be 4 inches (100 mm) square with raised single device cover.
4. Power Floor Boxes:
   a. Type Two Acceptable Products:

1) 887 cast iron box 885 brass duplex cover plate for carpet by Walker Systems.
2) B-2537 cast iron box with SF3925 brass duplex cover plate for carpet by Hubbell.
3) Equal as approved by Architect before installation. See Section 01 6200.

5. Air-Vapor Barrier Boxes:
   a. Pre-molded polyethylene box installed in all exterior framing walls (thermal envelope) around recessed outlet boxes.
   b. Class Two Quality Standard:
      1) Approved Manufacturer. See Section 01 6200 for definitions of Classes.
         a) Lessco Low Energy Systems Supply Company, Inc., Campbellsport, WI www.lessco-airtight.com.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Confirm dimensions, ratings, and specifications of materials to be installed and coordinate these with site dimensions and with other Sections.

3.2 INSTALLATION

A. Interface With Other Work:
   1. Coordinate with Divisions 22 and 23 for installation of raceway for control of plumbing and HVAC equipment.
   2. Before rough-in, verify locations of boxes with work of other trades to insure that they are properly located for purpose intended.
      a. Coordinate location of outlet for water coolers with Division 22.
      b. Coordinate location of outlets adjacent to or in millwork with Division 06 before rough-in. Refer conflicts to Architect and locate outlets under his direction.
   3. Coordinate installation of floor boxes in carpeted areas with carpet installer to obtain carpet for box covers.
   4. Install pull wires in raceways installed under this Section where conductors or cables are to be installed under other Divisions.

B. General:
   1. Sound and video system electrical components furnished and installed under this Section include following items:
      a. Metal equipment cabinet and control cabinets.
      b. Factory-fabricated speaker enclosures.
      c. Fittings.

C. Conduit And Raceway:
   1. Conceal raceways within ceilings, walls, and floors, except at Contractor's option, conduit may be exposed on walls or ceilings of mechanical equipment areas and above acoustical panel suspension ceiling systems. Install exposed raceway runs parallel to or at right angles to building structure lines.
   2. Seal all raceways penetrating fire rated walls, ceilings and barriers. See Section 07 8400.
   3. Keep raceway runs 6 inches (150 mm) minimum from hot water pipes.
   4. Make no more than four quarter bends, 360 degrees total, in any conduit run between outlet and outlet, fitting and fitting, or outlet and fitting.
      a. Make bends and offsets so conduit is not injured and internal diameter of conduit is not effectively reduced.
      b. Radius of curve shall be at least minimum indicated by NFPA 70.
   5. Cut conduit smooth and square with run and ream to remove rough edges. Cap raceway ends during construction. Clean or replace raceway in which water or foreign matter have accumulated.
   6. Run two spare conduits from each new panelboard to ceiling access area or other acceptable accessible area and cap for future use.

7. Bend PVC conduit by hot box bender and, for PVC 2 inches (50 mm) in diameter and larger, expanding plugs. Apply PVC adhesive only by brush.
8. Installation In Framing:
    a. Do not bore holes in joists or beams outside center 1/3 of member depth or within 24 inches (600 mm) of bearing points. Do not bore holes in vertical framing members outside center 1/3 of member width.
    b. Holes shall be one inch (25 mm) diameter maximum.
9. Underground Raceway And Conduit:
    a. Bury underground raceway installed outside building 24 inches (600 mm) deep minimum.
    b. Bury underground conduit in planting areas 24 inches (600 mm) deep minimum. It is permissible to install conduit 6 inch (150 mm) below concrete sidewalks, however, conduit must be buried 24 inches (600 mm) deep at point of exit from planting areas.
10. Conduit And Raceway Support:
    a. Securely support raceway with approved straps, clamps, or hangers, spaced as required.
    b. Do not support from mechanical ducts or duct supports without Architect's written approval. Securely mount raceway supports, boxes, and cabinets in an approved manner by:
        1) Expansion shields in concrete or solid masonry.
        2) Toggle bolts on hollow masonry units.
        3) Wood screws on wood.
        4) Metal screws on metal.
11. Prohibited Procedures:
    a. Use of wooden plugs inserted in concrete or masonry units for mounting raceway, supports, boxes, cabinets, or other equipment.
    b. Installation of raceway that has been crushed or deformed.
    c. Use of torches for bending PVC.
    d. Spray applied PVC cement.
    e. Boring holes in truss members.
    f. Notching of structural members.
    g. Supporting raceway from ceiling system support wires.
    h. Nail drive straps or tie wire for supporting raceway.

D. Telephone / Data Systems:
1. Install raceway from terminal board to each telephone and data outlet as indicated on Contract Drawings.

E. Boxes:
1. Boxes shall be accessible and installed with approved cover.
2. Do not locate device boxes that are on opposite sides of framed walls in the same stud space. In other wall construction, do not install boxes back to back.
3. Locate boxes so pipes, ducts, or other items do not obstruct outlets.
4. Install outlets flush with finished surface and level and plumb.
5. Support switch boxes larger than two-gang with side brackets and steel bar hangers in framed walls.
6. At time of substantial completion, install blank plates on uncovered outlet boxes that are for future use.
7. Install air-vapor barrier boxes.
    a. Follow Manufacturer's installation instructions.
    b. Care should be taken to cut above grade vapor barrier and seal around recessed outlet boxes to minimize air infiltration.
8. Location:
    a. Install boxes at door locations on latch side of door, unless explicitly shown otherwise on Contract Drawings. Verify door swings shown on electrical drawings with architectural drawings, and report discrepancies to Architect before rough-in. Distance of box from jamb shall be 6 inches (150 mm) from door jamb.
    b. Properly center boxes located in walls with respect to doors, panels, furring, trim and consistent with architectural details. Where two or more outlets occur, space them uniformly and in straight lines with each other, if possible.
    c. Center ceramic tile boxes in tile.

F. Support factory-fabricated speaker enclosures from structure or ceiling suspension system.

END OF SECTION

SECTION 26 0613 - ELECTRICAL EQUIPMENT MOUNTING HEIGHT SCHEDULE

PART 1 - GENERAL: Not Used

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor. Refer special conditions to Architect before rough-in and locate outlet under his direction.

B. Mounting Heights:

1. HVAC:
   - a. Temperature Control Junction Boxes: As indicated on Drawings.
   - b. Thermostats not mounted in occupied space: As indicated on Drawings.
   - c. Remote Temperature Sensors and thermostats mounted in occupied space:
     - 1) Wall-Mounted 50 inches (1 270 mm) to top.
   - d. Indoor Motor Disconnects: 60 inches (1 525 mm).
   - e. Outdoor Motor Disconnects: As indicated on Drawings.
   - f. Motor Controls: 60 inches (1 525 mm).
2. Plumbing:
   - a. Electric Water Cooler Outlets: Mount so outlet and cord are hidden by water cooler and outlet is accessible for resetting for GFCI trip.
3. Electrical:
   - a. Distribution Panels: 72 inches (1 830 mm) to top.
   - b. Receptacles: 18 inches (450 mm).
   - c. Wall Switches: 42 inches (1 065 mm).
   - d. Wall-Mounted Exit Lights: 90 inches (2 285 mm).
   - e. Emergency Lighting Units: 60 inches (1 525 mm).
4. Communications
   - a. Sound Distribution System Components: As indicated on Drawings.
   - b. Satellite Distribution System Components: As indicated on Drawings.
   - c. TV Distribution System Components: As indicated on Drawings.
   - d. Computer and TV: 18 inches (450 mm).
   - e. Telephone / Data Terminal Boards: 72 inches (1 800 mm) to top.
   - f. Telephones (wall type): 60 inches (1 500 mm).
   - g. Telephones (desk type): 18 inches (450 mm).
   - h. Telephone / Data (desk type): 18 inches (450 mm).
   - i. Data (desk type): 18 inches (450 mm).
   - j. Signal Chimes: 84 inches (2 100 mm).

END OF SECTION

SECTION 26 0924 - LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete lighting control system as described in Contract Documents consisting of the following:
      a. Lighting Control Panel.
      b. Programmable Digital Control Switches.
      c. Photocells.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 0523: 'Control-Voltage Electrical Cables'.

1.2 REFERENCES

A. Definitions:
   1. Class A: Equipment has been tested and found to comply with limits for Class A digital device, pursuant to part 15 of FCC Rules. These limits provide reasonable protection against harmful interference when equipment is operated in commercial environment.

B. Reference Standards:
   1. Federal Communications Commission (FCC):
      a. Emission requirements for Class A applications.
   2. Underwriters Laboratories:
      a. UL 916, 'Energy Management Equipment' (2015).

1.3 SUBMITTALS

A. Informational Submittals:
   1. Certifications:
      a. Technician Certification that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.

B. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Operations and Maintenance Data:
         1) Equipment operation and maintenance manual(s).

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. All control equipment shall be in compliance with FCC emissions' standards in Part 15 Subpart J for Class A application.
   2. Programmable panelboards shall be UL listed under UL 916 Energy Management Equipment.

B. Qualifications:
   1. Manufacturer Qualifications:
      a. Manufacturer of assembly shall be manufacturer of major components with assembly.

b. Manufacturer of this equipment shall have minimum of five (5) years manufacturing experience.

2. Technician Qualifications:
   a. Authorized by Manufacturer and trained.
   b. Have thorough knowledge of software, hardware and system programming.

C. Certifications:
1. Provide Technician Certification that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Equipment shall be delivered, handled and stored in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
1. Type One Acceptable Manufacturer:
   a. Acuity Brands Inc., Atlanta, GA www.acuitybrands.com.
   b. Douglas Lighting Controls, Burnaby, BC www.douglaslightingcontrolscom.
   c. Hubbell Building Automation, Austin, TX www.hubbell-automation.com.
   d. Leviton Manufacturing Co, Little Neck, NY www.leviton.com or Leviton Manufacturing of Canada Ltd, Pointe-Claire, QB (800) 461-2002 or (514) 954-1840.
   e. Lutron Electronics Co Inc, Coopersburg, PA www.lutron.com.
   f. Watt Stopper Inc., Santa Clara, CA www.wattstopper.com.
   g. Equal as approved by Architect before bidding. See Section 01 6200.

B. Design Criteria:
1. Lighting Control System shall meet or exceed following capabilities:
   a. Capable of switching for specific lighting zone for following:
      1) Time-of-day scheduling
      2) Daylight savings time adjustments.
      3) Light level sensors.

C. Components:
1. Light Control Panel:
   a. Enclosure/tub shall be NEMA 1 unless indicated otherwise on Drawings, sized to accommodate required components.
   b. Cover shall have hinged and lockable door and be configured for flush mounting of panel.
   c. Panel shall include power supply and interior assembly with motherboard and control electronics.
      1) Interior construction shall provide isolation between line voltage and low voltage (class 2) wiring.
   d. Panel shall be factory assembled and designed for disassembly for mounting enclosure first and reassembly after conduit installation.
   e. Panel shall utilize mechanically held latching relays rated for 30A ballast load at 120/277VAC with 10,000A short circuit current rating and shall include contactor for exterior lighting control.
      1) Visual LED status and manual override for each relay shall be included.
   f. Panel shall contain network clock/programmer and photocell control module for interface with interior and exterior photocell controls.
      1) Network clock shall provide menu driven control for seven (7) day repeating schedules and holiday provisions.
      2) Clock shall provide user selectable pre-programmed scenarios for: Scheduled on/off, Manual on/off, Scheduled off, and on/off when used with photocell control module.

g. Panel shall contain automation intelligence card for program, monitor, and control functions and group cards as required for control of groups of relays.

2. Programmable Digital Control Switches:
   a. Programmable digital control switches shall be provided with number of control buttons as indicated on Contract Drawings.
      1) Each button shall be capable of individual programming without use of computer or other programming device.
      2) Each button shall be able to control individual relay or group of relays.
      3) Individual buttons shall allow for permanent labeling.
   b. Switches shall be illuminated for ease of location in dark.
3. Photocells:
   a. Weatherproof Class 2 photocell shall be provided for exterior light levels.
   b. Adjustable interior photo cell shall be provided for day-lighting control.
      1) Photocell shall provide output suitable for controlling continuously dimming loads.
      2) Refer to Contract Drawings for fixtures to be controlled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
   1. Install switches flush with wall, straight and level.
   2. Permanently label switches as shown on drawing schedule in Contract Drawings.

B. Interface With Other Work:
   1. Coordinate with appropriate Sections of Divisions 26.
   2. Program system to meet the local energy code.

C. Space Control Requirements:
   1. Unless relevant provisions of applicable local Energy codes are more stringent, provide minimum application of lighting controls as follows:
      a. Provide occupancy/vacancy sensors with Manual-ON/OFF functionality in all.
      b. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room or classroom. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling-mounted sensors and Manual-ON switches, if necessary.

3.2 FIELD QUALITY CONTROL

A. Field Testing:
   1. Manufacturer shall provide Manufacturer's authorized Technician to adequately test supplied equipment and software to ensure system performs as intended including the following:
      a. Test start-up system and confirm proper installation, operation, and adjustment of all system components.
   2. Submit Certification in writing that equipment has been installed, adjusted and tested in accordance with Manufacturer's recommendations.

B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to following:
   1. Correct any work found defective or not complying with Contract Document requirements at no additional cost to the Owner.

3.3 CLOSE-OUT ACTIVITIES

A. Instruction of Owner:
   1. Provide Manufacturer's authorized Technician training session for Owner's Representative(s) for demonstrating operation and programming of completed system.
      a. Training program shall include instructions on control system, programming, and other major components. Provide Manufacturer Manual(s) to be submitted to Owner to assist training.
      b. Training program shall include:
         1) System review of all system components and their function.
         2) System review of all management software and its function.
         3) Operator training to develop experience with control applications.

END OF SECTION

SECTION 26 2417 - CIRCUIT-BREAKER PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install circuit-breaker panelboards as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 4301: 'Surge Protection Devices'.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 70E: 'Standard for Electrical Safety in the Workplace' (2018 or most recent edition adopted by AHJ).

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Cutler-Hammer Inc, Pittsburgh, PA www.eatonelectric.com.
      b. General Electric Industrial Systems, Charlotte, NC www.geindustrial.com.
      c. Siemens Energy & Automation, Alphrata, GA www.sea.siemens.com.
      d. Square D Co, Palatine, IL www.us.squared.com.

B. Performance:
   1. Capacities:
      a. Panelboard:
         1) Minimum integrated equipment short circuit rating of 22,000 amperes for 120 / 208 Volts.
         2) Rated for use as service entrance equipment.
      b. Lighting And Appliance Panelboards:
         1) Minimum integrated equipment short circuit rating of 10,000 amperes for 120 / 208 Volts.
      c. Load Centers:
         1) 125 Amp main lugs, 120 / 208 Volt, three-phase.
         2) Minimum integrated equipment short circuit rating of 10,000 Amps.

C. Material:
   1. Circuit-breaker type.
   2. Galvanized steel cabinets
   3. Bussing and lugs arranged as required.
   4. Multi-pole circuit-breakers shall be common trip.
   5. Circuit-breakers shall be molded case thermal magnetic type with inverse time characteristics.
   6. Main Panelboard:
      a. Surface-mounted and front accessible.
      b. Enclosures:

1) Exterior of Building:
a) NEMA / CEMA Type 3R with locking door.
2) Interior of Building:
a) NEMA / CEMA Type 1.

c. Minimum dimensions of 32 inches (800 mm) wide by 8 inches (200 mm) deep.
d. Space designation on Drawings indicates bus hardware and panelboard capacity for future acceptance of one 100 Amp, three-pole circuit-breaker.
e. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Type PRL4B by Cutler-Hammer.
2) Spectra Series by General Electric.
3) Type P4 by Siemens.
4) I-Line by Square D.

7. Lighting And Appliance Panelboards:
a. Plug-on or bolt-on breakers. Multi-pole breakers shall be common trip.
b. Factory installed or provided circuit number identification for each breaker and space.
c. Cabinets shall be locking type with no exposed latches or screws when door is closed. Key panels alike and provide minimum of three keys.
d. Minimum dimensions of 20 inches (500 mm) wide by 5-3/4 inches (146 mm) deep.
e. Space designation on Drawings indicates bus hardware and panelboard capacity for future acceptance of one 20 Amp, single-pole circuit-breaker.
f. Breakers specified to be shunt trip and shall include shunt trip accessories to remotely trip breaker using separate 120 V power source. Trip coil shall include coil-clearing contact to break coil current when breaker opens.
g. Use equipment from same manufacturer as main panelboard.
h. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Type PRL1a by Cutler-Hammer.
2) Type AL or AQ by General Electric.
3) Type P1 by Siemens.
4) Type NQOD by Square D.

8. Load Centers:
a. Surface-mounted, outdoor NEMA Type 3R enclosure with padlocking provisions. 12-1/2 inches (318 mm) wide by 4-1/2 inch (115 mm) deep minimum.
b. HACR type circuit breakers.
c. Use equipment from same manufacturer as main panelboard.
d. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Type CH by Eaton.
2) Type PowerMark Plus by General Electric.
3) Type PL by Siemens.
4) Type QO by Square D.

9. Labels:
a. All Switchboards shall be labeled with Arc-Flash Hazard Information per NFPA 70E 130.5 including:
1) Nominal system voltage.
2) Arc flash boundary.
3) Available incident energy.
4) Working distance.
5) Minimum arc rating of clothing.
6) Level of PPE.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
1. Examine wall framing and verify framing for proper spacing for installation of panelboard(s).

a. Notify Architect of improper spacing in writing.

B. Contractor shall be responsible for performing required calculations to determine ARC Flash Hazards and providing all appropriate labeling per NFPA 70E.

3.2 INSTALLATION

A. Label panelboards, load centers, and each breaker in main panelboard with 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch (6 mm) high.

B. Provide typewritten circuit schedules in lighting and distribution panelboards and load centers to identify panelboard and load served by each branch breaker.

C. Arrange conductors neatly within panelboards and load centers.

D. Secure to structure in accordance with requirements of Project seismic design category.

3.3 PROTECTION

A. Protect panelboards, load centers, and interior components from paint, gypsum board compound, dirt, dust, and other foreign matter during construction.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install wiring devices complete with plates as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 27 1116: 'Communications Cabinets, Racks, Frames, and Enclosures'.
   3. Section 27 1501: 'Communications Horizontal Cabling' for cables for telephone and data systems.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Cooper Wiring Devices, Peachtree City, GA www.cooperwiringdevices.com.
      b. General Electric Industrial Systems, Charlotte, NC www.geindustrial.com.
      c. Hubbell Building Automation, Austin, TX www.hubbell-automation.com.
      d. Hubbell Inc, Milford, CT www.hubbell-wiring.com or Hubbell Canada Inc, Pickering, ON (800) 263-4622 or (905) 839-4332.
      e. Hunt Control Systems Inc, Fort Collins, CO www.huntdimming.com.
      f. Intermatic Inc, Spring Grove, IL www.intermatic.com.
      g. IR-TEC America, Inc., Brea, CA www.irtec.com/en-ira/.
      h. Leviton Manufacturing Co, Little Neck, NY www.leviton.com or Leviton Manufacturing of Canada Ltd, Pointe-Claire, QB (800) 461-2002 or (514) 954-1840.
      i. Legrand, West Hartford, CT www.legrand.us.com or Vaughan, ON www.legrand.ca.com.
      j. Lutron Electronics Co Inc, Coopersburg, PA www.lutron.com.
      k. Ortronics, New London, CT www.ortronics.com.
      l. Paragon Electric Co Inc, Carol Stream, IL www.icca.invensys.com/paragon or Paragon Electric, Mississauga, ON (800) 951-5526 or (905) 890-5956.
      m. Pass & Seymour, Syracuse, NY www.passandseymour.com or Pass & Seymour Canada Inc, Concord, ON (905) 738-9195.
      n. Philips Lighting Co, Somerset, NJ www.lighting.philips.com/nam or Philips Lighting Canada, Scarborough, ON (416) 292-3000.
      o. Red Dot div of Thomas & Betts, Memphis, TN www.tnbcom.
      p. Schneider Electric North America, Palatine, IL www.schneider-electric.com (847) 397-2600.
      q. Sensorswitch, Wallingford, CT www.sensorswitch.com.
      r. Siemon Company, Watertown, CT www.siemon.com.
      s. Square D Co, Palatine, IL www.squared.com.
      t. Suttle, Hector, MN www.suttleonline.com.
      u. Tork Inc, Mount Vernon, NY www.tork.com.
      v. Watt Stopper Inc, Santa Clara, CA www.wattstopper.com.
   2. Product Options:
      a. Faces shall be nylon where available.
      b. Devices of single type shall be from same Manufacturer.

c. Devices are listed as white. Use white devices on light colored walls, brown on dark colored walls, and black on black walls.

B. Switches:
1. Furnace Disconnect:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) 20 AMP, single pole:
a) Cooper: 2221V.
b) Hubbell: HBL1221-I.
c) Pass & Seymour: 20AC1-I.
d) Leviton: 1221-2I.
2. Standard Style:
a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) 20 AMP, single pole:
a) Cooper: 2221V.
b) Hubbell: HBL1221-I.
c) Pass & Seymour: 20AC1-I.
d) Leviton: 1221-2I.
2) Two Pole:
a) Cooper: 2222V.
b) Hubbell: HBL1222-I.
c) Pass & Seymour: 20AC2-I.
d) Leviton: 1222-2I.
3) Three Way:
a) Cooper: 2223V.
b) Hubbell: HBL1223-I.
c) Pass & Seymour: 20AC3-I.
d) Leviton: 1223-2I.
4) Four Way:
a) Cooper: 2224V.
b) Hubbell: HBL1224-I.
c) Pass & Seymour: 20AC4-I.
d) Leviton: 1224-2I.
5) Pilot Switch:
a) Hubbell: HBL1221-PL.
b) Pass & Seymour: 20AC1-RPL.
c) Leviton: 1221-PLR.
6) Lighted Toggle Switch:
a) Single Pole:
(1) Cooper: 2221-LTV.
(2) Hubbell: HBL1221-IL.
(3) Pass & Seymour: 20AC1-ISL.
(4) Leviton: 1221-LHI.
b) Three Way:
(1) Cooper: 2223-LTV.
(2) Hubbell: HBL1223-IL.
(3) Pass & Seymour: 20AC3-ISL.
(4) Leviton: 1223-7LC.
3. Exhaust Fan Timer Switches:
a. Serving Area:
1) 0-60 minute, no hold position.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
a) Intermatic: FD60MWC.
b) Paragon: SWPD60M-W.
c) Tork: A560MW.

4. Digital Time/Timer Switch:
    a. As shown in small Storage, Mechanical and Electrical Rooms.
    b. Automatic countdown type:
        1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
            a) Leviton: LTT60-1L.
            b) Hubbell: TD200.
            c) Pass & Seymour: RT1W.
            d) Tork: SSA100.
            e) Watt Stopper: TS-400-W.
5. Dimmer Switches:
    a. Vertical slide control with faceplate.
    b. Preset, ON-OFF switch, 1000VA.
    c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        1) Hubbell: AS101/AS1I.
        2) Hunt: DAP-10-IV.
        3) Leviton: IPI10-I.
        4) Lutron: N-1003P-IV.
        5) Pass & Seymour: 91180-I.
        6) Phillips: MP1000-I.
        7) Watt Stopper: AD-1103-I.
6. Momentary Switches:
    a. 15 AMP, specification grade.
    b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        1) Cooper: 1895W.
        2) Hubbell: HBL1556W.
        3) Legrand: 1250W.

C. Receptacles:
1. Rectangular Face Designer Style:
    a. 15 AMP, specification grade, back and side wired, self grounding.
    b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        1) Cooper: 6262W.
        2) Hubbell: HBL2152WA.
        3) Leviton: 16252-W.
        4) Pass & Seymour: 26252-W.
2. Range Receptacle:
    a. Three pole, four wire grounding, 125 / 250 V, NEMA 14-50R, 50 AMP complete with plate.
    b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        1) Cooper: 1258.
        2) Hubbell: HBL9450A.
        3) Leviton: 279.
        4) Pass & Seymour: 3894.
3. Ground Fault Circuit Interrupter (GFCI):
    a. 15 AMP, specification grade.
    b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        1) Cooper: GF15W.
        2) Hubbell: GF5252WA.
        3) Leviton: 8599-W.
        4) Pass & Seymour: 1594-W.
4. Basketball Standard Receptacle:
    a. Three pole, four wire grounding, 125 / 250V, locking type, NEMA L14-20R, 20 AMP, complete with plate.
    b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
        1) Cooper: CWL1420R.
        2) Hubbell: HBL2410.
        3) Leviton: 2410.

4) Pass & Seymour: L1420-R.

D. Plates:
1. Standard Cover Plates:
a. Office / Occupied Areas:
1) Nylon or high impact resistant thermoplastic.
2) Color shall match wiring device.
b. All Other: Steel.
c. Ganged switches shall have gang plates.
d. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
1) Cooper.
2) Hubbell.
3) Leviton.
4) Pass & Seymour.
2. Weatherproof In-Use Receptacle Covers:
a. NEMA 3R rated.
b. Cast aluminum.
c. Compatible with GFCI receptacles.
d. Complete with weather resistant gaskets and stainless steel screws.
e. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Hubbell: WP26MH, horizontal; WP26M, vertical.
2) Intermatic: WP1010HMC, horizontal; WP1010MC, vertical.
3) Red Dot: CKMG, horizontal; CKMGV, vertical.

E. Occupancy Sensors:
1. Ceiling, ultrasonic type.
a. Complete with sensor and combined relay / control transformer.
b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Cooper Controls:
a) Sensor: OAC-U-0501-R.
b) Relay / Transformer: SP20-MV.
2) IR-TEC America:
a) Sensor: OS-361DT.
b) Relay / Transformer: PPU-300.
3) Leviton:
a) Sensor: OSC05-RUW.
b) Relay / Transformer: OPP20-D2.
4) Sensorswitch:
a) Sensor: CMPDT9.
b) Relay / Transformer: MP-20-SP0DM.
5) Watt Stopper:
a) Sensor: W-500A.
b) Relay / Transformer: BZ-150.
c. Provide manual ON and OFF momentary override switches. Refer to Contract Drawings for number of switches.
2. Ceiling, dual technology type.
a. Complete with sensor and relay / transformer.
b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Cooper Controls:
a) Sensor: OAC-DT-0501-R.
b) Relay / Transformer: SP20-MV.
2) IR-TEC America:
a) Sensor: OS-361DT.
b) Relay / Transformer: PPU-300.
3) Leviton:
a) Sensor: OSC05-RMW.

b) Relay / Transformer: OPP20-D2.
4) Sensorswitch:
a) Sensor: CMPDT9.
b) Relay / Transformer: MP-20-SP0DM.
5) Watt Stopper:
a) Sensor: DT-305.
b) Relay / Transformer: BZ-150.
c. Provide manual ON and OFF momentary override switches. Refer to Contract Drawings for number of switches.
3. Wall switch, passive infrared type.
a. Features include sensitivity and time delay adjustments.
b. Manual ON / auto OFF capability.
c. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
1) Cooper Controls: OSW-P-1001-MV-W.
2) IR-TEC America: LbS-700NW.
3) Leviton: ODS10-IDW.
4) Sensorswitch: WSD-V-WH.
5) Watt Stopper: PW-100-W.

F. Surge Protective Device (for landscape irrigation controller):
1. Type 3 as defined in UL 1449 and approved for exterior application.
2. Parallel metal oxide varistors, MOV, from each line to ground: 120 / 240 VAC. UV resistant construction with epoxy encapsulation of electrical connections.
3. Include 1/2 inch (12.7 mm) mounting nipple and locknut.
4. Category Four approved Products. See Section 01 6200 for definitions of Categories:
a. ASZ175B1 by Cooper Power Systems.
b. AG2401C by Intermatic.
c. 54175-SSA by Leviton.
d. TDS120XR50S by Square D.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices flush with walls, straight, and solid to box.

B. Label dimmer switch groupings with 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letter shall be 1/4 inch (6 mm) high.

C. Install surge protective device in knock-out of junction box installed on bottom of automatic sprinkler controller.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install disconnects as described in Contract Documents, except those provided integral with equipment.

B. Related Requirements:
   1. Section 26 0501: Common Electrical Requirements.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
      a. Disconnects: Same as Manufacturer of Project's main panelboard.
      b. Fuses.
         1) Cooper Bussmann, Ellisville, IL www.cooperbussmann.com.
         2) Edison Fuse, Ellisville, IL (314) 391-3443.
         3) Ferraz Shawmut, Newburyport, MA www.ferrazshawmut.com.
         4) Littelfuse Inc, Des Plaines, IL www.littelfuse.com.

B. Disconnects:
   1. Heavy-duty quick-make, quick-break type, non-fused unless indicated otherwise.
   2. Provide interlock to prevent opening of door when switch is in ON position.
   3. Provide means to lock switch in OFF position with padlock.
   4. Disconnects for motor circuits shall be horsepower rated.
   5. Disconnects For Furnace Units And Unit Heaters: Provide manual starter with thermal overload relay. Provide overload relay to match motor full load amps.
   6. Enclosures:
      a. Interior: NEMA / CEMA Type 1.
      b. Exterior: NEMA / CEMA Type 3R.
   7. Fuses:
      a. Fuse fused disconnects with dual-element time delay fuses and equip with rejection type fuse holders.
      b. Fuses on Project shall be from single manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Label disconnects to indicate equipment served, such as Condensing Unit CU-1. Use 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch (6 mm) high. Attach labels with screws.

B. Install furnace disconnects on furnace at location where it is accessible from front of unit and it does not interfere with unit's operation.

END OF SECTION

SECTION 26 4301 – SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install surge protective devices as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 0526: 'Grounding And Bonding For Electrical Systems'.
   3. Section 26 2417: 'Circuit-Breaker Panelboards'.
   4. Section 26 4100: 'Facility Lightning Protection'.

1.2 REFERENCES

A. Abbreviations And Acronyms:
   1. SPD: Surge Protective Device.

B. Association Publications:
   1. Institute of Electrical and Electronic Engineers:
      a. IEEE C62.41.1-2002, 'Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits'.
      b. IEEE C62.41.2-2002, 'Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits'.
      c. IEEE C62.45-2002, 'Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits'.
   2. National Electrical Contractors Association:
      a. NECA 1-2015, Standard for Good Workmanship in Electrical Contracting'.

C. Reference Standards:
   1. Military Standard:
      a. MIL-STD-220C, 'Method of Insertion Loss Measurement' (2009).
   2. National Electrical Manufactures Association:
      a. NEMA 250-2014, 'Enclosures for Electrical Equipment (1000 Volts Maximum)'.
      b. NEMA LS-1-1992(R2000), 'Low-Voltage Surge-Protection (LVSP) Devices' (Withdrawn August 19, 2009).
   3. National Fire Protection Association / American National Standards Institute:
      a. NFPA 70, 'National Electric Code (NEC)' (2017 or most recent edition adopted by AHJ including all applicable amendments and supplements).
   4. Underwriters Laboratories:
      a. UL 1449: 'Surge Protective Devices' (4th Edition or current edition including all Revisions).

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate size and location of over current device compatible with actual surge protective and location to be installed.
   2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.4 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

B. Informational Submittals:
   1. Manufacturer Instructions:
      a. Provide Manufacturer's written installation instructions for Surge Protection Devices (SPD).
   2. Manufacturer Reports:
      a. Manufacturer's documentation for compliance with following standards:
         1) UL 1449: 'Surge Protective Devices'.
      b. Test Reports:
         1) Provide test reports from Independent Testing Laboratory verifying COMPLETE SPD will survive published and specified maximum surge current rating:
            a) Test reports will clearly show that all components that make up COMPLETE system were included in these tests (including but not limited to all necessary fuses, thermal disconnects, integral disconnects, and monitoring systems).
            b) Testing shall be performed as described in NEMA LS-1 document.
            c) Less than 10 percent change in protective characteristics from pre to post test.
         2) Provide test data confirming that SPD will survive published and specified repetitive surge current rating (longevity characteristics).
         3) Per requirements of NEC Article 285.6, provide test data demonstrating that SPD is without use of external fusing.
         4) Provide COMPLETE set of test and ratings data per recommendations of NEMA LS-1.
   3. Qualification Statement:
      a. Provide Manufacturer Qualification documentation if requested by Architect.

C. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Warranty Documentation:
         1) Final, executed copy of Warranty.
      b. Record Documentation:
         1) Record actual connections and locations of surge protective devices.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. General:
      a. Conform to requirements of NFPA 70.
      b. Referenced Documentation:
         1) Maintain at project site copy of each referenced document that prescribes execution requirements.
      c. SPD shall:
         1) Bear UL 1449 current edition.
            a) 'Manufactured in accordance with' is not equivalent to UL listing and does not meet intent of this specification.
         2) Performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters with posing at UL.com shall not be approved.
   2. Qualifications:
      a. Manufacturer Qualifications:
         1) Company specializing in manufacturing products specified in this section with three (3) years minimum documented experience.

1.6 WARRANTY

A. Manufacturer's Warranty:
   1. Provide ten (10) year minimum warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
      a. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories.
      a. Source Limitations: Furnish surge protective devices produced by single manufacture and obtained from single supplier.
      b. Field-Installed, Externally Mounted Surge Protective Devices:
         1) Current Technology by Thomas & Betts Power Solutions, Richmond, VA www.tnbpowersolutions.com.
         2) GE Industrial Solutions (Division of GE), Plainville, CT www.geindustrial.com.
         3) EATON www.eaton.com.
         4) MTL Instruments Group, (Division of Cooper Crouse-Hinds), Great Marlings, Butterfield, Luton, UK www.mtl-inst.com.
         5) Schneider Electric, North American Division, Palatine, IL www.surgelocic.com.

B. Components:
   1. Surge Protective Devices:
      a. Description:
         1) Factory assembled surge protective devices (SPD) for 60 Hz service, listed and classified by UL suitable for purpose specified and indicated; system voltage as indicated on Contract Drawings.
      b. Design Criteria:
         1) Capable of surviving 6,000 ANSI/IEEE C62.41, Category C3 (10kA) impulses without failure or performance degradation of more than ten (10) percent.
         2) Integrally fused to pass requirements of UL 1449 and provide short circuit current rating of 200kAIC:
            a) Each MOV shall be individually matched to + or - volt and individually fused.
            b) LED indicator lights for powe and protection status.
            c) Audible alarm, with silencing switch, to indicate when protection has failed.
            d) One (1) set of dry contacts rated at 5A and 250-V, ac, for remote monitoring of protection status.
      c. Protected Modes:
         1) Wye Systems: L-N, L-G, N-G, L-L.
      d. Voltage Protection Ratings (VPR's) as per UL 1449:
         1) 208Y/120V System Voltage:
            a) Not more than 800 V for L-G, L-G, and N-G modes and 1,200 V for L-L mode.
         2) 480Y/277V System Voltage:
            a) Not more than 1,500 V for L-G, L-G, and N-G modes and 2,000 V for L-L mode.
      e. Maximum Continuous Operating Voltage (MCOV) as per UL 1449:
         1) Not less than one hundred fifteen (115) percent on nominal system voltage.
      f. Enclosure Environment Type as per NEMA 250:
         1) Unless otherwise indicated, as specified for following installation locations:
            a) Indoor clean, dry locations: Type 1.
            b) Outdoor locations: NEMA 4 enclosure.
      g. Mounted For Field-Installed, Externally Mounted SPD's: Unless otherwise indicated, as specified for following locations:
         1) Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.

2) Provide flush-mounted SPD where mounted in public areas or adjacent to flush-mounted equipment.

2. Surge Protective Devices For Service Entrance Locations:
   a. General:
      1) Provide field-installed, externally mounted SPD's.
   b. Design Criteria:
      1) List and label as complying with UL 1449, Type 1.
      2) Provide SPD's utilizing field-replaceable modular or non-modular protection circuits.
      3) Surge Current Rating:
         a) Not less than 125 kA per mode/250 kA per phase.
      4) Repetitive Surge Current Capacity: Not less than 5,000 impulses.
      5) Nominal Discharge Current (I-n) as per UL 1449: 20 kA.
      6) Short Circuit Current Rating (SCCR) as per UL:
         a) Not less than available fault current at installed location as indicated on Contract Drawings.
   c. Diagnostics:
      1) Protection Status Monitoring:
         a) Provide indicator lights to report protection for each phase.
      2) Alarm Notification:
         a) Provide indicator light and audible alarm to report alarm condition.
         b) Provide button to manually silence audible alarm.
   d. Provide surge rated integral disconnect switch for SPD's not connected to dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Verify field measurements are as shown on Contract Drawings.
   2. Verify service voltage and configuration marked on SPD are consistent with service voltage and configuration at Project location.
   3. Verify electrical equipment is ready to accept connection of SPD and that installed overcurrent device is consistent with requirements of Contract Drawings and Manufacturer's written Instructions.
   4. Verify system grounding and bonding is in accordance with Section 26 0526: 'Grounding And Bonding For Electrical Systems' including bonding of neutral and ground for service entrance and separately derived systems where applicable.
   5. Verify conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. General:
   1. Perform work in neat and workmanlike manner in accordance with Standard Practice Guidelines of NECA 1.

B. Install SPD in accordance with Manufacturer's written instructions.

C. Arrange equipment to provide minimum clearances in accordance with Manufacturer's written Instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E. Conductors:
   1. Proved conductors with minimum ampacity as indicated on Contract Drawings, as required by NFPA 70, and not less than Manufacturer's recommended minimum conductor size.

2. Install between SPD and equipment terminations as short and straight as possible, not exceeding Manufacturer's recommended maximum conductor length.
    a. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible.
    b. Twist conductors together to reduce inductance.

F. Energizing SPD's:
1. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526: 'Grounding And Bonding For Electrical Systems' where applicable.
2. Replace SPD's damaged by improper or missing neutral-ground bond.

3.3 FIELD QUALITY CONTROL

A. Field Testing:
1. Provide factory testing documents.
2. Verify electrical wiring installation complies with Manufacturer's written installation requirements.
3. Disconnect SPD prior to performing any high potential testing.
4. Replace SPD's damaged by performing high potential testing with SPD connected.

END OF SECTION

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install lighting system as described in Contract Documents, complete with lamps.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 5121: 'Interior Lighting: LED Dimming Drivers'.
   3. Section 09 5116: 'Acoustical Tile Ceilings'.

1.2 REFERENCES

A. Reference Standards:
   1. American National Standards Institute (ANSI):
      a. ANSI C78.377-2017, 'American National Standard for Electric Lamps: Specification for the Chromaticity of Solid State Lighting Products'.
   2. Federal Communications Commission (FCC):
      a. Code of Federal Regulations (CFR):
         1) FCC 47 CFR Part 18, 'Industrial, Scientific, and Medical Equipment'.
   3. Institute of Electrical and. Electronics Engineers (IEEE):
      a. IEEE C62.41.1-2002, 'Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits'.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Advance Transformer Co, Rosemont, IL www.advancetransformer.com.
      b. Cooper Wiring Devices by Eaton, Peachtree City, GA www.cooperindustries.com.
      c. General Electric Lighting, Hendersonville, NC or General Electric Lighting Canada Inc, Mississauga, ON www.gelighting.com/na.
      d. Howard Lighting Products, Laurel, MS www.howard-ind.com.
      e. Osram Sylvania, Danvers, MA www.sylvania.com or Osram Sylvania Ltd, Mississauga, ON (905) 673-6171.
      f. Philips Lighting Co, Somerset, NJ www.lighting.philips.com/nam or Philips Lighting Canada, Scarborough, ON (416) 292-3000.
      g. Universal Lighting Technologies, Nashville, TN www.universalballast.com.
      h. Venture Lighting International, Solon, OH www.venturelighting.com.
      i. Watt Stopper Inc, Santa Clara, CA www.wattstopper.com.
      j. Westinghouse Lighting Corp, Philadelphia, PA www.westinghouselightbulbs.com.
   2. Product Options: When several lighting fixtures are specified by name for one use on Drawings, select any one of those specified. Do not mix fixtures from different manufacturers specified for one use.

B. Materials
   1. Lighting Fixtures:
      a. Type One Acceptable Products:

1) See Fixture Schedule on Drawings for acceptable manufacturers and models.
2) Equals as approved by Architect before bidding. See Section 01 6200.

b. See 'Light Fixture Schedule' provided by Owner's Representative.
a)

2. Lamps:
a. Other Lamps:
1) Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
a) General Electric.
b) North American Philips.
c) Osram / Sylvania.
d) Westinghouse.

b. LED Lamps and Fixtures:
1) Replacement Lamps shall have minimum efficiency of 70 lm / W per LM 79.
2) Integral LED Lamps shall have minimum efficiency of 90 lm / W per LM 79.
3) Provide minimum rated life of 50,000 per LM 80 and LM 70 standards.
4) Color Temperature: 3000k.
5) Provide full spectrum color index of 65.

C. Factory Assembly:
1. Fixtures shall be fully assembled complete with necessary wiring, sockets, lamps, reflectors, ballasts, auxiliaries, plaster frames, recessing boxes, hangers, supports, lenses, diffusers, and other accessories essential for complete working installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:
1. Coordinate with Sections under 09 5000 heading to obtain symmetrical arrangement of fixtures in acoustic tile ceiling as shown on Reflected Ceiling Plan in Contract.
2. In mechanical equipment rooms, coordinate locations of light fixtures with equipment locations to provide proper room illumination without obstruction. Suspend fixtures that must be mounted below pipes, ducts, etc, with chains or other Architect approved method.

B. Securely mount fixtures. Support fixtures weighing 50 lbs (23 kg) or more from building framing or structural members.

C. Fasten lay-in fixtures to ceiling suspension system on each side with bolts, screws, rivets, or clips. In addition, connect lay-in fixtures with two (2) No. 12 gauge diagonal wires with three (3) turns each end; two (2) per fixture minimum to building framing or structural members. Connect to opposing corners of fixture. Wires may be slightly slack. Make final conduit connections to lay-in fluorescent fixtures with specified flexible conduit or flexible fixture whips.

D. Where fixtures are shown installed end to end, provide suitable connectors or collars to connect adjoining units to appear as a continuous unit.

E. Where recessed fixtures are to be installed, provide openings, plaster rings, etc, of exact dimensions for such fixtures to be properly installed. Coordinate fixture installation with ceiling type and thickness. Terminate circuits for recessed fixtures in an extension outlet box near fixture and connect with specified flexible conduit.

3.2 ADJUSTMENT

A. Repair scratches or nicks on exposed surfaces of fixtures to match original undamaged conditions.

END OF SECTION

SECTION 26 5121 - INTERIOR LIGHTING: LED DIMMING DRIVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install Interior Lighting LED Dimming Drivers as described in Contract Documents, complete with lamps.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.
   2. Section 26 0924, 'Lighting Control System'.
   3. Section 26 2726: 'Wiring Devices'.
   4. Section 26 5100: 'Interior Lighting'.

C. Reference Standards:
   1. American National Standards Institute (ANSI) / American National Standard Lighting Group (ANSLG):
      a. ANSI/ANSLG C78.377-2017, 'American National Standard for Electric Lamps: Specification for the Chromaticity of Solid State Lighting Products'.
      b. ANSI/ANSLG C82.11-2017, 'High-Frequency Fluorescent Lamp Ballasts'.
   2. American National Standards Institute (ANSI) / Illuminating Engineering Society (IES):
      a. ANSI/IES RP-16-10, 'Nomenclature and Definitions for Illuminating Engineering'.
   3. Federal Communications Commission (FCC):
      a. Code of Federal Regulations (CFR):
         1) FCC 47 CFR Part 15, 'Class B: Radio Frequency Devices'.
   4. Institute of Electrical and. Electronics Engineers (IEEE) / American National Standards Institute (ANSI):
      a. IEEE/ANSI C62.41.1-2002, 'Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits'.
   5. International Electrotechnical Commission (IEC):
      a. IEC 60929 ED. 4.0 B:2011. 'AC and/or DC Supplied Electronic Control Gear for Tubular Fluorescent Lamps - Performance Requirements'.
      b. IEC 61000-3-2 ED. 5.0 B:2018, 'Electromagnetic Compatibility (EMC) - Part 3-2: Limits for Harmonic Current Emissions (Equipment Input Current <= 16 A per phase)'.
      c. IEC 61347-1 ED. 3.1 B:2017, 'Lamp Controlgear - Part 1: General and Safety Requirements'.
      d. IEC 61347-2-13 ED. 2.1 B:2016, 'Lamp Controlgear - Part 2-13: Particular Requirements for d.c. or a.c. Supplied Electronic Controlgear for LED modules'.
      e. IEC 61547 ED. 2.0 B:2009, 'Equipment for General Lighting Purposes - EMC Immunity Requirements'.
      f. IEC 62384 ED. 1.0 B:2006, 'D.C. or A.C. Supplied Electronic Control Gear for LED Modules - Performance Requirements'.
      g. IEC 62386-101 ED. 2.1 B:2018, 'Digital Addressable Lighting Interface - Part 101: General Requirements - System'.
   6. National Electrical Manufacturers Association (NEMA):
      a. NEMA 410-2015, 'Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts'.
   7. Underwriters Laboratories (UL):
      a. UL 1310: 'Class 2 Power Units' (2018).
   8. Underwriters Laboratories (UL) / Underwriters Laboratories of Canada (ULC):
      a. UL 8750: 'Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products' (2015).

1.2 SUBMITTALS

A. Action Submittals:
   1. Product Data:

a. Manufacturer's published product data on dimensions, ratings, catalog numbers and identification of products and accessories for products included for project. Include performance data.

2. Shop Drawings:
   a. Provide fixture type(s) list for each specific driver.
   b. Provide wiring diagrams as needed for special operation or interaction with other system(s).

B. Informational Submittals:
1. Qualification Statements:
   a. Manufacturer: Provide experience compliance documentation.
   b. Products: Provide compliance documentation with UL / ULC requirements.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Warranty Documentation:
      1) Final, executed copy of Warranty on drivers.

1.3 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Meet UL / ULC requirements.

B. Qualifications. Requirements of Section 01 4301 applies but not limited to following:
1. Manufacturer:
   a. Manufacture with five (5) years experience in manufacture of dimmable electronic lighting drivers.
   b. Provide experience documentation.

1.4 FIELD CONDITIONS

A. Ambient Conditions:
1. General:
   a. Proceed with installation only when following ambient conditions can be maintained:
      1) Install when the temperature is between minus 4 deg F (minus 20 deg C) minimum and 122 deg. F (50 deg. C) maximum and relative humidity is ninety (90) percent, non-condensing.
      2) Protect from dust and excess moisture during installation.

1.5 WARRANTY

A. Manufacturer Warranty:
1. Provide five (5) year warranty on drivers to operate driver at or below required driver warranty temperature.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers:
1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
   a. eldoLED America, San Jose, CA www.eldoled.com.
   b. General Electric Lighting, Hendersonville, NC or General Electric Lighting Canada Inc, Mississauga, ON www.gelighting.com/na.
   c. Howard Lighting Products, Laurel, MS www.howard-ind.com.

d. OSRAM Sylvania, Danvers, MA or OSRAM Sylvania LTD, Mississauga, Ontario Canada www.Sylvania.com.
e. Philips Lighting Co, Somerset, NJ www.lighting.philips.com/nam or Philips Lighting Canada, Scarborough, ON (416) 292-3000.

B. LED Dimming Driver:
1. Description:
a. LED Dimming Driver:
1) 4 wire (010V DC Voltage Controlled) Dimming Drivers.
2) Integral Diming Driver for replacement lamp.
2. Design Criteria:
a. Driver:
1) Driver must be able to operate for (+/- 10 percent) supply voltage of 120V through 277VAC at 60Hz.
2) Driver to be UL / ULC recognized under component program and shall be modular for simple field replacement. Drivers that are not UL / ULC recognized or not suited for field replacement will not be used.
3) Driver shall have ability to provide no light output when analog control signal drops below 0.5 V, and shall consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture to fixture output.
b. Range and Quality:
1) LED dimming to be equal in range and quality to commercial grade incandescent dimmer:
a) Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experience in commercial environment.
2) Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.
c. Inrush Current:
1) Driver must limit inrush current as followings:
a) Minimum Requirement: Meet or exceed NEMA 410 driver inrush standard of 430 amps per 10 amps load with maximum of 370 $amps^2$ per second.
b) Preferred Requirement: Meet or exceed 30mA^2s at 277VAC for up to 50 watts of load and 75A at 240us at 277VAC for 100 watts of load.
d. Withstand up to 1,000 volt surge without impairment of performance as defined by IEEE/ANSI C62.41.1 Category A.
e. Light Output:
1) No visible change in light output with variation of plus/minus 10 percent line voltage input.
f. Harmonic Distortion:
1) Total Harmonic Distortion less than 20 percent and meet ANSI/ANSLG C82.11 maximum allowable THD requirements at full output.
2) THD shall at no point in dimming curve allow imbalance current to exceed full output THD.
g. Automatic Adaptation:
1) Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance.
a) Adjustment of forward LED voltage, supporting 3V through 55V.
b) Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1 mA.
c) Adjustment for operating hours to maintain constant lumens (within 5 percent) over 50,000 hour design life of system, and deliver up to 20 percent energy savings early in life cycle.
h. Light Quality:
1) Over entire range of available drive currents, driver shall provide step-free, continuous dimming to black from 100 - 1 percent light output and step to 0 percent where indicated. Driver shall respond similarly when raising from 0 percent to 100 percent.
2) Drivers to track evenly across multiple fixtures at all light levels, and shall have input signal to output light level that allows smooth adjustment over entire dimming range.
3) Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within dimming range from 100-0.1 percent luminaire shall have:

a) LED dimming driver shall provide continuous step-free, flicker free dimming similar to incandescent source.
b) Minimum Requirement: Flicker index shall less that 5 percent at all frequencies below 1000 Hz.
c) Preferred specification: Flicker index shall be equal to incandescent, less that 1 percent at all frequencies below 1000 Hz.

i. Control Input:
1) 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:
a) Must meet IEC 60929 ED. 4.0 B Annex E for General White Lighting LED drivers.
b) Connect to devices compatible with 0 to 1 OV Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at low end of 0.3V. Limit number of drivers on each 0-1 OV control output based on voltage drop and control capacity.
c) Control relays or contactors and transformers for up to six circuits
d) Sensor controller with HIGH, LOW, and DEADBAND adjustments.
2) Integral Dimmer Driver for replacement lamps:
a) LED Driver shall not cause shadows.
b) LED Driver shall be line voltage controlled and shall be compatible with any universal dimmer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of driver to meet Manufacturer's prescribed methods and instructions.

B. Meet Ambient Conditions requirements for installation.

C. Driver may be remote mounted up to 300 ft (90 m) depending on power level and wire gauge.

D. 0-10V input shall be protected from line voltage miswire, and immune and output unresponsive to induced AC voltage on control leads.

END OF SECTION

SECTION 26 5200 - EMERGENCY LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install emergency battery units as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0501: 'Common Electrical Requirements'.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Beghelli, Miramar, FL www.beghelliusa.com.
      b. Bodine Emergency Lighting, Collierville, TN www.bodine.com
      c. Dual-Lite, Cheshire, CT www.dual-lite.com.
      d. Iota Engineering Co, Tucson, AZ www.iotaengineering.com
      e. Lightolier, Fall River, MA www.lightolier.com.
      f. Lithonia Lighting, Conyers, GA www.lithonia.com.
      g. McPhilben / Day-Brite Lighting, Tupelo, MS www.mcphilben.com.
      h. Sure-Lites / Cooper Lighting, Elk Grove, IL www.cooperlighting.com.

B. Materials:
   1. Fluorescent Battery Packs:
      a. Design Criteria:
         1) Batteries shall be long life nickel cadmium type.
         2) Complete with charging indicator light and test switch.
         3) Components shall be fully concealed and easily accessible for maintenance or replacement.
         4) Factory installed in lighting fixture, or field installed to same standards.
      b. Linear Fluorescent Lighting Fixtures:
         1) Battery pack shall operate one (1) lamp at approximately 600 lumens initially and 60 percent minimum of initial lumens after ninety (90) minutes.
         2) Charger shall be capable of full recharge in twenty four (24) hours.
      c. Class Two Quality Products: See Section 01 4301 for Manufacturer Qualifications and Section 01 6200:
         1) Any Manufacturer that conforms to Contract Documents requirements.
   2. Emergency Lighting Units And Fixtures:
      a. Design Criteria:
         1) Shall operate indicated number of lamps for ninety (90) minutes of emergency operation.
         2) Sealed, maintenance free, lead calcium type battery.
         3) Painted steel housing and complete with power indicator light and test switch.
         4) Lamps to be designed for wet locations and with full vertical and horizontal adjustment of lamps.
      b. Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         1) See Contract Drawings for approved fixtures. Coordinate emergency lighting unit and fixture so that systems function as required.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Battery Packs:
   1. General:
      a. Wire so unit can be tested with lights on.
      b. Wire so lamps in normal mode are switched off with other lighting in area. Connect unit to unswitched conductor of normal lighting circuit.
   2. Linear Fluorescent Lighting Fixtures:
      a. Install in ballast channel of fixture with charging indicator light and test switch mounted on fixture end, or visible and accessible through lens.

B. Emergency Lighting Units:
   1. Aim lamps to maximize lighting of first 50 feet (15 meters) of egress path.
   2. Wire so lamps are normally off and operate upon loss of normal building power.
   3. Connect units to un-switched conductor of normal lighting circuit.

END OF SECTION

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install exterior lighting system as described in Contract Documents.

B. Products Furnished But Not Installed Under This Section:
   1. Anchor bolts.

C. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for bases for light poles and installation of anchor bolts.
   2. Section 26 0501: 'Common Electrical Requirements'.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
   1. Manufacturer Contact List:
      a. Cutler-Hammer Inc, Milwaukee, WI www.cutler-hammer.eaton.com or Cutler-Hammer/Eaton Yale Ltd, Burlington, ON (905) 333-6442.
      b. General Electric Industrial Systems, Charlotte, NC or G E Lighting Canada Inc, Mississauga, ON www.geindustrial.com.
      c. Intermatic Inc, Spring Grove, IL www.intermatic.com.
      d. Paragon Electric Co Inc, Carol Stream, IL www.icca.invensys.com/paragon or Paragon Electric / Maple Chase, Mississauga, ON (800) 951-5526 or (905) 890-5956.
      e. Siemens Energy & Automation, Alphrata, GA www.sea.siemens.com or Siemens Canada, Mississauga, ON (905) 819-8000.
      f. Square D Co, Palatine, IL or Square D / Schneider Electric, Toronto, ON www.squared.com.
      g. Tork Inc, Mount Vernon, NY www.tork.com.

B. Materials:
   1. Exterior Fixtures:
      a. Finish shall be high quality polyester powder coating:
         1) Finish process shall consist of cleaning, electrostatically applying power coat, and thermal curing.
         2) Weather, scratch, UV, and fade resistant.
      b. Color shall be Manufacturer's standard white, natural aluminum, or medium bronze as selected by Architect before bidding.
      c. Type One Acceptable Products:
         1) As indicated on Fixture Schedule. Do not mix fixtures from different manufacturers for one use.
         2) Equals as approved by Architect before bidding. See Section 01 6200.
   2. Parking Area Poles:
      a. Designed for wind loading required for Project location as determined by Architect.
      b. Aluminum hinged base type with matching aluminum anchor bolt cover secured to base.
      c. Include hand hole with cover at pole base.
      d. Finish And Color: Match parking area fixtures.
   3. Exterior Lighting Control:
      a. Photo Cell:

1) 120 volts.
2) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
   a) Paragon: CW201-00.
   b) Tork: 2101.

b. Lighting Contactor:
1) 120 volt coil, 20 amps, 2 pole, NEMA 1 enclosure.
2) By same manufacturer as main panelboard.
3) Category Four Approved Products. See Section 01 6200 for definitions of Categories.
   a) Cutler Hammer: CN35.
   b) General Electric: CR260L-21CA22.
   c) Siemens: LEN01B200120A.
   d) Square D: Class 8903, Type LG-20.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:
1. Coordinate location of anchor bolts and conduit in concrete bases so pole will be properly mounted and centered on base.
2. Install hinged light pole bases so poles can be completely lowered to ground without obstruction out into parking area.
3. Install time switches, manual bypass switches, and contactor inside building to control parking area and building exterior lighting. Label each component to identify lighting controlled, I.E. 'PARKING LIGHTING' or 'BUILDING LIGHTING.' Label with 1/16 inch (1.5 mm) thick laminated plastic composition material with contrasting color core. Engraved letters shall be 1/4 inch (6 mm) high.
4. Locate photocell(s) outside building under soffit and away from any light source and direct sunlight.
5. Wire photocell and time switch in series for photo cell ON, time switch OFF operation.

END OF SECTION

DIVISION 27 – COMMUNICATIONS

27 1116	Communications Cabinets, Racks, Frames, and Enclosures
27 1501	Communications Horizontal Cabling
27 5117	Audio Systems

SECTION 27 1116 – COMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

PART 1 - GENERAL

1.1 SUMMARY

A. Selection Includes But Is Not Limited To:
   1. Furnish and install communications cabinets, racks, frames, and enclosures as described in Contract Documents.

B. Related Requirements:
   1. Section 26 0526: 'Grounding And Bonding For Electrical Systems'.
   2. Section 27 1501: 'Communications Horizontal Cabling'.
   3. Section 27 5117: 'Audio Systems'.

C. Products Installed But Not Furnished Under This Section:
   1. Cable Management, Vertical Cable Management, and Horizontal Cable Management.

1.2 REFERENCES

A. Association Publications:
   1. British Standards Institution (BSI):
      a. BS EN 50310:2006, 'Application of Equipotential Bonding and Earthing in Buildings with Information Technology Equipment.
   2. Building Industry Consulting Service International (BISCI:
      a. Information Transport Systems Installation Methods Manual (ITSIMM) (5th Edition).
      b. Telecommunications Distribution Methods Manual (TDMM) (12th Edition).
   3. Institute of Electrical and Electronics Engineers:
      a. IEEE 802.3-2018, *'Standard for Ethernet'*.
      b. IEEE 1100-2005, 'Recommended Practice for Powering and Grounding Electric Equipment'.
   4. Telecommunications Industry Association:
      a. TIA TSB-162, 'Telecommunication Cabling Guidelines for Wireless Access Points' (November 2013).

B. Reference Standards:
   1. International Electrotechnical Commission:
      a. IEC 60603-7:2011, 'Connectors for electronic equipment – Part 7 'Detail specification for 8-way, unshielded, free and fixed connectors'.
   2. International Organization for Standardization / International Electrotechnical Commission:
      a. ISO/IEC 11801 ED.2.0 EN CORR3:2008, 'Information Technology-Generic Cabling for Customer Premises'.
   3. National Fire Protection Association:
      a. NFPA 70, 'National Electrical Code (NEC)' (2017 or most recent edition adopted by AHJ).
   4. Telecommunications Industry Association:
      a. TIA-568.2, 'Balanced Twisted-Pair Telecommunications Cabling and Components Standards' (Revision D, 2018).
      b. TIA-569, 'Telecommunications Pathways And Spaces' (Revision D, 2015).
      c. TIA-606, 'Administration Standard for Telecommunications Infrastructure' (Revision C, 2017).
      d. TIA-607, 'Telecommunications Bonding and Grounding (Earthling) for Customer Premises' (Revision C, 2015).
      e. TIA-758, 'Customer-Owned Outside Plant Telecommunication Infrastructure Standard' (Revision B, 2012).
      f. TIA-942, 'Telecommunications Infrastructure Standard for Data Centers' (Revision B, 2017).
      g. TIA-1152, 'Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling' (Revision A 2016).

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data:
      a. Provide Manufacturer's documentation and descriptive information on each piece of equipment to be used.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
   1. Category Four Approved Manufacturers. See Section 01 6200 for definitions of Categories:
      a. Atlas Sound, Phoenix, AZ www.atlassound.com.
      b. Lowell Manufacturing Co., Pacific, MO www.lowellmfg.com
      c. Middle Atlantic Products, Fairfield, NJ www.middleatlantic.com.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Installers:
   1. Approved installers in Section 27 5117 are to both furnish and install components of this section. See Section 01 4301. Installer requirements of Section 01 4301 applies.

3.2 INSTALLATION

A. Equipment Cabinet:
   1. See Section 27 5117 'Sound System' for installation of Sound Equipment.

B. Equipment Cabinet:
   1. Install vent panels at top and bottom of equipment cabinets and between components where possible for maximum ventilation when equipment locations is not specified in Contract Drawings. Locate amplifiers at top of cabinet. Locate equalizers below amplifiers, separated by several vent panels.
   2. Securely fasten equipment plumb and square in place. Utilize all fastening holes in front of cabinet.
   3. Securely fasten in place equipment that is not rack mounted, including relays and other small components. Do not use sticky-back tape.
   4. Install balancing / isolation transformer when balanced and unbalanced components are connected.
   5. Wire XLR-type connections with pin 2 hot, pin 1 shield.
   6. Connect powered components to 120 VAC outlets on voltage suppressor power bars. Do not connect to outlets on other components.
   7. Identification:
      a. Legibly identify user-operated system controls and system input / output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexan labels. Label equipment and controls within equipment cabinets using similar labels or printed labels from a label maker or laser printer.
      b. Affix label to rack panel inside cabinet listing name and telephone number of installer. Appropriate warranty instructions may be included.

C. Communications Racks, Frames and Enclosures:
   1. Racks shall be installed as per Manufacturer's recommendations.
   2. Racks shall be securely attached to concrete floor with 3/8 inch (9.5 mm) minimum hardware or as required by local codes.

3. Place racks with 36 inches (900 mm) minimum clearance front and back from walls and 28 inches (710 mm) clear on one side of rack. When mounted in row, maintain 36 inches (900 mm) minimum from wall behind and in front of row of racks and from wall at each end of row.
4. Grounding:
    a. Racks shall be grounded to telecommunications ground bus bar as per Section 26 0526 'Grounding And Bonding For Electrical Systems'.
    b. Racks shall be grounded in accordance with TIA-607.
5. Seismic Bracing:
    a. Comply with IBC and local seismic requirements for all equipment and conduit pathways.
6. Rack mount screws not used for installing patch panels and other hardware shall be bagged and left with rack upon completion of installation.
7. Mounted termination block fields shall be mounted on Terminal Board in Technology Room provided by Electrical as shown in Contract Documents.
    a. Wall mounted termination block fields shall be installed with lowest edge of Terminal Board.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
    1. Correct any work found defective or not complying with Contract Document requirements at no additional cost to Owner.

END OF SECTION

SECTION 27 1501 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish, install, and test communications horizontal cabling as described in Contract Documents including following:
      a. Cables and related terminations.
      b. Patch cords and modular connectors.
      c. Surface raceway and outlet poles.
      d. Support and grounding hardware.
      e. UTP Cable.
      f. UTP Patch cords.
      g. UTP Connector Modules.
      h. Installation and testing of Owner Furnished Network Equipment.

B. Related Requirements:
   1. Division 26: Raceways and surface boxes.
   2. Section 07 8400: 'Firestopping' for furnishing and installation of firestopping.
   3. Section 26 0526: 'Grounding And Bonding For Electrical Systems' for installation and termination.
   4. Section 27 1116: 'Communications Cabinet, Racks, Frames, and Enclosures'.
   5. Section 27 4117: 'Video And Satellite Distribution Systems'.
   6. Section 27 5117: 'Audio Systems'.

C. Products Installed But Not Furnished Under This Section:
   1. Owner Furnished Network Equipment as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents including:
      a. Internet Firewall.
      b. ISP Modem.
      c. Network Switch.
      d. Wireless Access Port.

D. Related Requirements:
   1. Section 01 6400: Owner will provide Network Equipment as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents. Contract Documents establishes quality of materials and installation for information of Contractor, Architect, and Owner's Representatives. Design Criteria in PART 2 of this Section identifies Contractor's responsibility for Owner Network Equipment.

1.2 REFERENCES

A. Association Publications:
   1. Building Industry Consulting Service International (BISCI:
      a. *Information Technology Systems Installation Methods Manual* (ITSIMM) (7th Edition).
      b. *Telecommunications Distribution Methods* Manual (TDMM) (14th Edition).
   2. Institute of Electrical and Electronics Engineers:
      a. IEEE 802.3-2018, *'Standard for Ethernet'*.
      b. IEEE 1100-2005, '*Recommended Practice for Powering and Grounding Electric Equipment'*.
   3. Telecommunications Industry Association:
      a. TIA TSB-162, 'Telecommunication Cabling Guidelines for Wireless Access Points' (Revision A, 2013).

B. Reference Standards:

1. National Fire Protection Association:
    a. NFPA 70, 'National Electrical Code (NEC)' (2020 or most recent edition adopted by AHJ).
2. Telecommunications Industry Association:
    a. TIA-568.1 'Commercial Building Telecommunications Infrastructure Standard' (Revision D, 2019)
    b. TIA-568.2, 'Balanced Twisted-Pair Telecommunications Cabling and Components Standards' (Revision D, 2018).
    c. TIA-568.4 'Broadband Coaxial Cabling and Components Standard (Revision D, 2017)
    d. TIA-606, 'Administration Standard for Telecommunications Infrastructure' (Revision C, 2017).
    e. TIA-607, 'Telecommunications Bonding and Grounding (Earthling) for Customer Premises' (Revision D, 2019).
    f. TIA-758, 'Customer-Owned Outside Plant Telecommunication Infrastructure Standard' (Revision B, 2012).
    g. TIA-1152, 'Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling' (Revision A 2016).
3. Underwriters Laboratories:
    a. UL 94: Standard for Test for Flammability of Plastic Materials for Parts in Devices and Appliances (March 2013 6th Edition).
        1) 94HB, 'Horizontal Burn Test'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate with Project Manager and/or Facility Manager well in advance of Substantial Completion for installation of all Owner Furnished Network Equipment.

1.4 SUBMITTALS

A. Action Submittals:
1. Product Data:
    a. Provide Manufacturer's documentation, installation instructions, and descriptive information on each piece of equipment to be used.
2. Shop Drawings:
    a. Provide three (3) copies of labeling system reflecting approved label scheme for cable installation for racks, cables, panels, and outlets.

B. Informational Submittals:
1. Certificates:
    a. Provide Installer certificates of qualifications required.
2. Design Data:
    a. Identification and labeling:
        1) Provide labeling system for cable installation to be approved by Owner.
            a) Clearly identify all components of system: racks, cables, panels and outlets.
            b) Designate cables origin and destination and unique identifier for cable within facility by room number and port count.
            c) Racks and patch panels shall be labeled to identify location within cable system infrastructure.
    b. After system installation, provide three (3) full documentation sets to Consulting Engineer/Architect for approval.
3. Tests And Evaluation Reports:
    a. Submit documentation within ten (10) working days of completion of each testing phase. This is inclusive of all test results and record drawings.
    b. Draft drawings may include annotations done by hand. Final copies of all drawings shall be submitted within thirty (30) working days of completion of each testing phase.
    c. At request of Consulting Engineer, provide copies of original test results.
4. Field Quality Control Submittals:
    a. Architect will provide floor plans in paper and electronic formats on which record documentation information can be recorded.
5. Qualification Statements:

a. Letter from Manufacturer certifying level of training and experience of Installer.

C. Closeout Submittals:
1. Include following information in Operations And Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data:
1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
b. Warranty Documentation:
1) Final, executed copy of Warranty.
c. Record Documentation:
1) Manufacturers documentation:
a) Manufacturer's literature or cut sheet.
2) Tests and evaluation reports.
3) As-built Documentation:
a) Provide record document to include cable routes and outlet locations.
(1) Sequential number shall identify outlet locations.
(2) Numbering, icons, and drawing conventions used shall be consistent throughout all documentation.
(3) Provide labeling system information.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. System shall meet approval of authority having jurisdiction (AHJ). NEC and State and/or local ordinances and regulations shall govern unless more stringent requirements are specified.
2. Meet all TIA/EIA commercial building wiring standards.
3. Meet Telecommunications Distribution Methods Manual (TDMM) (12th Edition) requirements for installation and testing.
4. All Networks shall be installed per applicable standards and manufacturer's guidelines.
5. Cable assemblies shall be UL / CE Listed and CSA Certified. Cables shall be a distinctive green or green/yellow in color, and all jackets shall be UL, VW-1 flame rated.
6. Grounding shall conform to all required Commercial Building Grounding and Bonding Requirements for Telecommunications, Electrical Codes, and Manufacturer's grounding requirements.

B. Qualifications: Requirements of Section 01 4301 applies, but is not limited to following:
1. Manufacturer Qualifications:
a. Provide single source for all products of system:
1) KeyConnect by Belden.
2) Netkey by Panduit.
3) System 6 by Siemon.
4) Uniprise Media 6 by CommScope.
2. Installers Qualifications:
a. Approved and Certified by Manufacturer (installation and maintenance trained):
1) Belden Certified System Vendor (CSV).
a) Belden Certified LDS Partner.
2) CommScope Certified Business Partner.
a) CommScope Certified LDS Partner.
3) Panduit Certified Installer (PCI).
4) Siemon Certified Installers (CI).
b. Three (3) year experience with similar projects. Provide documentation.

1.6 WARRANTY

A. Special Warranty:
1. Cabling System:

a. Provide warranty for permanent link cabling system to meet Category 6 standard requirements for structured cabling system for twenty (20) years.

2. Installer Warranty:
   a. Installer guarantees that all work is in accordance with all express and implied requirements of Contract Documents, that all work is of good quality, and further warrants work and material for period of (1) year from date of substantial completion of project, unless longer period of time is specified in Contract. All work not conforming to these requirements, may be considered defective:
      1) If, within one (1) year after substantial completion of work, or within such longer period of time as may be prescribed by law or by terms of any warranty in Contract, any of work is found to be defective or not in accordance with Contract, Installer shall at Installer cost correct it promptly after receipt of written notice from Owner.
      2) Installer's obligation shall survive termination of Contract.
      3) Owner shall give such notice within reasonable time after discovery of condition.
   b. Installer warrants to Owner that all materials and equipment furnished under this Contract shall be new unless otherwise specified, free from faults and defects and in conformance with Contract Documents:
      1) Contractor shall secure manufacturer's warranties and deliver copies thereof to Owner upon completion of work.
      2) All such warranties shall commence from date of substantial completion and will not in any way reduce Installer's responsibilities under this Contract.
      3) Whenever guarantees or warranties are required by specifications for longer period than one year, such longer period shall govern.
   c. Installer will provide twenty (20) year minimum end to end manufacturer warranty.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS

A. Category Four Products. See Section 01 6200 for definitions of Categories:
   1. Owner Furnished Network Equipment as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents including:
      a. Internet Firewall.
      b. ISP Modem.
      c. Network Switch(es).
      d. Wireless Access Points.
   2. Coordination:
      a. Coordinate installation of all Owner Furnished Network Equipment including but limited to:
         1) Installation and configure devices in accordance with Owner requirements.
         2) Proper set-up of network equipment.
         3) Owner Furnished internet service to building prior to final installation of AV and Voice Data Equipment.
         4) Testing of network equipment.

2.2 SYSTEMS

A. Manufacturers:
   1. Category Four Approved Manufacturers and Products. See Section 01 6200 for definitions of Categories:
      a. Belden, St. Louis, MO www.belden.com.
      b. Panduit Corporation, Tinley Park IL www.panduit.com.
      c. Systimax Solutions, a CommScope Company, Hickory, NC www.systimax.com.
      d. The Siemon Company, Watertown, CT www.siemon.com.

B. Design Criteria:
   1. Must install single manufacture as complete permanent link.

a. Category 6 minimum compliance margin on all parameters beyond category 6 and Power Sum ACR out to 250 MHz.

2. Entire Category 6 system to be provided by single approved Manufacturer throughout.
3. Install structured cabling system that will be able to support interconnections to active telecommunications equipment for voice and data applications in multi vendor, multi product environment. Structured cabling system should adhere to TIA-568, TIA-606; TIA-607, and TIA-942 standards with respect to pathways, distribution, administration, and grounding of the system.
4. Each room drop will consist of two drops each consisting of two terminations can be interoperable to accommodate either voice or data applications. Provide convenience phone drops that will consist of single termination that will be installed in proper faceplate for each location's phone.
5. Install, terminate, test, and guarantee each drop according to customer all applicable standards and customer preferences.
6. Horizontal cables will be rated Category 6 (250 MHz) in performance and rated to comply with TIA-568 to connector outlets at Work Area. Horizontal cables will home run back to Technology Room (Entrance Facility / Main Cross Connect) and will terminate on individual Category 6 rated jacks to populate modular 48 port angled patch panel on open or flat patch panel inside enclosures. All cables will be patched at cutover as interconnection into floor serving active equipment using RJ45 modular equipment cables rated to Category 6.
7. Match additions to horizontal raceway to complete system according to TIA-568 where suspension and protection gaps exist.

C. Components – Work Area Subsystem:

1. Provide connectivity equipment used to connect horizontal cabling subsystem and equipment in work area. Both copper and fiber media shall be supported. Connectivity equipment shall include following options:
   a. Patch (equipment) cords and modular connectors.
   b. Outlets and surface mount boxes.
   c. Surface raceway and outlet poles.
   d. Consolidation point / MUlO.
2. Patch Cords and Modular Connectors:
   a. Match horizontal cabling medium and rating. Same Manufacturer shall provide modular connectors and patch cords. Total patch cord length at work area is not to exceed 10 feet (3.0 m).
   b. Copper Connectivity:
      1) Network Cabling System:
         a) Provide for Work Area subsystem, including all modular connectors.
         b) Modular connectors shall support of high-speed networks and applications designed for implementation on copper cabling.
         c) Outlets shall utilize fully interchangeable and individual connector modules that mount side-by-side to facilitate quick and easy moves, adds and changes.
      2) Modular Connections:
         a) Data Modules shall be Category 6:
            (1) Eight position modules required in all work areas and shall exceed connector requirements of TIA Category 6 standard.
            (2) Prove termination cap with strain relief on cable jacket, ensure cable twists are maintained to within 1/8 inch (3 mm) and include wiring scheme label. Wiring scheme label shall be available with TIA-568 wiring schemes.
         b) Terminations shall use for TIA-568 wiring scheme.
         c) Modules shall terminate 4 pair 23 100-ohm solid unshielded twisted pair cable.
         d) Modules shall meet ISO 11801 standard including complying with intermateability standard IEC 60603-7 for backward compatibility.
         e) Category 6 modules shall have UL and CSA approval.
         f) Modules shall have ETL verified Category 6 performance and ISO 11801 Class E performance in both basic and channel links.
         g) Modules shall be universal in design, accepting 2, 3, or 4 pair modular plugs without damage to outer jack contacts.
         h) Modules shall be able to be re-terminated minimum of 10 times and be available in 11 standard colors for color-coding purposes.
         i) Jack shall snap into all outlets and patch panels.
         j) Module shall include black base to signify Category 6 400 MHz performance.
      3) Patch Cords:

a) Category 6 patch cords 'shall be factory terminated with modular plugs featuring one-piece, tangle-free latch design and strain-relief boots to support easy moves, adds, and changes.
b) Constructed with Category 6 23-AWG stranded UTP cable.
c) Each patch cord shall be one hundred (100) percent performance tested at factory in channel test to TIA Category 6 standard.
d) Patch cords shall come in standard lengths of 3, 5, 7, 9, 14 and 20 feet (0.90, 1.50, 2.15, 2.75, 4.20 and 6.1 meters) and 6 standard colors of Blue or White.
e) Provide one (1) each 8 feet (2.45 m) patch cord for 50 percent of terminated work station ports.

3. Outlets and Surface Mount Boxes:
   a. Outlets and surface mount boxes shall support network system by providing high-density in-wall, surface mount cabling applications.
   b. Provide faceplates for flush mount:
      1) Outlets faceplates shall be manufactured from high-impact thermoplastic material with UL 94 flammability rating of 94 HB or better.
4. Copper Cable:
   a. Design Criteria:
      1) Performance exceeds all TIA-568 Category 6 and ISO 11801 for Class E cable requirements.
      2) ETL tested and verified for Category 6 component performance.
      3) Conductors are twisted in pairs with four pairs contained in flame retardant PVC jacket separated by a spline.
      4) Performance tested to 650 MHz.
      5) Plenum (CMP) and non-plenum/riser (CMR) flame rated.
      6) Maximum installation tension of 25 lbs (110 N).
      7) Installation temperature range: 32 deg F (0 deg C) to 140 deg F (60 deg C).
      8) Operating temperature range: 14 deg F (minus 10 deg C) to 140 deg F (60 deg C).
      9) Cable diameter: Riser – 0.26 inch (6.604 mm) 0.260"; Plenum – 0.25 inch (6.35 mm).
      10) Easy payout, reel-in-a-box and descending length markings on cable speed installation.
      11) Supports following applications: Ethernet 10BASE-T, 100BASE-T (Fast Ethernet) and 1000BASE-T (Gigabit Ethernet); 1.2Gb/s ATM; Token Ring 4/16; digital video; and broadband/baseband analog video.
      12) Color shall be blue.

D. Horizontal Distribution Cabling:
   1. General:
      a. Horizontal distribution cabling system is portion of telecommunications cabling system that extends from work area telecommunications outlet/connector to horizontal cross-connect in Technology Room (Entrance Facility / Main Cross Connect).
         1) Horizontal cabling in office should terminate in Technology Room (Entrance Facility / Main Cross Connect) located on same floor as Work Area being served.
         2) Horizontal cabling is installed in star topology (home run).
         3) Bridged taps and splices are not permitted as part of copper horizontal cabling.

E. Components – Technology Room (Entrance Facility / Main Cross Connect):
   1. General:
      a. Connect networking equipment to horizontal and backbone cabling subsystems:
         1) Termination hardware (connectors and patch cords), racks, cable management products and cable routing products.
         2) Cable termination hardware.
      b. Terminate each horizontal or backbone cabling run using appropriate connectors or connecting blocks depending upon cable type:
         1) Matching patch cords will be used to perform cross-connect activities or to connect into the networking/voice hardware:
            a) Category 6 Enhanced Unshielded Twisted Pair (UTP).
      c. Four-pair Category 6 UTP cabling shall be terminated onto four-pair Category 6 module:
         1) All modules shall be terminated using 568-B wiring scheme.
         2) Eight position module shall exceed connector requirements of TIA Category 6.standard.

3) Jack termination to 4-pair, 100 ohm solid unshielded twisted pair cable shall be by use of forward motion termination cap and shall not require use of punchdown or insertion tool.

2. Rack, Cabinet, and Cabling Management Enclosure:
   a. Cable Management:
      1) Cable Management System shall be used to provide neat and efficient means for routing and protecting fiber and copper cables and patch cords on telecommunication racks and enclosures.
      2) Provide complete cable management system comprised of vertical and horizontal cable managers to manage cables on both front and rear of rack.
      3) System shall protect network investment by maintaining system performance, controlling cable bend radius and providing cable strain relief.
   b. Vertical Cable Management:
      1) General:
         a) Vertical cable managers include components that aid in routing, managing and organizing cable to and from equipment.
         b) Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief.
      2) Provide panels with universal design mounting to 19 inches (480 mm) rack and constructed of steel bases with PVC duct attached.
      3) Covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds, and changes.
   c. Horizontal Cable Management:
      1) General:
         a) Horizontal cable managers include components that aid in routing managing and organizing cable to and from equipment.
         b) Panels shall protect network equipment by controlling cable bend radius and providing cable strain relief.
      2) Provide panels with universal design mounting to 19 inches (480 mm) rack and constructed of steel bases with PVC duct attached.
      3) Duct fingers shall include retaining tabs to retain cables in place during cover removal.
      4) Covers shall be able to hinge from either side yet still be easily removed to allow for quick moves, adds, and changes.
3. Patch Cords:
   a. Provide patch cords between modular patch panels configured as cross-connect or between patch panel and networking hardware when patch is used as interconnect. Provide one (1) each 3 feet (0.90 m) patch cord for each terminated patch panel port.
   b. Provide patch cords as indicated on Drawings and Specifications as shown in Contract Documents. Ensure all devices are fully connected to network equipment.
   c. Provide additional patch cords with appropriate length to connect all Owner provided internet enabled appliances (IEA) as specified on TT (Technology Telecommunication) and TA (Technology Audiovisual) Drawings as shown in Contract Documents.
   d. Patch cords shall be factory terminated with modular plugs featuring one-piece, tangle-free latch design and black strain-relief boots to support easy moves, adds and changes.
   e. Construct patch cords with Category 6 24-AWG stranded UTP cable.
   f. Patch cords shall be one hundred (100) percent performance tested at factory in channel test to Category 6 standard.
4. Patch Panels:
   a. Four-pair Category 6 UTP cabling shall be terminated onto four-pair-punch-down style connecting hardware mounted to rear of integral patch panels and routed to Category 6 modules on front face of patch panel.
   b. Patch panels shall be universal for TIA-568 wiring configurations.
   c. Patch panels shall have removable 6-port design that allows 6-port module to be removed without disrupting other ports.
   d. Integral cable tie mounts shall be included in panel for cable management on back of panel.
   e. Port and panels shall be easy to identify with write-on areas and optional label holder for color-coded labels.
   f. Rack mountable patch panels shall mount to standard 19 inches (480 mm) rack.
5. Grounding and Bonding:
   a. Provide Telecommunications Bonding Backbone:

1) Ground all telecommunications cable shields, equipment, racks, cabinets, raceways, and other associated hardware that has potential to act as current carrying conductor.
2) Install telecommunication Bonding Backbone independent of building's electrical and building ground.
3) Designed in accordance with recommendations contained in TIA-607 Telecommunications Bonding and Grounding Standard.

b. All wires used for telecommunications grounding purposes shall be identified with green insulation:
1) Non-insulated wires shall be identified at each termination point with wrap of green tape.
2) All cables and bus bars shall be identified and labeled as required.

6. Firestopping: Furnish and install firestopping as per Section 07 8400.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. Install communications system in accordance with Manufacturer's written instructions, and complying with applicable portions of NEC 'Standard of Installation'.

B. Work Area Outlets:
1. Cables shall be coiled in in-wall or surface-mount boxes if adequate space is present to house cable coil without exceeding Manufacturers bend radius.
a. No more than 12 inches (300 mm) of UTP slack shall be stored in in-wall box, modular furniture raceway, or insulated walls.
b. Excess slack shall be loosely configured and stored in ceiling above each drop location when there is not enough space present in outlet box to store slack cable.
2. Cables shall be dressed and terminated in accordance with TIA-568, Manufacturer's recommendations, and best industry practices.
3. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
4. Pair untwist at termination shall not exceed 0.125 inch (3.175 mm).
5. Bend radius of cable in termination area shall not be less than 4 times outside diameter of cable.
6. Cable jacket shall be maintained to within one inch (25 mm) of termination point.
7. Data / voice jacks, unless otherwise noted in Contract Documents, shall be located on each faceplate.
8. Horizontal Cabling:
a. Data jacks in horizontally oriented faceplates shall occupy rightmost position(s).
b. Voice jacks shall occupy the top position(s) on the faceplate. Voice jacks in horizontally oriented faceplates shall occupy the left-most position(s).

C. Horizontal Cross Connect:
1. Cables shall be dressed and terminated in accordance with TIA-568, Manufacturer's recommendations, and best industry practices.
2. Pair untwist at termination shall not exceed 0.125 inch (3.175 mm).
a. Bend radius of cable in termination area shall not be less than 4 times outside diameter of cable.
3. Cables shall be neatly bundled and dressed to their respective panels or blocks.
a. Each panel or block shall be fed by individual bundle separated and dressed back to point of cable entrance into rack or frame.
b. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
4. Cable jacket shall be maintained as close as possible to termination point.
5. Each cable shall be clearly labeled on cable jacket behind patch panel at location that can be viewed without removing bundle support ties.
a. Cables labeled within bundle, where label is obscured from view shall not be acceptable.
6. Horizontal Cabling:

a. A pull cord (nylon; 1/8 inch (3 mm) minimum) shall be co-installed with all cable installed in any conduit.
b. Cable raceways shall not be filled greater than required by TIA-569 maximum fill for particular raceway type.
c. Cables shall be installed in continuous lengths from origin to destination (no splices) except for transition points, or consolidation points.
d. Where transition points or consolidation points are allowed, they shall be located in accessible locations and housed in enclosure intended and suitable for purpose.
e. Cable's minimum bend radius and maximum pulling tension shall not be exceeded.
f. If J-hook or trapeze system is used to support cable bundles, all horizontal cables shall be supported at 48 inch (1 200 mm) to 60 inches (1 500 mm) maximum intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
g. Horizontal distribution cables shall be bundled in groups of no more than 25 cables. Cable bundle quantities in excess of 25 cables may cause deformation of bottom cables within bundle and degrade cable performance.
h. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
i. Cable shall be installed above fire-sprinkler systems and shall not be attached to system or any ancillary equipment or hardware. Cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
j. Cables shall not be attached to ceiling grid or lighting fixture wires. Where support for horizontal cable is required, install appropriate carriers to support cabling.
k. Cables shall be identified by self-adhesive label and meet requirements of TIA-606. Cable label shall be applied to cable behind faceplate on section of cable that can be accessed by removing cover plate.
l. Unshielded twisted pair cable shall be installed so that there are no bends smaller than four times the cable outside diameter at any point in run and at termination field.
m. Pulling tension on 4-pair UTP cables shall not exceed 25 lbf (111 N) for a four-pair UTP cable.

D. Vertical Outlet Pole And Surface Raceway:
1. Horizontal Cabling:
a. General:
1) Vertical outlet poles and Surface Raceway refers to surface raceway system used for branch circuit wiring and/or data network, voice, video and other low-voltage cabling. Surface raceway shall be used in solid wall applications or for applications where moves, additions and changes are very typical to workflow.
b. Raceway system shall consist of raceway, appropriate fittings and accessories to complete installation per electrical Contract Documents. Non-metallic surface raceway is to be utilized in dry interior locations only as covered in Article 352, part B of the NEC, as adopted by the NFPA and as approved by the ANSI.

E. Copper Termination Hardware:
1. Cables shall be dressed and terminated in accordance with TIA-568, Manufacturer's recommendations, and best industry practices.
2. Pair untwist at termination shall not exceed 0.125 inch (3.175 mm).
a. Bend radius of cable in termination area shall not be less than 4 times outside diameter of cable.
3. Cables shall be neatly bundled and dressed to their respective panels or blocks.
a. Each panel or block shall be fed by individual bundle separated and dressed back to point of cable entrance into rack or frame.
b. Cables shall be bundled using Velcro straps at least 0.25 inch (6.35 mm) wide. Use of plastic wire ties or zip ties is not allowed on project.
4. Cable jacket shall be maintained as close as possible to termination point.
5. Each cable shall be clearly labeled on cable jacket behind patch panel at location that can be viewed without removing bundle Velcro support straps.
a. Cables labeled within bundle, where label is obscured from view shall not be acceptable.

F. Grounding System:
1. Where required, Telecommunications Bonding Backbone shall be designed and/or approved by qualified Installer.
2. Follow requirements of TIA-607.

G. Seismic Bracing:
1. Comply with IBC and local seismic requirements for all equipment and conduit pathways.

H. Identification and Labeling:
1. Apply machine generated approved labeling for racks, cables, panels and outlets:
a. Designate cables origin and destination and unique identifier for cable by room name and/or number and port count.
b. Racks and patch panels shall be labeled to identify location within cable system infrastructure.
2. Place labeling within view at termination point on each end.
3. Outlet, patch panel and wiring block labels shall be installed on, or in, space provided on device.
4. See Contract Drawings for labeling scheme.
5. Conform to IP addressing assignments as listed in Attachment 'FACILITIES ZONE IP ADDRESS ASSIGNEMENT TABLE'.

a. See Attachment 'FACILITIES ZONE IP ADDRESS ASSIGNEMENT TABLE' for 'IP Address Assignments.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
1. Provide testing upon completion of installation.
a. General:
1) Testing to be in accordance with TIA standards and Manufacturer's system warranty guidelines and best industry practice.
a) If any of these are in conflict, discrepancies shall be brought to attention of Architect/Consulting Engineer for clarification and resolution.
b. Cables and termination hardware:
1) Test complete system for defects in installation.
2) Verify cabling system performance under installed conditions according to requirements of TIA-568:
a) All pairs of each installed cable shall be verified prior to system acceptance.
b) Any defect in cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure one hundred (100) percent useable conductors in all cables installed.
c. Copper channel testing:
1) All twisted-pair copper cable links shall be tested for compliance to requirements of TIA-568 for appropriate Category of cabling installed.
2) Backbone multimode fiber cabling shall be tested at both 850 nm and 1300 nm.
d. UTP Cables and Links testing:
1) UTP cabling channel must be tested at swept frequencies up to 250 MHz for internal channel performance parameters as defined in IEEE 802.3 and TIA-568. Certifications shall include following parameters for each pair of each cable installed:
a) Wire map (pin to pin connectivity).
b) Length (in feet or millimeters).
c) Near End Crosstalk (NEXT).
d) Far End Crosstalk (FEXT).
e) ELFEXT.
f) Attenuation/Crosstalk Ration (ACR).
g) Return Loss.
h) Propagation Delay.
i) Delay Skew.
j) Test equipment shall provide electronic and printed record of these tests.
2) Test each pair of cable for opens, shorts, grounds, and pair reversal.
a) Correct short or grounded and reversed pairs.
b) Examine open and shorted pairs to determine if problem is caused by improper termination.
c) If termination is proper, tag bad pairs at both ends and note on termination sheets.
d) If horizontal cable contains bad conductors, remove and replace cable.
e. Testing Equipment:
1) Comply with requirements of TIA-568.
a) Appropriate level III tester shall be used to verify Category 6 cabling systems.
2) UTP Cables and Links test equipment:

a) Category Four Approved Testing Equipment. See Section 01 6200 for definitions of Categories:
(1) Fluke Networks DTX-1800 with firmware version 2.04 or later.
(a) Test lead to be P/N DTX-PLA001 or PLA002 universal permanent link interface adapter.
(2) Agilent Wirescope Pro N2640A with firmware version 2.1.9 or later.
(a) Test lead to be P/N N2644A-101 universal CAT6A link smart probes.

f. Re-Testing:
1) Consulting Engineer may request ten (10) percent random field re-test to be conducted on cable system, at no additional cost to Owner, to verify documented findings.
a) Tests shall be repeat of those defined above.
b) If findings contradict documentation submitted, additional testing can be requested to extent determined necessary by Consulting Engineer, including one hundred (100) percent re-test at no additional cost to Owner.

g. Tests And Evaluation Reports:
1) Printouts generated for each cable by wire test instrument shall be submitted as part of documentation package. Installer may furnish this information in electronic form.
a) Media shall contain electronic equivalent of test results as defined by the Section along with software necessary to view and evaluate test reports.
2) Submit documentation within ten (10) working days of completion of each testing phase. This is inclusive of all test results and record drawings.
3) Draft drawings may include annotations done by hand. Final copies of all drawings shall be submitted within thirty (30) working days of completion of each testing phase.
4) If requested by Consulting Engineer, provide copies of original test results.

h. Test Documentation:
1) Provide electronic format documentation within three (3) weeks after completion of project.
2) Documentation shall be clearly marked on outside front cover with following:
a) "Project Test Documentation".
b) Project name.
c) Date of completion (month and year).
3) Test results shall include following:
a) Record of test frequencies.
b) Cable type.
c) Conductor pair and cable (or outlet) I.D.
d) Measurement direction.
e) Reference setup.
f) Crew member name(s).
g) Test equipment name, manufacturer, model number, serial number, software version.
h) Last calibration date:
(1) Unless Manufacturer specifies more frequent calibration cycle, annual calibration cycle is required on all test equipment used on project.
(2) Document shall detail test method used and specific settings of equipment during test as well as software version being used in field test equipment.

B. Non-Conforming Work: Non-conforming work as covered in General Conditions applies, but is not limited to following:
1. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced at no additional cost to Owner.
2. Any defect in cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure one hundred (100) percent useable conductors in all cables installed at no additional cost to Owner.
3. Correct deviation and repeat applicable testing at no additional cost to Owner.
4. Correct any work found defective or not complying with Association Publications and TDMM requirements at no additional cost to Owner.
a. Document all problems found and corrective action taken.
b. Include both failed and passed test data.

END OF SECTION

SECTION 27 5117 – AUDIO SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install complete and operational sound system as described in Contract Documents including:
      a. Complete systems for amplifying sound signals from media source equipment and distributing them to loudspeakers at various locations.
   2. Assist Audiovisual Consultant with final inspection and equalization of system and provide necessary test equipment for audio system and partition noise isolation tests if applicable. Correct problems found at time of final inspection of system.

B. Related Requirements:
   1. Division 26 'Electrical':
      a. Raceway, boxes, and installation of speaker enclosures and mounting rings furnished by Division 27.
      b. Power to equipment location and power relay wiring if applicable.
   2. Section 27 1116: 'Communications Cabinet, Racks, Frames, and Enclosures'.
   3. Section 27 1501: 'Communications Horizontal Cabling'.
   4. Audiovisual Consultant will perform final inspection, system balance, and instruct CES personnel in operation of system.

C. Related Requirements:
   1. Section 01 6400: This Section establishes quality of materials and installation for information of Contractor, Architect, and Owner's Representatives.

1.2 REFERENCES

A. Association Publications:
   1. Building Industry Consulting Service International (BISCI):
      a. *Information Transport Systems Installation Methods Manual* (ITSIMM) (5th Edition).
      b. *Telecommunications Distribution Methods Manual* (TDMM) (12th Edition).
   2. InfoComm International Association:
      a. *Audiovisual Best Practices: The Design & Integration Process for the AV and Construction Industries*.
      b. *AV Design Reference Manual* (1st Edition, 2006).
      c. *Basics of Audio and Visual Systems Design* (2003).
   3. Institute of Electrical and Electronics Engineers:
      a. IEEE 1100-2005, '*Recommended Practice for Powering and Grounding Electric Equipment*'.

B. Reference Standards:
   1. American National Standards Institute/InfoComm International Association:
      a. ANSI/INFOCOMM 1M:2009, 'Audio Coverage Uniformity in Enclosed Listener Areas'.
      b. ANSI/INFOCOMM 2M:2010, 'Standard Guide for Audiovisual Systems Design and Coordination Processes'.
      c. ANSI/INFOCOMM 4:2012, 'Audiovisual Systems Energy Management'.
   2. National Fire Protection Association:
      a. NFPA 70, 'National Electrical Code (NEC)' (2017 or most recent edition adopted by AHJ).
      b. NFPA 72, 'National Fire Alarm and Signaling Code' (2019 or most recent edition adopted by AHJ).
   3. Telecommunications Industry Association:
      a. TIA-568.2, 'Balanced Twisted-Pair Telecommunications Cabling and Components Standards' (Revision D, 2018).
      b. TIA-569, 'Telecommunications Pathways And Spaces' (Revision D, 2015).
      c. TIA-606, 'Administration Standard for Telecommunications Infrastructure' (Revision C, 2017).
      d. TIA-607, 'Telecommunications Bonding and Grounding (Earthling) for Customer Premises' (Revision C, 2015).
      e. TIA-758, 'Customer-Owned Outside Plant Telecommunication Infrastructure Standard' (Revision B, 2012).
   4. Underwriters Laboratories (UL):

a. UL 486A-486B, 'Wire Connectors' (3rd Edition April 2018).

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate final inspection schedule of both audio and video systems before Audiovisual Consultant's final inspection.

B. Schedule:
1. After completion of audio system installation of this section, Installer to perform Field Testing before Audiovisual Consultant Final Inspection of audio system.
2. Notify Audiovisual Consultant two (2) weeks minimum before Audiovisual Consultant's final inspection as specified in Field Quality Control in Part 3 of this specification.

1.4 SUBMITTALS

A. Informational Submittals:
1. Special Procedure Submittals:
a. Provide itemized list of equipment to be supplied.
b. Provide proposed labeling for system components.
2. Qualification Statement:
a. Installer:
1) Provide Qualification documentation as requested by Engineer/Architect including:
a) List of Projects requested.
b) List of certified technician(s) with dates of training courses completed.

B. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data:
1) Equipment Manufacture's manual:
a) Audio system operation and maintenance instructions.
b) List of equipment provided, including portable equipment, showing make, model, and serial number.
b. Warranty Documentation:
1) Include copy of final, executed warranty.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. System shall be installed in accordance with applicable standards, requirements, and recommendations of International Building Code, National Electrical Code and all local authorities having jurisdiction.

B. Qualifications:
1. Installer. Requirements of Section 01 4301 applies, but not limited to following:
a. Approved Installers:
1) Installers are to furnish and install components of audio system and meet qualification requirements.
2) Approval subject to agreement process for Pre-Approval Installers.
b. Alternate Installer(s):
1) Firm specializing in performing work of this section:
a) Minimum three (3) years of successful installation experience of AV system projects of comparable size, and complexity required for this project. Audio systems must have included complete installation and setup work and must have been completed by factory trained and certified technician.
b) Firm successfully completed minimum of three (3) projects in past two (2) years before bidding.
c) Firms must have certified technician that has successfully completed all relevant training courses recommended by manufacturers and proficient of all specified equipment of this section.

d) Comply with specifications and Contract Documents.

2) Submit documentation of compliance of qualifications before bid to Architect or Owner's Representative.

c. Same Approved Installer shall furnish and install components of Section 27 1116 'Communications Cabinets, Racks, Frames and Enclosures' and Section 27 4117 'Video Systems'.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Materials shall be delivered in original, unopened packages with labels intact.

B. Storage And Handling Requirements:
1. Provide secure location protected from weather in cool, dry location, out of direct sunlight in compliance with Manufacturer's instructions and recommendations.
2. Keep materials free from dirt and foreign matter.

1.7 WARRANTY

A. Special Warranty:
1. Provide complete warranty repair or replacement for one (1) year at no cost to Owner, except in case of obvious abuse.
2. If failure causes audio system to be inoperative or unusable for its intended purpose, Installer, when notified of problem shall repair system within five (5) days so it will be operational and usable. If defective components cannot be repaired in time, furnish and install temporary loaner equipment as required.
3. Honor component warranties for term established by Manufacturer, if greater than one (1) year.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers Contact List:
1. Category Four components as shown on Drawings from following Manufacturers. See Section 01 6200 for definition of Categories.
a. Atlas Sound, Phoenix, AZ www.atlassound.com.
b. Belden Wire & Cable Co, Richmond, IN www.belden.com.
c. Community Professional Loudspeakers, Chester, PA www.communitypro.com.
d. Emtech Electronics Inc, Orem, UT www.emtechelectronics.com.
e. Extron, Anaheim, CA www.extron.com.
f. Hubbell Inc, Orange, CT www.hubbell-wiring.com.
g. Leviton Manufacturing Co, Little Neck, NY www.leviton.com.
h. Liberty AV Solutions, Colorado Springs, CO www.libertycable.com.
i. Middle Atlantic Products, Fairfield, NJ www.middleatlantic.com.
j. Radio Design Labs, Carpenteria, CA www.rdlnet.com.
k. TOA Electronics, South San Francisco, CA www.toaelectronics.com.

B. Performance:
1. Capabilities:
a. No noise, hum, RFI pickup or distortion shall be audible under normal operating conditions.
b. Audio systems shall reproduce program material at level of 80 to 85 dBA without audible distortion.
c. All input levels shall be pre-set so system may be operated without going into feedback under normal conditions.

C. System Requirements:
1. General:

a. Provide complete and fully functional audio systems using materials and equipment of types, sizes, ratings, and performances as indicated in equipment list in accompanying drawings:
   1) Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information.
   2) Coordinate features of materials and equipment so they form integrated system with components and interconnections matched for optimum performance of specified functions.

2. Provide all wire, cable, and connectors as required to complete installation of all systems as designed and specified.

D. Equipment And Materials:
1. General:
   a. Provide equipment selected from equipment list on drawings, or as substituted following proscribed substitution process, using all solid state components fully rated for continuous duty at ratings indicated or specified.
   b. Select equipment for normal operation on input power supplied at 105 130 V, 60 Hz.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Installers:
1. Category Four Approved Installers. See Section 01 6200 for definitions of Categories:
   a. Qualifications:
      1) Meet qualification requirements as specified in Quality Assurance in Part 1 of this specification.
   b. General Communications: (801) 266-5731.
   c. Marshall Industries: (801) 266-2428.

3.2 EXAMINATION

A. Verification Of Conditions:
1. Verify compliance with following items before beginning work of this Section:
   a. No cables spliced.
   b. Isolated ground run back to electrical panel from all equipment cabinets.
   c. Specified conduit, cables, speaker enclosures and equipment cabinets are properly installed.
   d. Location and angle of speaker cabinets.
2. Ensure that no solid structural or decorative member impedes sound propagation from speakers and that no member with cross section greater than 3/4 inch (19 mm) is placed in front of speakers.
3. Verify installation of fiberglass insulation in field-fabricated speaker enclosures.

3.3 INSTALLATION

A. General:
1. Install system in accordance with NFPA 70 'National Electrical Code', NFPA 72 'National Fire Alarm and Signaling', and other applicable codes. Install equipment in accordance with manufacturer's written instructions.

B. Mounting And Securing Equipment:
1. Equipment shall be firmly secured in place unless requirements of portability dictate otherwise.
2. Fastenings and supports shall be adequate to support their loads with safety factor of at least three (3) times weight of equipment being installed.
3. Any structural mounting that is not able to meet this requirement due to specific nature of equipment, manufacturer's requirements or limitations of facility, shall not be installed without prior approval of Engineer.
4. Install all boxes, equipment, hardware, and other materials plumb, level, and square.

C. Millwork:

1. Install technology equipment and support equipment in podium and other millwork in neat and cosmetically dressed out manner.
2. Saw cuts, holes and recesses into laminates and woodwork shall be straight.
3. Radius and circular cuts shall be consistent, and all uneven surfaces shall be corrected. This shall include use of moldings, grommets, bushings, laminates, and wood products as required to dress out installation of equipment.
4. Install equipment and panels in technology racks and podiums using matching screws, hardware and grommets.

D. Speakers:
1. Maintain uniform polarity in speakers and wiring.
2. Employ no positive stop in rotation of speaker volume controls. Controls shall be capable of continuous rotations in either direction.
3. Mount transformers with screws securely to speaker brackets or enclosures. Adjust torsion springs as necessary to securely support speaker assembly.
4. Neatly mount speaker grilles, panels, connector plates, control panels, etc., tight, plumb, and square unless indicated otherwise on drawings.
5. Provide brackets, screws, adapters, springs, rack mounting kits, etc, recommended by manufacturer for correct assembly and installation of speaker assemblies and electronic components.
6. Line factory-fabricated speaker back boxes with one inch (25 mm) minimum fiberglass if not done by Back box Manufacturer.
7. Speaker Back Boxes shall be secured to structure using 12 ga (2.7 mm) minimum seismic safety cables.

E. Technology:
1. Provide sufficient ventilation for adequate cooling of equipment.
2. Install vent rack panels in unused spaces. Install vent panels at top and bottom and above each power amplifier.
3. Securely fasten equipment plumb and square in place. Where equipment is installed in rack cabinets, utilize all fastening holes and cove open spaces with perforated panels.
4. Securely fasten relays and small components. Do not use sticky-back tape for fasteners.
5. Install balancing transformer on each unbalanced input or output that connects to devices outside equipment cabinet, or that connects to balanced input or output within equipment cabinet.
6. Connect powered components to 120 VAC outlets on transient voltage surge suppressors. Do not connect to outlets on other components.
7. Leave sufficient service loops to uniform length on cables to allow operation of system with chassis outside cabinet.
8. Equipment shall be held firmly in place with proper types of mounting hardware as recommended and/or supplied by manufacturer:
    a. Mounting hardware provided with equipment shall be used when practical. This shall include, but not be limited to, front and rear rack rails, angle brackets and rack mount kits.
    b. Equipment shall be installed so as to provide reasonable safety to operator.

F. Cables, Wires, And Connectors:
1. Cables:
    a. Cable and wire shall be new and unspliced.
    b. Splicing:
        1) Splicing of cables and conductors is expressly prohibited in any location other than equipment racks.
        2) Splicing of control and speaker level conductors shall be accomplished via punch block or terminal strip connections only.
    c. Additional cable length shall be provided at all connector locations. Duplex box, junction box, and floor box locations shall be installed with sufficient cable length behind cover plates to permit wiring maintenance and connector replacement in the future.
    d. When cable runs utilize vertical cable raceways located within walls, acoustic integrity of walls shall be maintained:
        1) Cables that pass-through cover plates of junction boxes and raceways, through slab-to-slab walls, and through conduit lines shall be properly gasketted and sealed. Acoustic material shall be restored or replaced.
    e. Separation between system cables and other services shall be maximized to prevent and/or minimize potential for electro-magnetic interference (EMI):
        1) Provide at least 12 inches (305 mm) separation from electrical lines whenever feasible.
        2) Where separation is unavoidable, distribution cables shall cross other services at right angles whenever practical to minimize EMI.

f. Do not install signal cables on top of light fixtures, ceiling speakers, projection screens, HVAC controls or sensing devices, fire safety and sprinkler system detection technology, or any other technology or mechanical equipment.
g. Do not lay cables directly on top of T-bar grid ceiling tiles:
    1) Support cables installed outside of conduit at 4 feet (1.20 m) maximum intervals from building structure.
    2) Do not utilize support wires from other trades or systems.
h. Install system cables shall not block access to other equipment or services, across removable service panels and/or in any other manner to prohibit routine maintenance of HVAC systems, fire safety equipment and building mechanical control systems.
i. Inter-rack cabling:
    1) Inter-rack cabling shall be neatly laced, dressed, strain relieved and adequately supported.
    2) Inter-rack cables shall be grouped according to signals being carried to reduce signal contamination. Separate groups shall be formed for following:
        a) Power.
        b) Control.
        c) Video.
        d) Audio cables carrying signals less than -20 dBM.
        e) Audio cables carrying signals between -20 dBM and +20 dBM.
        f) Audio cables carrying signals over +20 dBM.
j. Power cables, control cables, and high-level cables shall be run on left side of equipment racks as viewed from rear. All other cables shall be run on right side of all equipment racks as viewed from rear.
k. Cables, except video cables which must be cut to electrical length, shall be cut to length dictated by cable run.
l. Terminal blocks, boards, strips or connectors, shall be furnished by installer for all cables which interface with racks, cabinets, consoles, or equipment modules. Affix terminal blocks, boards, strips or connectors to equipment racks using screws only. Double sided tape will not be accepted.
m. Shields for audio cables shall be grounded at input end only of various equipment items on system to prevent potential for ground loops.
n. Shields for microphone cables shall be grounded at both ends to allow Phantom Power to pass.
o. Where AV cable is installed in areas that are exposed to view of end users, install AV cable and associated power cables inside nylon braided sleeving (wire loom):
    1) Examples of such areas include, but are not limited to cables installed to projectors and monitors, and cables installed to devices in/on lecterns such as touch panels and document cameras.
    2) Where security cables are specified for physical security to such devices, install the specified security cables inside nylon braided sleeving along with AV cables.

2. Wiring and Cabling:
    a. Comply with industry standard circuit polarity and loudspeaker wiring polarity. No cables shall be terminated with polarity reversal between connectors at either end.
    b. System wire, after being cut and stripped, shall have wire strands twisted back to their original lay and be terminated by approved soldered or mechanical means. No bare wire ends shall be accepted.
    c. Do not place any wires and cables for this system in any conduit, raceway, wire way or cable tray that is used for mechanical systems of building.
    d. Route all cable and wiring within equipment racks, cabinets and millwork according to function, separating wires of different signal levels (microphone, line level, amplifier output, AV, control, etc.) by as much distance as possible. Neatly arrange, harness and bundle all cable with velcro straps.
    e. After completion of wiring and cable installation, all trough and box covers shall be notched out and grommetted for clearance of various cable bundles, (i.e., separate audio, video, and control). Panel covers shall be screwed back in place and all gaskets shall be restored or replaced.
3. Connectors:
    a. Provide connectors of type and quality as detailed in Contract Drawings and/or as required to meet minimum bandwidth requirements of equipment to which connectors are terminated. Overall quantity of connectors shall not be limited by quantities indicated in Contract Drawings and shall be provided as required.
    b. No connectors shall be installed in non-accessible locations or used for splicing cables. Connectors shall be new.
    c. Connectors shall incorporate strain relief mechanisms which firmly grip the jacket of connected cables.
    d. Connectors shall be properly polarized to prevent improper seating.
    e. Connectors shall provide appropriate electrical characteristics for circuitry to which they are attached.
    f. Exposed conductors inside of equipment racks shall be dressed with heavy duty neoprene heat-shrink tubing.

g. Heat-shrink type tubing shall be used to insulate and dress ends of all wire and cables including separate tube for ground or drain wire.
h. Solder connections shall be made with rosin-core solder. Temperature controlled soldering irons rated at least 60 watts shall be used for all soldering work. No soldering guns, gas or butane, or temperature unregulated irons shall be used on job site.
i. Mechanical connections shall be made with approved crimp lugs of correct size and type for connection. Wire nuts shall not be permitted except inside speaker enclosures. Each connector shall be attached with proper size controlled-duty-cycle ratcheting crimp tool approved by manufacturer.
j. Conventional non-ratcheting type crimping tools are unacceptable, and shall not be used on job site. Presence of such tools on job site shall constitute evidence of mechanical connections made with unauthorized tools and shall provide sufficient grounds for rejection of all mechanical connections in system, and will be considered non-conforming work.

G. Equipment Cabinet:
1. Install vent panels at top and bottom of equipment cabinets and between components where possible for maximum ventilation. Locate amplifiers at top of cabinet. Locate equalizers below amplifiers, separated by several vent panels.
2. Securely fasten equipment plumb and square in place. Utilize all fastening holes in front of cabinet.
3. Securely fasten in place equipment that is not rack mounted, including relays and other small components. Do not use sticky-back tape.
4. Install balancing / isolation transformer when balanced and unbalanced components are connected.
5. Wire XLR-type connections with pin 2 hot, pin 1 shield.
6. Connect powered components to 120 VAC outlets on voltage suppressor power bars. Do not connect to outlets on other components.
7. Identification:
a. Legibly identify user-operated system controls and system input / output jacks using engraved, permanently attached laminated plastic plates or imprinted Lexan labels. Label equipment and controls within equipment cabinets using similar labels or printed labels from a label maker or laser printer.
b. Affix label to rack panel inside cabinet listing name and telephone number of installer. Appropriate warranty instructions may be included.

H. Identification And Labeling:
1. Cables, regardless of length, shall be identified with machine-printed wrap-around labeling system at both ends:
a. These labels shall be self-laminating to ensure durability.
b. Label format used shall be equal, or better than, system detailed.
2. There shall be no unmarked cables any place in system.
3. Marking codes used on cables shall correspond to codes provided with submittals, and/or written documentation of 'Record Drawings'.
4. Connectors, controls, equipment components, terminal blocks and equipment racks are to be permanently labeled in format approved during submittal process.
5. Equipment labels are to be permanently engraved in metal. Alternative method shall be approved during submittal process only.
6. Clearly and permanently label all jacks, controls, connections, and so forth. Embossed or printed label tape shall not be used and is considered unacceptable for this system. Attach labels with double stick tape as required.
7. Labeling shall be completed prior to acceptance of final system.

I. Grounding:
1. Provide equipment grounding connections for audio system as indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A-486B to assure permanent and effective grounds.
2. Ground equipment, conductor, and cable shields to eliminate shock hazard and to eliminate ground loops, common mode returns, noise pickup, cross talk, and other impairments. Provide 5 ohm ground at main equipment location. Measure, record, and report ground resistance.
3. Provide grounding conductor with green insulation between as indicated on Contract Drawings. Comply with IEEE and TIA standards.

J. Seismic Bracing:
1. Comply with IBC and local seismic requirements for all equipment and conduit pathways.

3.4 FIELD QUALITY CONTROL

A. Field Tests:
   1. Installer Testing:
      a. After completion of installation but before inspection by Audiovisual Consultant, perform following:
         1) Conduct system tests and make necessary corrections for proper system operation including, but not limited to, following:
            a) Output level uniformity.
            b) Polarity.
            c) Shock, strain excited hum, and oscillation.
            d) Clipping, hum, noise, and RFI in all system configurations.
            e) Speaker line impedances.
            f) Loose parts and poor workmanship or soldering.
         2) Sweep speaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to speakers or enclosures. Notify Contractor and Audiovisual Consultant of external causes of buzzes or rattles.
         3) Rough Balance: Balance system well enough that it can be used for meetings before final inspection.
      b. Complete documentation required by Audiovisual Consultant and submit to consultant within five (5) days of Substantial Completion.

B. Field Inspections:
   1. Audiovisual Consultant Inspection And Equalization:
      a. Coordinate final inspection schedule with Audiovisual Consultant two (2) weeks minimum before Consultant's final inspection.
      b. Have copy of Installer redlined documents sent to Audiovisual Consultant two (2) weeks minimum to before field inspection.
      c. Have loose equipment (microphones, cables, etc.) available at time of inspection.
      d. Assist Audiovisual Consultant in final inspection of completed system.
      e. Assist Audiovisual Consultant in noise isolation testing of folding partitions and office doors.
      f. Provide following test equipment in good working order:
         1) Laptop computer:
            a) Operating System: Microsoft Window 7.
            b) Processor: 2 GHz Dual-Core Intel Processor or faster (or compatible).
            c) RAM: 2 GB or greater.
            d) Video: Graphics processor with 128 M dedicated video RAM, minimum 1024x768 display or better.
            e) Sound Hardware: Audio Hardware with OS compatible ASIO, Wav/WDB drivers, sample rate of up to 192kHz and bit-resolutions of up to 32. Bit,or better.
         2) 1/3 octave real-time audio spectrum analyzer with SPL meter, and precision microphone.
         3) Digitally generated random pink noise generator, 20Hz-20KHz, minimum two (2) hour repetition rate or ten (10) minutes minimum of equivalent signal recorded on compact disc.
         4) Direct reading audio impedance meter, minimum three (3) frequencies, and ten (10) percent accuracy.
         5) Digital Volt-Ohmmeter.
         6) Audio oscillator, variable frequency, 20Hz-20KHz.
         7) MP3 player with pre-recorded speech and music program material.
         8) Necessary chargers, cables, test leads, adapters, and other accessories for test equipment.
         9) Tools and spare parts for making adjustments and corrections to system.
         10) CAT-5 / RJ-45 continuity tester similar to Ideal 62-200 or Amprobe DCT-300.
      g. Correct minor items so Audiovisual Consultant may certify satisfactory completion during his visit.

C. Non-Conforming Work:
   1. Correct any work found defective or not complying with contract document requirements at no additional cost to the Owner.

D. Manufacturer Services:
   1. Provide services of factory authorized service representative to supervise field assembly and connection of components and pretesting, testing, and adjustment of system.

3.5 CLEANING

A. Waste Management:
   1. All work areas are to be kept clean, clear and free of debris at all times.
   2. Disposal of rubbish, debris, and packaging materials to Contractor provided Dumpster.

END OF SECTION

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 3101 Fire Detection and Alarm System

SECTION 28 3101 – FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install fire alarm and detection system as described in Contract Documents.
   2. Furnish and install raceway, cable and conductors, boxes, and miscellaneous items necessary for complete system.

B. Products Furnished But Not Installed Under This Section:
   1. Door Plates for door hold / release devices.

C. Related Requirements:
   1. Division 21: Furnishing and installing of water flow switches, post indicating valves, valve tamper switches, and low air pressure switch.
   2. Section 23 0933: Furnishing and installing of duct smoke detectors in main return air ducts.
   3. Division 26: Quality of and installation standards for wiring, raceway, conduit, and boxes.

1.2 REFERENCES

A. Reference Standards:
   1. National Fire Protection Association:
      a. NFPA 72, 'National Fire Alarm and Signaling Code' (2019 or most recent edition adopted by AHJ).
   2. Underwriters Laboratories:
      a. UL 268, 'Smoke Detectors for Fire Alarm Systems'.
      b. UL 464, 'Audible Signal Appliances'.
      c. UL 521, 'Heat Detectors for Fire Protective Signaling Systems'.
      d. UL 864, 'Control Units and Accessories for Fire Alarm Systems'.
      e. UL 1480, 'Speakers for Fire Alarm, Emergency, and Commercial and Professional'.
      f. UL 1481, 'Power Supplies for Fire-Protective Signaling Systems'.
      g. UL 1971, 'Standard for Signaling Devices for the Hearing Impaired'.

1.3 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Prepared by authorized factory representative and including:
         1) Single line diagram of actual system. Typical riser diagrams are not acceptable.
         2) Complete wiring diagrams.
         3) Manufacturer's original catalog data and descriptive information on each piece of equipment to be used.

B. Informational Submittals:
   1. Certificates:
      a. Certificate of completion, from Manufacturer's Representative, in accordance with NFPA 72 requirements.
   2. Qualification Statement:
      a. Installer:

1) Provide NICET Certification documentation.

C. Closeout Submittals:
1. Include following information in Operations And Maintenance Manual specified in Section 01 7800:
a. Operations and Maintenance Data:
1) Provide operating and maintenance instructions for each item of equipment submitted under Product Data.
2) Provide instruction manual from Manufacturer that explains what is to be done in event of various indications.
b. Record Documentation:
1) Include copy of approved shop drawings.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. System shall meet approval of authority having jurisdiction (AHJ). NEC and local ordinances and regulations shall govern unless more stringent requirements are specified.
2. Equipment, devices, and cable shall be UL or Factory Mutual listed for use in fire alarm systems.

B. Qualifications:
1. Installer:
a. Project Forman or Person in Charge at all times to be NICET Level III Certified for work performed by this Section.
b. Provide Certificate documentation before installation.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Manufacturers:
1. Type One Acceptable Manufacturers:
a. Autocall, Milwaukee, WI www.autocall.com.
b. Fire-Lite Alarms, Northford, CT www.firelite.com.
c. Mircom / Summit Systems Technologies, Cheektowaga (Buffalo), NY, Vaughan (Toronto), Ontario www.mircom.com / www.summit-st.net.
d. Potter Electric Signal Company, St. Louis, MO www.pottersignal.com.
e. Silent Knight Security Systems, Northford CT www.silentknight.com.
f. Equal as approved by Architect before bidding. See Section 01 6200.

B. Performance:
1. Design Criteria:
a. Automatic fire alarm system consisting of control panel, power supplies, alarm initiating devices, notification appliances, and off-site communicating devices. System shall be non-coded and addressable, and monitored for integrity of conductors.
b. Class A loop type initiating device circuits and Class A loop type notification appliance circuits.
c. Class B initiating device circuits and Class B notification appliance circuits including end-of-line devices.
d. Equipment and accessories furnished under this Specification shall be standard products of single manufacturer, or include written statement by Control Panel Manufacturer confirming compatibility of components and inclusion of these components under system warranty.

C. Operation:

1. Operation Sequences:
    a. Operation of manual station or automatic activation of any smoke detector, heat detector, or sprinkler flow device shall:
        1) Cause system notification appliances to operate.
        2) Indicate zone in alarm on control panel.
        3) Initiate off-site alarm notification system.
        4) Indicate zone or device in alarm on remote annunciator.
    b. System shall return to normal when operated device is returned to normal and control panel is manually reset, except alarms may be silenced as specified below.
    c. Alarm may be silenced by switch in control panel.
        1) Ring Back Feature: When silenced, this shall not prevent the resounding of subsequent alarms if another zone should alarm.
    d. When alarms are silenced, zone indicating red LEDs on control panel and remote annunciator shall remain indicated until operated device is returned to normal and control panel is manually reset.
    e. Green pilot LED, or other visual annunciation, shall normally be on indicating that system is receiving normal power. In addition, failure of normal power shall be annunciated.
    f. Trouble alarm and annunciation, operating together, shall signal trouble condition. Following conditions shall signal trouble condition:
        1) Failure of normal power.
        2) Opens or short circuits on indicating circuits.
        3) Disarrangements in system wiring.
        4) Control panel circuit board removal.
        5) Ground faults.
        6) Trouble silencing switch shall silence trouble alarm, but visual annunciation shall remain on until system is restored to normal. As ring-back feature, trouble alarm shall resound as reminder to return silencing switch to normal position.
    g. Supervisory LED, separate from trouble LED, and alarm, operating together, shall signal operation of supervisory device, such as control valve tamper, low air pressure, and low temperature switches. Alarm silence switch shall operate in same manner as trouble alarm.

D. Components:
1. Control Panel:
    a. Listed under UL Standard 864.
    b. Solid-state design with flush or semi-flush mounting.
    c. Control functions shall be behind locked door with annunciating devices visible through door. Single key shall operate all keyed functions in system. Provide three keys.
    d. Each zone shall be electrically supervised in accordance with wiring style specified.
    e. Provide integral surge protection.
    f. Make provisions for connection to off-site alarm notification system including all required programming. Provide separate dry contacts for alarm and supervisory/trouble alarms.
    g. Power Supply:
        1) Provide indication of normal power supply.
        2) Loss of normal power shall activate trouble alarm.
        3) Meet requirements of and size in accordance with UL Standard 1481 and NFPA 72.
        4) Include standby batteries, charger, and automatic transfer equipment.
    h. Visual Annunciation:
        1) Separate indication on each zone for alarm, trouble, or supervisory conditions.
        2) Visual indication shall be by LED lights or other easily identifiable method.
        3) On zoned system, permanently custom label zones by zone name, not number.
        4) Fault or trouble condition on any zone shall not affect any other zone.
    i. Audible Voice Alarm Annunciation:
        1) Alarm signal shall be annunciated by audible voice evacuation message. Message shall be digitally recorded with message content meeting requirements of local code authority. Message shall be field programmable and retained in memory if power is interrupted.
        2) Output level shall be adjustable at control panel.
        3) Alarm signal shall also operate strobe lights, if specified.

4) Provide alarm silence switches at control panel.
5) Trouble alarm shall be horn integral to control panel.
6) Supervisory alarm may be same audible alarm as trouble alarm, but with separate visual annunciation.

2. Off-Site Alarm Notification System:
   a. Provide one (1) analog telephone lines to fire alarm control panel.
   b. Install, program and connect cellular communication device furnished by Owner. Coordinate with Owner at least four (4) weeks in advance for equipment delivery.
   c. Provide dialer system equipment and programming compatible with Owner selected monitoring service (refer to alarm.ldschurch.org for details).
   d. Owner will arrange for monitoring connection contract.
   e. Communicator device shall transmit all zone identification, device identification alarm identification, and all other signals available at panel to Owner's Central Station using standard contact ID codes.
   f. Phone Dialer device shall be of same manufacturer as Fire Alarm Panel or shall be supplied, approved and tested by Fire Alarm Panel Manufacturer.
3. Alarm Initiating Devices:
   a. Smoke Detectors:
      1) Photoelectric type.
      2) Listed under UL Standard 268.
      3) Provide visual indication of alarm on unit.
   b. Duct Smoke Detectors:
      1) Furnished and Installed by Division 23.
      2) Power provided by Division 26.
      3) Connect to Fire Detection And Alarm System by this Section.
   c. Heat Detectors:
      1) Non-settable 135 deg F (57 deg C) fixed temperature.
      2) Provide visible indication that device has operated.
      3) Listed under UL Standard 521.
   d. Low Building Temperature Device:
      1) Set for contact closure at 35 deg F (2 deg C).
      2) Type Two Acceptable Products;
         a) Honeywell T631A1006.
         b) Equal as approved by Architect before installation. See Section 01 6200.
   e. Manual Fire Alarm Boxes:
      1) Non-coded and double-action requiring two actions to initiate alarm. Breakable glass type is not approved.
      2) Box shall mechanically latch when actuated and require key to reset. Key shall match control panel door lock.
4. Notification Appliances:
   a. Color: White.
   b. Combination Speaker / Strobe:
      1) Wall mounted flush or semi-flush.
      2) Audible voice output of 90 dB minimum at 10 feet (3 meters).
      3) Integrally mounted flashing light unit with block letters 'FIRE.' Adjustable light intensity of 15-110 candela and flash rate between one and three Hertz, except where higher rated output devices are indicated on Drawings.
      4) Listed under UL Standard 1480 and UL Standard 1971.
   c. Strobe Only:
      1) Wall mounted flush or semi-flush.
      2) Integrally mounted flashing light unit with block letters 'FIRE.' Adjustable light intensity of 15-110 candela and flash rate between one and three Hertz.
      3) Listed under UL Standard 1971.
5. Accessory Devices:
   a. Notification Appliance Protective Devices: Provide wire guard covers for appliances installed in Cultural Center.
6. Cables And Wiring:
   a. Comply with NEC Article 760.

b. Jacket and insulation color shall be red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fire alarm and detection systems as indicated, in accordance with Equipment Manufacturer's written instructions, and complying with applicable portions of NEC, NFPA, and NECA's 'Standard of Installation'.
   1. Mounting Heights:
      a. Unless otherwise indicated, mount center of outlets or boxes at following heights above finish floor:
         1) Control Panel: 72 inches (1 800 mm) to top.
         2) Wall-Mounted Horn / Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
         3) Wall-Mounted Strobe: 80 inches (2 1032 mm). 6 inches (150 mm) below ceiling, whenever ceiling is below 80 inches (2 1032 mm).
         4) Manual pull stations: 48 inches (1 200 mm).
         5) Remote annunciator panel: 60 inches (1 500 mm).
   2. Locate fire alarm manual stations 24 inches (600 mm) minimum away from any light switch.

B. Identification:
   1. Label zone indicators on control unit indicating location and type of initiating device, i.e., CORRIDOR SMOKE, VALVE TAMPER, AIR SYSTEM SMOKE, etc. Labels shall be engraved plastic laminate, or other permanent labeling system as supplied by Control Unit Manufacturer.
   2. Post copy of wire identification list inside fire alarm panel door or other area accessible to fire alarm service personnel.
   3. Print location of circuit disconnecting means inside panel.

C. Conductors:
   1. Install conductors and make connections to water flow switches, valve tamper switches, low air pressure switches, and duct smoke detectors.
   2. Loop wires through each device on zone for proper supervision. Tee-taps not permitted.
   3. Minimum conductor size shall be 14 AWG unless otherwise specified.

D. Do not install ceiling mounted detectors within 36 inches (900 mm) of air discharge grilles. Do not install manual fire alarm boxes within 24 inches (610 mm) of light switches. Coordinate with other trades as required.

3.2 FIELD QUALITY CONTROL

A. Field Tests:
   1. Provide factory-trained representative to perform complete system testing in presence of Owner's representative and local fire department personnel upon completion of installation.
      a. Test each initiating and annunciating device for proper operation, except fixed temperature heat detectors.
      b. Test operation of trouble annunciation on each circuit.
      c. Perform complete testing of control panel functions including off-site monitoring.

3.3 CLOSEOUT ACTIVITIES

A. Instruction Of Owner:
   1. Instruct Owner's Representative in proper operation and maintenance procedures.

3.4 PROTECTION

A. Provide dust protection for installed smoke detectors until finish work is completed and building is ready for occupancy.

B. Protect conductors from cuts, abrasion and other damage during construction.

END OF SECTION

DIVISION 31 – EARTHWORK

31 0501	Common Earthwork Requirements
31 1100	Clearing and Grubbing
31 1123	Aggregate Base
31 1413	Topsoil Stripping and Stockpiling
31 2213	Rough Grading
31 2216	Fine Grading
31 2316	Excavation
31 2323	Fill
31 2324	Flowable Fill
31 3116	Termite Control
31 6421	Aggregate Pier Ground Improvement

SECTION 31 0501 - COMMON EARTHWORK REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited to:
   1. General procedures and requirements for earthwork.

B. Related Requirements:
   1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
   2. Pre-Installation conferences held jointly with Section 31 0501 as described in Administrative Requirements on Part 1 of this specification section:
   3. Section 32 9001: 'Common Planting Requirements':
      a. Pre-installation conference held jointly with other landscape related sections.

1.2 REFERENCES

A. Definitions:
   1. Aggregate Base: Layer of granular material immediately below concrete and asphalt paving or miscellaneous site concrete (sidewalks, curbs, etc) and below interior concrete slabs on grade.
   2. Base: See aggregate base.

3. Building Grading: sloping of grounds immediately adjacent to building. Proper grading causes water to flow away from a structure. Grading can be accomplished either with machinery or by hand.
4. Compacted Fill: Placement of soils on building site placed and compacted per Contract Documents. Used to replace soils removed during excavation or to fill in low spot on building site.
5. Excavation: Removal of soil from project site or cavity formed by cutting, digging or scooping on project site.
6. Fine Grading (FG): Preparation of subgrade preceding placement of surfacing materials (aggregate base, asphalt or concrete paving, and topsoil) for contour of building site required. Fine Grading is conducted to ensure that earth forms and surfaces have been properly shaped and subgrade has been brought to correct elevations. It is performed after rough grading and placement of compacted fill but before placement of aggregate base or topsoil.
7. Finish Grading: Completed surface elevation of landscaping areas for seeding, sodding, and planting on building site.
8. Natural Grade: Undisturbed natural surface of ground.
9. Rough Grading (RG): Grading, leveling, moving, removal and placement of existing or imported soil to its generally required location and elevation. Cut and fill is part of rough grading.
10. Subgrade (definition varies depending upon stage of construction and context of work being performed):
    a. Prepared natural soils on which fill, aggregate base, or topsoil is placed.

       or

    b. Prepared soils immediately beneath paving or topsoil.
11. Topsoil Placement and Grading: Topsoil placement and finish grading work required to prepare site for installation of landscaping.
12. See geotechnical Evaluation Report prepared by AGEC, project No. 1220210, dated May 4, 2022.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference for common earthwork sections:
      a. Schedule conference after completion of site clearing but before beginning grading work.
      b. Participate in pre-installation conference held jointly with following sections:
         1) Section 03 3111: 'Cast-In-Place Structural Concrete'.
         2) Section 31 1100: 'Clearing and Grubbing'.
         3) Section 31 1123: 'Aggregate Base'.
         4) Section 31 1413: 'Topsoil Stripping and Stockpiling'.
         5) Section 31 2213: 'Rough Grading'.
         6) Section 31 2216: 'Fine Grading'.
         7) Section 31 2316: 'Excavation'.
         8) Section 31 2323: 'Fill'.
         9) Section 32 1216: 'Asphalt Paving'.
         10) Section 32 1313: 'Concrete Paving'.
         11) Section 33 3313: 'Sanitary Utility Sewerage'.
      c. In addition to agenda items specified in Section 01 3100, review following:
         1) Review Geotechnical Evaluation Report.
         2) Review common earthwork schedule.
         3) Review protection requirements.
         4) Review cleaning requirements.
         5) Review safety issues.
         6) Review field tests and inspections requirements.
      d. In addition to agenda items specified above, review following. These are items that will occur before pre-installation conference for landscape sections:
         1) Review clearing and grubbing requirements.
         2) Review topsoil stripping and stockpiling requirements.

3) Review landscape grading requirements.
4) Review landscape finish grade tolerance requirements.
5) Review landscape and plant tolerances.
6) Review surface preparation of landscape and planting areas.
7) Review additional agenda items as specified in related sections listed above.

2. Participate in pre-installation conference for landscape sections as specified in Section 32 9001:
   a. Schedule pre-installation conference after completion of Fine Grading specified in Section 31 2216, but one (1) week minimum before beginning landscape work and held jointly with following sections:
      1) Section 32 8423: 'Underground Sprinklers'.
      2) Section 32 9120: 'Topsoil And Placement'.
      3) Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
      4) Section 32 9122: 'Topsoil Grading'.
      5) Section 32 9223: 'Sodding'.
      6) Section 32 9300: 'Plants'.
   b. In addition to agenda items specified in Section 01 3100 and Section 32 9001, review following that these items have been installed correctly:
      1) Review topsoil placement requirements.
      2) Review topsoil surface preparation requirements.
      3) Review topsoil depth requirements.
      4) Review landscape finish grade tolerance requirements.
      5) Review surface preparation of landscape and planting areas.

B. Sequencing:
   1. General Earthwork:
      a. Excavation.
      b. Rough Grading.
      c. Fill.
      d. Fine Grading.
      e. Aggregate Base or Topsoil Grading.

1.4 QUALITY ASSURANCE

A. Testing And Inspection:
   1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
      a. Owner will employ testing agencies to perform testing and inspection as specified in Field Quality Control in Part 3 of this specification:
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
         2) See Section 01 1200: 'Multiple Contract Summary'.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Forty-eight (48) hours minimum before performing any work on site, contact **811 BLUE STAKES OF UTAH, www.bluestakes.org, 1-800-662-4111** to arrange for utility location services.
   2. Perform minor, investigative excavations to verify location of various existing underground facilities at sufficient locations to assure that no conflict with the proposed work exists and sufficient clearance is available to avoid damage to existing facilities.
   3. Perform investigative excavating ten (10) days minimum in advance of performing any excavation or underground work.
   4. Upon discovery of conflicts or problems with existing facilities, notify Architect by phone or fax within twenty-four (24) hours. Follow telephone or fax notification with letter and diagrams indicating conflict or problem and sufficient measurements and details to evaluate problem.

3.2 PREPARATION

A. Protection:
   1. Spillage:
      a. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways.
      b. Remove spillage and sweep, wash, or otherwise clean project, streets, and highways.
   2. Dust Control:
      a. Take precautions necessary to prevent dust nuisance, both on-site and adjacent to public and private properties.
      b. Correct or repair damage caused by dust.
   3. Existing Plants And Features:
      a. Do not damage tops, trunks, and roots of existing trees and shrubs on site that are intended to remain.
      b. Do not use heavy equipment within branch spread.
      c. Interfering branches may be removed only with permission of Architect.
      d. Do not damage other plants and features that are to remain.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:

1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
    a. Quality Control is sole responsibility of Contractor. Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform The Work or Contractors own Testing and Inspection services.
2. Testing and inspection of earthwork operations is required.
3. Field Tests and Laboratory Tests:
    a. Owner reserves right to require additional testing to re-affirm suitability of completed work including compacted soils that have been exposed to adverse weather conditions.
4. Field Inspections:
    a. Notify Architect forty-eight (48) hours before performing excavation or fill work.
    b. If weather, scheduling, or any other circumstance has interrupted work, notify Architect twenty-four (24) hours minimum before intended resumption of grading or compacting.

B. Non-Conforming Work:

1. If specified protection precautions are not taken or corrections and repairs not made promptly, Owner may take such steps as may be deemed necessary and deduct costs of such from monies due to Contractor. Such action or lack of action on Owner's part does not relieve Contractor from responsibility for proper protection of The Work.

END OF SECTION

SECTION 31 1100 CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Perform clearing and grubbing as necessary to prepare site for rough grading and structure excavation as described in Contract Documents.

B. Related Requirements:

1. Section 31 0501: Common Earthwork Requirements:
   a. General procedures and requirements for earthwork.
   b. Pre-installation conference held jointly with other common earthwork related sections.
   c. Pre-installation conference held jointly with other landscape related sections.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in pre-installation conferences as specified in Section 31 0501.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Tree And Brush Removal:

1. Cut off trees, shrubs, brush, and vegetative growth 12 inches maximum above ground.

2. Do not pull up or rip out roots of trees and shrubs that are to remain. If excavation through roots is required, excavate by hand and cut roots with sharp axe. Make clean, smooth, sloping cuts.
3. Cut roots 6 inches or larger in diameter only with Architect's written permission.

B. Grubbing:
1. Grub out stumps and roots 12 inches minimum below original ground surface, except as follows:
a. Under buildings, remove roots one inch and larger entirely.
b. Entirely remove roots of plants that normally sprout from roots, as identified by Architect.

3.2 CLEANING

A. Remove from site trees, shrubs, uprooted stumps, vegetative layer, and surface debris and dispose of legally.
B. Do not bury cuttings, stumps, roots, and other vegetative matter or burnt waste material on site.

END OF SECTION

SECTION 31 1123 AGGREGATE BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install the following as described in Contract Documents:
    a. Aggregate Base:
        1) Interior concrete slabs-on-grade.
        2) Miscellaneous exterior concrete (sidewalks, curb, gutter and equipment pads).
        3) Asphalt paving.
        4) Concrete paving.

B. Related Requirements:

1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
3. Section 03 3111: 'Cast-In-Place Structural Concrete'.
4. Section 31 0501: 'Common Earthwork Requirements':
    a. General procedures and requirements for earthwork.
    b. Pre-installation conference held jointly with other common earthwork related sections.
5. Section 31 2213: 'Rough Grading'.

6. Section 31 2216: 'Fine Grading' for subgrade procedures.
7. Section 31 2323: 'Fill' for compaction procedures and tolerances.
8. Section 32 1216: 'Asphalt Paving.
9. Section 32 1313: 'Concrete Paving'.

C. Products Installed But Not Furnished Under This Section:
1. Vapor Retarder:
a. Interior slabs on grade:
1) Under-slab vapor retarder and seam tape.

D. Related Requirements:
1. Section 07 2616: 'Below-Grade Vapor Retarders' for:
a. Furnishing of vapor retarder and seam tape.

1.2 REFERENCES

A. Definitions:
1. Aggregate (Asphalt Paving):
a. Aggregate: A hard inert mineral material, such as gravel, crushed rock, slag, or sand.
b. Coarse Aggregate: Aggregate retained on No. 8 (2.36 mm) sieve.
c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
d. Fine Aggregate: Aggregate passing No. 8 (2.36 mm) sieve.
e. Reclaimed Asphalt Pavement (RAP): Existing asphalt mixture that has been pulverized, usually by milling, and is used like an aggregate in recycling of asphalt pavements.
2. Gravel (Concrete Paving):
a. Gravel: Material passing 75-mm (3-inch) sieve and retained on 4.75-mm (No. 4) sieve.
b. Coarse Gravel: Material passing 75-mm (3-inch) sieve and retained on 19.0-mm (3/4-inch) sieve.
c. Fine Gravel: Material passing 19.0-mm (3/4-inch) sieve and retained on 4.75-mm (No. 4) sieve.
d. Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is required to pass.
e. Nominal Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is permitted to pass.
3. Sand (Concrete Paving):
a. Sand: Material passing 4.75-mm sieve (No. 4) and retained on 0.075-mm (No. 200) sieve.
b. Coarse Sand: Material passing 4.75-mm sieve (No. 4) and retained on 2.00-mm (No. 10) sieve.
c. Medium Sand: Material passing 2.00-mm sieve (No. 10) and retained on 0.475-mm (No. 40) sieve.
d. Fine Sand: Material passing 0.475-mm (No. 40) sieve and retained on 0.075-mm (No. 200) sieve.
e. Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is required to pass.
f. Nominal Maximum Size (of aggregate) - in specifications for, or description of aggregate, smallest sieve opening through which entire amount of aggregate is permitted to pass.

B. Reference Standards:
1. ASTM International:
a. ASTM C131/C131M-14, 'Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine'.
b. ASTM D1556/D1556M-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method'.
c. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)'.

d. ASTM D1883-16, 'Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils.
e. ASTM D2167-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method'.
f. ASTM D2419-14, 'Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate'.
g. ASTM D4318-17, 'Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils'.
h. ASTM D6938-17, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.
i. ASTM E1643-18a, 'Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
1. Participate in MANADORY pre-installation conference as specified in Section 31 0501.
2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
a. Review requirements and frequency of testing and inspections.
b. Review aggregate base installation requirements.
c. Review vapor retarder installation requirements.
d. Review proposed miscellaneous exterior concrete schedule.
e. Review proposed asphalt paving schedule.
f. Review proposed concrete paving schedule.
g. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
1) Review frequency of testing and inspections.

B. Sequencing:
1. Compaction as described in Section 31 2216 'Fine Grading'.
2. Exterior Footings and Foundations are installed.
3. Vapor Retarder below interior concrete slabs on grade:
a. Install below-grade vapor retarder on top of aggregate base.
4. Aggregate Base:
a. Install aggregate base at location shown in Contract Drawings.
5. Concrete Slab is installed.

C. Scheduling:
1. Interior slab-on-grade concrete:
a. Notify Architect twenty-four (24) hours minimum before installation of concrete to allow inspection of vapor retarder installation.
b. Notify Testing Agency and Architect twenty-four (24) hours minimum before installation of interior concrete slabs to allow inspection of aggregate base.
c. Allow special inspector to review all sub grades and excavations to determine if building pad has been prepared in accordance with geotechnical report prior to placing any aggregate base.
2. Miscellaneous exterior concrete:
a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing concrete for exterior site work concrete (sidewalks, curbs, gutters, etc.), footings, foundation walls, and building slabs to allow inspection of aggregate base.
3. Asphalt Paving:
a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing aggregate base to allow inspection of aggregate base.

4. Concrete Paving:
    a. Notify Testing Agency and Architect twenty-four (24) hours minimum before placing aggregate base to allow inspection of aggregate base.

1.4 SUBMITTALS

A. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    a. Record Documentation:
        1) Testing and Inspection Reports:
            a) Testing Agency Testing and Inspecting Reports of aggregate base.

1.5 QUALITY ASSURANCE

A. Testing And Inspection:
1. Owner will provide Testing and Inspection for aggregate base:
    a. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
    b. Owner will employ testing agencies to perform testing and inspection for aggregate base as specified in Field Quality Control in Part 3 of this specification.
        1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
        2) See Section 01 1200: 'Multiple Contract Summary'.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:
1. Materials shall be delivered in original, unopened packages with labels intact.

1.7 FIELD CONDITIONS

A. Ambient Conditions:
1. Do not perform work during unfavorable conditions as specified below:
    a. Aggregate Base:
        1) Presence of free surface water.
        2) Over-saturated sub base materials.
    b. Vapor Retarder:
        1) Unacceptable conditions for installation include presence of high winds which would tear or damage vapor retarder.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate Base:
1. Under Interior Slab-On-Grade Concrete (Section 03 3111 'Cast-In-Place Structural Concrete'):
    a. New Aggregate Base:
        1) Gravel: 3/4 inch minimum to one inch maximum well-graded, clean gravel or crushed rock.

2) Base type gravel or crushed rock, graded by weight as follows (three-quarter to one-inch clean gap-graded gravel):
a) Road Base type gravel or crushed stone (slag not allowed), graded as follows:

	Sieve		Percent of Weight Passing
(a)	1 inch	(25.4 mm)	100
(b)	3/4 inch	(19.0 mm)	90 - 80
(c)	1/2 inch	(12.7 mm)	20 - 40
(d)	3/8 inch	(9.5 mm)	5 - 10
(e)	No. 4	(4.750 mm)	0 - 12

2. Under Exterior Concrete (Section 03 3111 'Cast-In-Place Structural Concrete') excluding Concrete Paving):
   a. New Aggregate Base:
      1) Road Base to conform to State DOT Specifications.
3. Under Asphalt Paving (Section 32 1216 'Asphalt Paving'):
   a. New Aggregate Base:
      1) Road Base to conform to 1-1/2 inches minus State DOT Specifications and Gradations.
      2) Aggregate base shall be non-plastic.
4. Under Concrete Paving (Section 32 1313 'Concrete Paving'):
   a. New Aggregate Base:
      1) Road Base to conform to 1-1/2 inches minus State DOT Specifications and Gradations.
      2) Aggregate base shall be non-plastic.

PART 3 - EXECUTION

3.1 PREPARATION

A. Stockpiles:
   1. Provide area for each stockpile of adequate size, reasonably uniform in cross-section, well drained, and cleared of foreign materials.
   2. Locate piles so that there is no contamination by foreign material and no intermingling of aggregates from adjacent piles. Do not use steel-tracked equipment on stockpiles.
   3. Do not store aggregates from different sources, geological classifications, or of different gradings in stockpiles near each other unless bulkhead is placed between different materials.
   4. Do not use washed aggregates sooner than twenty-four (24) hours after washing or until surplus water has drained out and material has uniform moisture content.
   5. Do not stockpile higher than 15 feet. Cover or otherwise protect stockpiles for use in HMA to prevent buildup of moisture.
B. Surface Preparation (Miscellaneous Exterior Concrete):
   1. Subgrade:
      a. Finish grade to grades required by Contract Documents.
      b. Compact subgrade as specified in Section 31 2323.
C. Surface Preparation (Asphalt Paving):
   1. Subgrade:
      a. Finish grade parking surface area to grades required by Contract Documents.
      b. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Recompact and retest subgrade soils that have been left exposed to weather.
D. Surface Preparation (Concrete Paving):
   1. Subgrade:
      a. Finish grade parking surface area to grades required by Contract Documents.

b. Aggregate base and paving must be placed before any moisture or seasonal changes occur to subgrade that would cause compaction tests previously performed to be erroneous. Recompact and retest subgrade soils that have been left exposed to weather.

E. Surface Preparation (Interior Slab-On-Grade Concrete):

1. Vapor Retarder:

a. Install vapor retarder in accordance with ASTM E1643 except where Contract Documents indicate otherwise and following instructions:

1) Install vapor retarder over aggregate base over compacted subgrade so entire area under slab is covered.
2) Install vapor retarder in accordance with ASTM E1643 at interior stem walls.
3) Lap joints 6 inches minimum and seal with specified seam tape.
4) Seal vapor retarder around pipes, conduits, and other utility items that penetrate vapor retarder using factory-fabricated boot installed as recommended by Manufacturer.
5) Except for punctures required for reinforcing and anchor bolts at top of stem walls, seal tears and punctures.

3.2 INSTALLATION

A. Aggregate Base:

1. General:

a. Do not place aggregate base material when subgrade is frozen or unstable.

b. Spread aggregate base material with equipment except in limited or restricted areas where use of hand spreading is allowed.

c. Spread aggregate base material in manner that does not break down material and eliminates segregation, ruts, and ridges.

d. Correct damage to aggregate base caused by construction activities and maintain corrected aggregate base until subsequent course is placed.

e. Do not allow traffic on aggregate base.

f. Remove all standing storm water.

2. Under interior concrete slab-on-grade aggregate base:

a. Place 4 inches minimum of aggregate base under vapor retarder, level, and compact with vibratory plate compactor.

3. Under miscellaneous exterior concrete aggregate base:

a. Except under mow strips, place 4 inches minimum of aggregate base, level, and compact as specified in Section 31 2323.

4. Asphalt paving aggregate base:

a. Match existing roadway thickness minimum (for roadway patching) after compaction in accordance with Contract Drawings.

b. If roller is smaller than 8 ton , lay aggregate base and compact in two courses.

c. Compact as specified in Section 31 2323.

d. Priming: Prime aggregate base with application of 0.2 to 0.5 gallons of asphalt cement primer per square yard if pavement will be laid more than three days after compaction of aggregate base, or if precipitation is anticipated between completion of compaction of aggregate base and laying of asphalt paving.

e. Recompact unprimed aggregate base if it receives precipitation before pavement is laid.

f. Remove or repair improperly prepared areas as directed by Architect.

5. Concrete paving aggregate base:

a. 4-inch thick minimum after compaction in accordance with Contract Drawings.

b. Compact to ninety-five (95) percent minimum density as determined by ASTM D1557.

c. Recompact unprimed aggregate base if it receives precipitation before paving is laid.

d. Remove or repair improperly prepared areas as directed by Architect.

B. Tolerances:

1. Asphalt Paving Areas:
    a. Aggregate base:
        1) 0.00 inches high.
        2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
        3) Finished base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet.
        4) Maximum variation from required grades shall be 1/10 of one foot.
    b. Concrete Paving Areas:
        1) 0.00 inches high.
        2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
        3) Finished base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet.
        4) Maximum variation from required grades shall be 1/10 of one foot.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:
1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
    a. Quality Control is sole responsibility of Contractor.
        1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
            a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
2. Aggregate Base:
    a. Interior slab-on-grade concrete areas:
        1) Testing Agency shall provide testing and inspection for interior aggregate base.
        2) Number of tests may vary at discretion of Architect.
        3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
            a) Building Slab Areas: One test for every 2,500 sq. ft. or less of building slab area but no fewer than three tests.
    b. Miscellaneous exterior concrete areas:
        1) Testing Agency shall provide testing and inspection for exterior aggregate base.
        2) Number of tests may vary at discretion of Architect.
        3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
            a) Sitework Areas: One test for every 10,000 sq. ft. or less of exterior pads area but no fewer than three tests.
    c. Asphalt paving area:
        1) Testing Agency shall provide testing and inspection for exterior aggregate base.
        2) Number of tests may vary at discretion of Architect.
        3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
        4) Sitework Areas: One test for every 10,000 sq. ft. or less of exterior pads area but no fewer than three tests.
    d. Concrete paving area:
        1) Testing Agency shall provide testing and inspection for exterior aggregate base.
        2) Number of tests may vary at discretion of Architect.
        3) Testing Agency will test compaction of base in place according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
            a) Sitework Areas: One test for every 10,000 sq. ft. or less of exterior pads area but no fewer than three tests.

3.4 PROTECTION

A. Interior Slab-On-Grade Concrete:

1. Vapor Retarder:

a. Do not allow water onto vapor retarder or aggregate base before placing concrete.

b. Protect membrane from possible punctures caused by reinforcing bar supports before placing concrete.

END OF SECTION

SECTION 31 1413 TOPSOIL STRIPPING AND STOCKPILING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Strip and stockpile acceptable topsoil as described in Contract Documents.

B. Related Requirements:
   1. Section 31 0501: 'Common Earthwork Requirements':
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
      c. Pre-installation conference held jointly with other landscape related sections.
   2. Section 31 1100: 'Clearing and Grubbing'.
   3. Section 31 2213: 'Rough Grading'.
   4. Section 31 2316: 'Excavation'.
   5. Section 32 9001: 'Common Planting Requirements'.
   6. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
   7. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
   8. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

1.2 REFERENCES

A. Definitions:
   1. Existing topsoil: Defined as total amount of soil stripped and stored for reuse, less vegetation layer stripped and disposed of as specified in Paragraphs below.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in pre-installation conferences as specified in Section 31 0501.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Strip existing vegetation layer **2** inches deep minimum from areas of site to receive buildings, landscaping, and paving and remove from site before stripping topsoil for storage and reuse.

B. After stripping vegetation layer, strip existing topsoil additional **16** inches deep minimum from areas of site to receive buildings and paving and store on site for later use.

1. Existing topsoil is property of Contractor with restriction that topsoil is to be used first for Project landscape topsoil requirements and second for non-structural fill and backfill.

2. After Project fill, backfill, and landscape topsoil requirements are satisfied, remove excess existing topsoil from site. Do not remove existing topsoil from site without Architect's written approval.

C. Screen existing topsoil to meet standards established as specified in Section 32 9120 'Topsoil And Placement'.

END OF SECTION

SECTION 31 2213 ROUGH GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform rough grading work required to prepare site for construction as described in Contract Documents.

B. Related Requirements:
   1. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
   2. Section 03 3053: Miscellaneous Exterior Cast-In-Place Concrete.
   3. Section 31 0501: 'Common Earthwork Requirements' for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   4. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
   5. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
   6. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
   7. Section 31 2316: 'Excavation'.
   8. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
   9. Section 32 1216: 'Asphalt Paving'.
   10. Section 32 1313: 'Concrete Paving'.
   11. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501:
   2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
      a. Identify benchmark to be used in establishing grades and review Contract Document requirements for grades, fill materials, and topsoil.

b. Examine site to pre-plan procedures for making cuts, placing fills, and other necessary work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used for fill shall be as specified for backfill in Section 31 2323 'Fill'.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Verify elevations of rough grading are correct before compacted fill, fine grading, aggregate base or landscape grading are placed.

3.2 PREPARATION

A. Surface Preparation:
   1. Before making cuts, remove topsoil over areas to be cut and filled that were not previously removed by stripping specified in Section 31 1413 'Topsoil Stripping And Stockpiling'. Stockpile this additional topsoil with previously stripped topsoil.

3.3 PERFORMANCE

A. Subgrade (Natural Soils):
   1. Subgrade beneath compacted fill or aggregate base under asphalt or concrete paving shall be constructed smooth and even.

B. Special Techniques:
   1. Compact fills as specified in Section 31 2323 'Fill'.
   2. If soft spots, water, or other unusual and unforeseen conditions affecting grading requirements are encountered, stop work and notify Architect.

C. Tolerances:
   1. Maximum variation from required grades shall be 1/10 of one foot.

END OF SECTION

SECTION 31 2216 FINE GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Perform fine grading of subgrade work required to prepare site for paving finish grading and for placement of topsoil as described in Contract Documents.
2. Asphalt Paving:
   a. Prepare natural soil subgrade as described in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in this specification section for asphalt paving.
3. Concrete Paving:
   a. Prepare natural soil subgrade as described in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in this specification section for concrete paving.

B. Related Requirements:

1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
3. Section 31 0501: 'Common Earthwork Requirements' for:
   a. General procedures and requirements for earthwork.

b. Pre-installation conference held jointly with other common earthwork related sections.

4. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
5. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
6. Section 31 2213: 'Rough Grading' for grading and preparation of natural soil subgrades below fill and aggregate base materials.
7. Section 31 2316: 'Excavation'.
8. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
9. Section 32 1216: 'Asphalt Paving' for finish grading for asphalt paving.
10. Section 32 1313: 'Concrete Paving' for finish grading for concrete paving.
11. Section 32 9001: 'Common Planting Requirements'.
    a. Pre-installation conference held jointly with other common planting related sections.
12. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
13. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
14. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501 and Section 32 9001.
2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:
    a. Review backfill requirements.
    b. Review geotechnical report.
    c. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
        1) Review requirements and frequency of testing and inspections.

B. Scheduling:
   1. Notify Testing Agency and Architect twenty-four (24) hours minimum before installation of fill / engineered fill to allow inspection.
   2. Allow special inspector to review all subgrades and excavations to determine if site has been prepared in accordance with geotechnical report prior to placing any fill, aggregate base or concrete.
   3. Allow inspection and testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after inspections and test results for previously compacted work comply with requirements.

1.3 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Record Documentation:
         1) Testing and Inspection Reports:
            a)Testing Agency Testing and Inspecting Reports of fill / engineered fill.

1.4 QUALITY ASSURANCE

A. Testing And Inspection:
   1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
   2. Owner will provide Testing and Inspection for fill / engineering fill:
      a. Owner will employ testing agencies to perform testing and inspection for fill / engineering fill as specified in Field Quality Control in Part 3 of this specification.
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
         2) See Section 01 1200: 'Multiple Contract Summary'.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection Of In-Place Conditions: Protect utilities and site elements from damage.
B. Surface Preparation:
   1. Landscaping and Planting Areas:
      a. Before grading, dig out weeds from planting areas by their roots and remove from site. Remove rocks larger than 1-1/2 inches in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc.
      b. Remove imported paving base material present in planting areas down to natural subgrade or other material acceptable to Architect.
   2. Asphalt Paving:
      a. Survey and stake parking surfaces to show grading required by Contract Documents.
      b. Subgrade (material immediately below aggregate base):
         1) Compact subgrade as specified in Section 31 2213 (natural soils) and Section 31 2323 (fill).
         2) Fine grade parking surface area to grades required by Contract Documents.
         3) Subgrade to be constructed smooth and even.
   3. Concrete Paving:
      a. Survey and stake parking surfaces to show grading required by Contract Documents.
      b. Subgrade (material immediately below aggregate base):

1) Compact subgrade as specified in Section 31 2213 (natural soils) and Section 31 2323 (fill).
2) Fine grade parking surface area to grades required by Contract Documents.
3) Subgrade to be constructed smooth and even.

3.2 PERFORMANCE

A. Interface With Other Work: Do not commence work of this Section until grading tolerances specified in Section 31 2213 are met.

B. General:

1. Do not expose or damage existing shrub or tree roots.

C. Tolerances:

1. Site Tolerances:
   a. Subgrade (material immediately below aggregate base):
      1) 0.00 inches high.
      2) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
   b. Maximum variation from required grades shall be 1/10 of one foot.
2. Aggregate Base (Asphalt Paving) Tolerances:
   a. Aggregate base shall be 6 inches thick minimum after compaction, except where shown thicker on Drawings.
   b. Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.
3. Aggregate Base (Concrete Paving) Tolerances:
   a. Finished base course shall be 4 inches thick minimum after compaction and true to line and grade within plus or minus 1/4 inch in 10 feet.
4. Landscaping and Planting Tolerances:
   a. Maximum variation from required grades shall be 1/10 of one foot.
   b. To allow for final finish grades as specified in Section 32 9121 of planting areas refer to landscape plan depths shown to determine fine grade elevations before placing topsoil and mulch.
5. Slope grade away from building as specified in Section 32 9120.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:

1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
   a. Quality Control is sole responsibility of Contractor:
      1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
         a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
2. Site Preparation:
   a. Prior to placement of fill / engineered fill, inspector shall determine that site has been prepared in accordance with geotechnical report.
   b. Footing subgrade: At footing subgrades, Certified Inspector is to verify that soils conform to geotechnical report.

3. Fill / Engineered Fill:
    a. Testing Agency shall provide testing and inspection for fine grading.
    b. Number of tests may vary at discretion of Architect.
    c. Testing Agency is to provide one (1) moisture-maximum density relationship test for each type of fill material.

END OF SECTION

SECTION 31 2316 EXCAVATION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform Project excavating and trenching as described in Contract Documents, except as specified below.
   2. Procedure and quality for excavating and trenching performed on Project under other Sections unless specifically specified otherwise.

B. Related Requirements:
   1. Section 31 0501: 'Common Earthwork Requirements' for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   2. Section 31 1100: Clearing and Grubbing.
   3. Section 31 1123: 'Aggregate Base'.
   4. Section 31 1413: 'Topsoil Stripping and Stockpiling'.
   5. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
   6. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
   7. Section 31 2323: 'Fill' for compaction procedures and tolerances for base.
   8. Performance of excavating inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
   1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501:
   2. In addition to agenda items specified in Section 01 3100 and Section 31 0501, review following:

a. Review protection of existing utilities requirements.

PART 2 - PRODUCTS: Not Used

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
   1. Carefully examine site and available information to determine type soil to be encountered.
   2. Discuss problems with Architect before proceeding with work.

3.2 PREPARATION

A. Protection of Existing Utilities:
   1. Protect existing utilities identified in Contract Documents during excavation.
   2. If existing utility lines not identified in Contract Documents are encountered, contact Architect before proceeding.

3.3 PERFORMANCE

A. Interface With Other Work:
   1. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
   2. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.

B. Excavation:
   1. Building Footings And Foundations:
      a. Under Building:
         1) Excavate at least 18 inches (for topsoil removal) and 5 feet beyond perimeter of buildings and structures and as necessary for proper placement and forming of footings and foundations so that final grade allows for (minimum 38 inches or depth specified by structural engineer plans, whichever is greater) of engineered fill below slab.
      b. Under Paving:
         1) Excavate at least 18 below existing grade so final grade allows for four inches of compacted fill below paving.
      c. Bottom of excavations to receive footings shall be undisturbed soil.
      d. Excavation Carried Deeper Than Required:
         1) Under Footings: Fill with concrete specified for footings.
         2) Under Slabs: Use specified compacted backfill material.
   2. Pavement And Miscellaneous Cast-In-Place Concrete:
      a. Excavate as necessary for proper placement and forming of concrete site elements and pavement structure. Remove vegetation and deleterious material and remove from site.
      b. Backfill over-excavated areas with compacted base material specified in Section 31 1123.
      c. Remove and replace exposed material that becomes soft or unstable.
   3. Utility Trenches:
      a. Unless otherwise indicated, excavation shall be open cut. Short sections of trench may be tunneled if pipe or duct can be safely and properly installed and backfill can be properly tamped in tunnel sections and if approved by Architect.
      b. Excavate to proper alignment, depth, and grade. Excavate to sufficient width to allow adequate space for proper installation and inspection of utility piping.
      c. If trenches are excavated deeper than required, backfill until trench bottom is proper depth with properly compacted native material.
      d. Pipe 4 Inches In Diameter Or Larger:

1) Grade bottom of trenches to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its length.
2) Except where rock is encountered, take care not to excavate below depths indicated.
   a) Where rock excavations are required, excavate rock with minimum over-depth of 4 inches below required trench depths.
   b) Backfill over-depths in rock excavation and unauthorized over-depths with loose, granular, moist earth, thoroughly compacted.
3) Whenever wet or unstable soil incapable of properly supporting pipe, as determined by Architect, occurs in bottom of trench, remove soil to depth required and backfill trench to proper grade with coarse sand, fine gravel, or other suitable material acceptable to Architect.

4. If unusual excavating conditions are encountered, stop work and notify Architect.

3.4 REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

3.5 CLEANING

A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION

SECTION 31 2323 FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Perform Project backfilling and compacting as described in Contract Documents, except as specified below.
2. Procedure and quality for backfilling and compacting performed on Project under other Sections unless specifically specified otherwise.

B. Related Requirements:

1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
3. Section 31 0501: 'Common Earthwork Requirements' for:
   a. General procedures and requirements for earthwork.
   b. Pre-installation conference held jointly with other common earthwork related sections.
4. Section 31 1100: 'Clearing and Grubbing'.
5. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
6. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
7. Section 31 2213: 'Rough Grading' for grading and preparation of natural soil subgrades below fill and aggregate base materials.
8. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
9. Section 31 2316: 'Excavation'.
10. Section 31 2324: 'Flowable Fill'.

11. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
12. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
13. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.
14. Division 32: Compaction of subgrade under walks and paving.
15. Performance of backfilling and compacting inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International (Following are specifically referenced for fill and aggregate base testing):
      a. ASTM D698-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3)'.
      b. ASTM D1556/D1556M-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method'.
      c. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)'.
      d. ASTM D2167-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method'.
      e. ASTM D2487-17, 'Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)'.
      f. ASTM D6938-17a, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
   1. Participate in MANDATORY pre-installation conference as specified in Section 31 0501.
   2. In addition to agenda items specified in Section 01 3100, Section 31 0501, and Section 31 2324 if Flowable Fill is included, review following:
      a. Review backfill requirements.
      b. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
         1) Review requirements and frequency of testing and inspections.
B. Sequencing:
C. Scheduling:
   1. Notify Testing Agency and Architect seventy-two (72) hours minimum before installation of fill / engineered fill to perform proctor and plasticity index tests on proposed fill or subgrade.
   2. Notify Testing Agency and Architect twenty-four (24) hours minimum before installation of fill / engineered fill to allow inspection.
   3. Allow special inspector to review all subgrades and excavations to determine if site has been prepared in accordance with geotechnical report prior to placing any fill (or concrete).
   4. Allow inspection and testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after inspections and test results for previously compacted work comply with requirements.

1.4 SUBMITTALS

A. Closeout Submittals:
   1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
      a. Record Documentation:
         1) Testing and Inspection Reports:
            a)Testing Agency Testing and Inspecting Reports of fill / engineered fill.

1.5 QUALITY ASSURANCE

A. Testing and Inspection:
   1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
   2. Owner will provide Testing and Inspection for fill / engineering fill:
      a. Owner will employ testing agencies to perform testing and inspection for fill / engineering fill as specified in Field Quality Control in Part 3 of this specification.
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
         2) See Section 01 1200: 'Multiple Contract Summary'.

1.6 FIELD CONDITIONS

A. Ambient Conditions:
   1. Do not perform work during unfavorable conditions as specified below:
      a. Aggregate Base:
         1) Presence of free surface water.
         2) Over-saturated sub base materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Site Material:
   1. Existing excavated material on site is suitable for use as fill and backfill to meet Project requirements.
B. Imported Fill / Backfill:
   1. Well graded material conforming to ASTM D2487 free from debris, organic material, frozen materials, brick, lime, concrete, and other material which would prevent adequate performance of backfill.
      a. Under Building Footprint And Paved Areas: Fill shall comply with soil classification groups GW, CL, GP, GM, SW, SP, or SM. Fill may not contain stones over 6 inches diameter and ninety-five (95) percent minimum of fill shall be smaller than 1-1/2 inch in any direction.
      b. Under Landscaped Areas:
         1) Fill more than 36 inches below finish grade shall comply with soil classification groups GW, CL, GP, GM, SW, SP, or SM. Fill may not contain stones over 6 inches diameter and ninety (90) percent minimum of fill shall be smaller than 1-1/2 inch in any direction.
         2) Fill less than 36 inches below finish grade shall comply with soil classification groups SW, SP, SM, or SC. Fill may not contain stones larger than 1-1/2 inches in any direction and ninety (90) percent minimum of fill shall be smaller than 3/8 inch in any direction.
   2.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before placing fill, aggregate base, or finish work, prepare existing subgrade as follows:
   1. Do not place fill or aggregate base over frozen subgrade.
   2. Under Building Slab and Equipment Pad Areas:
      a. Scarify subgrade 6 inches deep, moisture condition to uniform moisture content of between optimum and four (4) percent over optimum, and mechanically tamp 6 inches deep to ninety-five (95) percent minimum of relative compaction.
   3. Under Driveways And Parking Areas:

a. Scarify subgrade 6 inches deep, moisture condition to uniform moisture content between optimum and four (4) percent over optimum, and mechanically tamp to ninety-five (95) percent minimum of relative compaction.

4. Under Miscellaneous Concrete Site Elements And Outside Face of Foundation Walls
   a. Scarify subgrade 6 inches deep, moisture condition to uniform moisture content between optimum and four (4) percent over optimum, and mechanically tamp to ninety-five (95) percent minimum of relative compaction.
5. Landscape Areas:
   a. Compact subgrade to eighty-five (85) percent relative compaction.

3.2 PERFORMANCE

A. Interface With Other Work:
   1. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
   2. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
   3. Section 31 2324: 'Flowable Fill' for backfilling of piping systems and other utilities under paving'.

B. Fill / Backfill:
   1. General:
      a. Around Buildings And Structures: Slope grade away from building as specified in Section 31 2216. Hand backfill when close to building or where damage to building might result.
      b. Site Utilities:
         1) In Landscape Areas: Use backfill consisting of on-site soil for utility trenches that are above the water table. Utility trenches that extend below the original free water level should be backfilled with free-draining gravel. Refer to Geotech report for required compaction requirements.
         2) Under Pavement and Concrete Site Elements: Extend excavatable flowable fill / backfill to elevation of subgrade. Do not place aggregate base material until excavatable flowable fill / backfill has cured seventy-two (72) hours. For utility for trenches that are above the water table, backfill consisting of on-site material is acceptable. Utility trenches that extend below the original free water level should be backfilled with free-draining gravel. Refer to Geotech report for required compaction requirements.
         3)
      c. Do not use puddling or jetting to consolidate fill areas.
   2. Compacting:
      a. Fill / Backfill And Aggregate Base:
         1) All fill material shall be well-graded granular material with maximum size less than 3 inch and with not more than fifteen (15) percent passing No. 200 sieve.
         2) Under Building Slab and Equipment Pad Areas:
            a) Place in 8 inch maximum layers, moisture condition to plus or minus two (2) percent of optimum moisture content, and mechanically tamp to ninety five (95) percent minimum of maximum laboratory density as established by ASTM D1557.
         3) Under Driveways And Parking Areas:
            a) Place in 8 inch maximum layers, dampen but do not soak, and mechanically tamp to ninety five (95) percent minimum of maximum laboratory density as established by ASTM D1557.
         4) Under Miscellaneous Concrete Site Elements And Outside Face of Foundation Walls:
            a) Place in 8 inch maximum layers, dampen but do not soak, and mechanically tamp to ninety five (95) percent minimum of maximum laboratory density as established by ASTM D1557.
         5) Utility Trenches:
            a) Site:
               (1) Place fill in 12 inch layers and moisture condition to plus or minus two (2) percent of optimum moisture content.
               (2) Compact fill to ninety-five (95) percent minimum relative compaction to within 12 inches of finish grade.
               (3) Compact fill above 12 inches to eighty-five (85) percent relative compaction.
            b) Under Slabs:
               (1) Under Slabs: Place fill in 6 inch layers, moisture condition to plus or minus two (2) percent of optimum moisture content, and compact to ninety five (95) percent minimum relative compaction to within 4 inches of finish grade.

(2) Final 4 inches of fill shall be aggregate base as specified in Section 31 1123.

6) Fill Slopes: Compact by rolling or using sheepsfoot roller.
7) Backfill Under Footings if required by Geotechnical Evaluation Report.
8) Landscape Areas:
   a) Compact fill to eighty-five (85) percent minimum relative compaction.
9) Other Backfills: Place other fills in 12 inch layers and compact to ninety five (95) percent relative compaction.
10) Loose material from compacted subgrade surface shall be immediately removed before placing compacted fill or aggregate base course.
11)

3.3 REPAIR / RESTORATION

A. Repair damage to other portions of the Work resulting from work of this Section at no additional cost to Owner. On new work, arrange for damage to be repaired by original installer.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':
      a. Quality Control is sole responsibility of Contractor:
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
            a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.
   2. Fill / Engineered Fill:
      a. Testing Agency shall provide testing and inspection for fill.
      b. Number of tests may vary at discretion of Architect.
      c. Testing Agency is to provide one (1) moisture-maximum density relationship test for each type of fill material.
      d. Prior to placement of engineered fill, inspector shall determine that site has been prepared in accordance with geotechnical report.
      e. Footing subgrade: At footing subgrades Certified Inspector is to verify that soils conform to geotechnical report.
      f. Testing Agency will test compaction of soils according to ASTM D1556/D1556M, ASTM D2167, and ASTM D6938, as applicable. Lift thicknesses shall comply with geotechnical report. Inspector shall determine that in-place dry density of engineered fill material complies with geotechnical report. Tests will be performed at following locations and frequencies:
         1) Paved Areas: At each compacted fill and backfill layer, at least one (1) test for every 10,000 sq. ft. or less of paved area but in no case less than three (3) tests.
         2) Building Slab Areas: At each compacted fill and backfill layer, at least on test for every 2,500 sq. ft. or less of building slab area but in no case less than three (3) tests.
         3) Foundation Wall/Continuous Footing Backfill: At each compacted backfill layer, at least one (1) test for each 40 linear feet or less of wall length, but no fewer than two (2) tests.
         4) Trench Backfill: At each 12 inch compacted lift for each 100 linear feet or less of trench length but no fewer than two (2) tests.
         5) Sidewalks, Curbs, Gutters, Exterior Pads: Minimum of one (1) test for each lift for each 40 lineal feet or one (1) test for every 5,000 sq. ft. or less of pad area but no fewer than three (3) tests.
      g. Required verification and inspection of soils as referenced in 2015 IBC (or latest approved edition) Table 1704.7 'Required Verification And Inspection Of Soils'. Periodic and continuous inspections include:
         1) Verify materials below shallow foundations are adequate to achieve design bearing capacity (periodic).
         2) Verify excavations are extended to proper depth and have reached proper material (periodic).
         3) Perform classification and testing of compacted fill materials (periodic).
         4) Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill (continuous).
         5) Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly (periodic).

3.5 CLEANING

A. Debris and material not necessary for Project are property of Contractor and are to be removed before completion of Project. However, if material necessary for Project is hauled away, replace with specified fill / backfill material.

END OF SECTION

SECTION 31 2324 FLOWABLE FILL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Furnish and install cement stabilized sand as described in Contract Documents.

B. Related Requirements:
   1. Section 01 1200: 'Multiple Contract Summary' for multiple contracts.
   2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
   3. Section 31 0501: 'Common Earthwork Requirements' for:
      a. General procedures and requirements for earthwork.
      b. Pre-installation conference held jointly with other common earthwork related sections.
   4. Section 31 1123: 'Aggregate Base' for aggregate base requirements.
   5. Section 31 2213: 'Rough Grading' for grading and preparation of natural soil subgrades below fill and aggregate base materials.
   6. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
   7. Section 31 2316: 'Excavation'.
   8. Performance of backfilling and compacting inside and outside of building required for electrical and mechanical work is responsibility of respective Section doing work unless arranged differently by Contractor.

1.2 REFERENCES

A. Association Publications:
   1. American Concrete Institute, Farmington Hills, MI www.concrete.org. Abstracts of ACI Periodicals and Publications.
      a. ACI 229R-99, *Controled Low-Strength Materials* (Reapproved 2005).

B. Definitions:
   1. Excavatable Flowable Fill /Controlled Low Strength Materials CLSM:
      a. Controlled Low Strength Material, (CLSM): Self-leveling and self-compacting, cementitious material.

b. Excavatable Flowable Fill: Unconfined compressive strength of 150 psi or less. Strengths exceeding this limit can be excavated using mechanical equipment, depending on mix composition and equipment. Due to continued strength-gaining characteristics of component materials such as fly ash and slag, excavatability of mixtures exceeding 150 psi should be proven prior to final placement.

c. Excavatibility: Material properly which relates to ease at which material may be removed.

d. Flowability: Material property which relates to rheology of material.

e. Flowable fill: Cementitious slurry consisting of mixture of fine aggregate or filler, water, and cementitious material(s), which is used as fill or backfill in lieu of compacted earth. This mixture is capable of filling all voids in irregular excavations and hard to reach places (such as under undercuts of existing slabs), is self-leveling, and hardens in matter of few hours without need for compaction in layers. Flowable fill is sometimes referred to as excavatable flowable fill, controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable fill. Flowable fill is not concrete nor used to replace concrete. It is intended to contain low cementitious content for reduced strength development.

C. Reference Standards:
1. ASTM International (Following are specifically referenced for fill and aggregate base testing):
a. ASTM C33/C33M-18, 'Standard Specification for Concrete Aggregates'.
b. ASTM C40/C40M-19, 'Standard Test Method for Organic Impurities in Fine Aggregates for Concrete'.
c. ASTM C42/C42M-18a, 'Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete'.
d. ASTM C94/C94M-18, 'Standard Specification for Ready-Mixed Concrete'.
e. ASTM C123/C123M-14, 'Standard Test Method for Lightweight Particles in Aggregate'.
f. ASTM C142/C142M-17, 'Standard Test Method for Clay Lumps and Friable Particles in Aggregates'.
g. ASTM C150/C150M-18, 'Standard Specification for Portland Cement'.
h. ASTM D558-11, 'Standard Test Methods for Moisture-Density (Unit Weight) Relations of Soil-Cement Mixtures'.
i. ASTM D2487-17, 'Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)'.
j. ASTM D3665-12(2017), 'Standard Practice for Random Sampling of Construction Materials'.
k. ASTM D4318-17, 'Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils'.
l. ASTM D6938-17a, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
1. Participate in MANDATORY pre-installation conference in conjunction with Section 31 2323.
2. In addition to agenda items specified in Section 01 3100, Section 31 2323, and Section 31 0501, review following:
a. Review backfill requirements.

1.4 SUBMITTALS

A. Informational Submittals:
1. Design Data:
a. Submit mix designs to meet following requirements:
1) Excavatable Fill (Flowable/Controlled Low Strength Materials CLSM):
a)Provide mix designs for review.
2. Design Data:
a. Submit mix designs to meet following requirements:
1) Excavatable Fill (Flowable/Controlled Low Strength Materials CLSM):
a) Provide target cement content and production data for sand-cement mixture in accordance with requirements as specified in Part 2 of this specification.
2) Cement Stabilized Sand:
a) Design will be based on strength specimens molded in accordance with ASTM D558 at moisture content within 3 percent of optimum and within four (4) hours of batching.
(1) Design will be based on strength specimens molded in accordance with ASTM D558 at moisture content within three (3) percent of optimum and four (4) hours of batching.
(2) Determine minimum cement content from production data and statistical history. Provide no less than 1.1 sacks of cement per ton of dry sand.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
1. Dosage capsules have storage tolerance in temperature range of 0 deg F to 55 deg F.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement Stabilized Sand:
   1. Cement: Type I Portland cement conforming to ASTM C150/C150M.
   2. Sand:
      a. Clean, durable sand meeting grading requirements for fine aggregates of ASTM C33/C33M, and the following requirements:
         1) Classified as SW, SP, SW-SM, SP-SM, or SM by Unified Soil Classification System of ASTM D2487.
         2) Maximum compressive strength of 125 psi maximum at 28 days.
         3) Minimum compressive strength of 65 psi maximum at 28 days.
         4) Deleterious Materials:
            a) Clay lumps, ASTM C142/C142M less than 0.5 percent.
            b) Lightweight pieces, ASTM C123/C123M less than 5 percent.
            c) Organic impurities, ASTM C40/C40M color no darker than standard color.
         5) Plasticity index of 4 or less when tested in accordance with ASTM D4318.
   3. Water: Potable water, free of oils, acids, alkalies, organic matter or other deleterious substances, meeting requirements of ASTM C94/C94M.

B. Excavatable Flowable Fill /Controlled Low Strength Materials CLSM:
   1. Excavatable application:
   2. Follow recommendations of ACI 229R.
   3. Contain maximum of 50 lbs to 100 lbs of cement per yard of flowable fill / backfill
   4. Air content:
      a. General:
         1) Stable air content of fifteen (15) to thirty-five (35) percent.
      b. Darafill:
         1) Stable air content of twenty (20) percent, Darafill dosage as necessary.
   5. Fly ash:
      a. Fly ash between 0 to 900 lbs per cu yd.
      b. When using less than 75 lbs per cu yd of Portland cement, combined quantity of Portland cement and fly ash must be at least 100 lbs per cu yd .
   6. Water content:
      a. Select water content as necessary to produce consistency that will result in flowable, self-leveling product at time of placement.
      b. Maximum water content of 36 gallons per yard of backfill.
   7. Slump: 7 inch minimum.
   8. Type Two Acceptable Products:
      a. Darafill by W R Grace & Co, Cambridge, MA www.na.graceconstruction.com.
      b. Equal as approved by Architect before use. See Section 01 6200.

2.2 MIXING MATERIALS

A. Cement Stabilized Sand:
   1. Add required amount of water and mix thoroughly in pug mill-type mixer.
   2. Stamp batch ticket at plant with time of loading. Reject material not placed and compacted within four (4) hours after mixing.

2.3 MIXING QUALIFICATION

A. Cement Stabilized Sand:

1. Determine target cement content of material as follows:
    a. Obtain samples of sand-cement mixtures at production facility representing range of cement content consisting of at least three (3) points.
    b. Complete molding of samples within four (4) hours after addition of water.
    c. Perform strength tests (average of two (2) specimens) at forty-eight (48) hours and seventy (7) days.
    d. Perform cement content tests on each sample.
    e. Perform moisture content tests on each sample.
    f. Plot average forty-eight (48) hour strength vs. cement content.
    g. Record scale calibration date, sample date, sample time, molding time, cement feed dial settings, and silo pressure (if applicable).
2. Test raw sand for following properties at point of entry into pug-mill:
    a. Gradation.
    b. Plasticity index.
    c. Organic impurities.
    d. Clay lumps and friable particles.
    e. Lightweight pieces.
    f. Moisture content.
    g. Classification.
3. Present data obtained in format similar to that provided in sample data form attached to this Section.
4. Target content may be adjusted when statistical history so indicates. For determination of minimum product performance use formula:
    a. *f c% 1/2 standard deviation.*

PART 3 - EXECUTION

3.1 PERFORMANCE

A. Interface With Other Work:

1. Section 31 2323: 'Fill'.

B. Fill / Backfill:

1. Site Utilities:
    a. In Landscape Areas: Use backfill consisting of on-site soil.
    b. Under Pavement and Concrete Site Elements: Extend excavatable flowable fill / backfill to elevation of subgrade. Do not place aggregate base material until excavatable flowable fill / backfill has cured seventy-two (72) hours.
2. Do not use puddling or jetting to consolidate fill areas.

3.2 PLACING

A. Cement Stabilized Sand:

1. Place sand-cement mixture in maximum 12 inch thick loose lifts and compact to ninety-five (95) percent of maximum density as determined in accordance with ASTM D558, unless otherwise specified:
    a. Refer to related specifications for thickness of lifts in other applications.
    b. Target moisture content during compaction is +3 percent of optimum.
    c. Perform and complete compaction of sand-cement mixture within four (4) hours after addition of water to mix at plant.
2. Do not place or compact sand-cement mixture in standing or free of water.

3.3 FIELD QUALITY CONTROL

A. Testing:

1. Flowable Fill:

a. Testing is not required.

b. Inspection of mix design, placement and compaction is required.

END OF SECTION

SECTION 31 3116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install complete soils treatment with termiticide under and adjacent to building to provide uniform toxic barrier continuous treated zone in all routes of termite entry.

B. Related Requirements:

1. Section 31: Earthwork.

a. Section 31 0501: 'Common Earthwork Requirements'.
b. Section 31 1123: 'Aggregate Base':

1) Installation of below-grade vapor retarder.

c. Section 31 2216: 'Fine Grading'.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate soil treatment application with excavation, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.
2. Interior slab-on-grade concrete:

a. Coordinate work so vapor retarder can be installed as soon as possible after application of termite protection on top of soil base or aggregate base.

B. Pre-Installation Conference:

1. Participate in mandatory pre-installation conference.
2. Schedule pre-installation conference for new Projects after completion of Fine Grading specified in Section 31 2216, but before beginning Aggregate Base as specified in Section 31 1123. This conference may be held jointly with pre-installation conference for Common Planting Requirements specified in Section 32 9001.
3. In addition to agenda items specified in Section 01 3100, review following:

a. Review Applicator Qualification requirements.
b. Review Ambient Conditions for acceptability for application of termiticide products.
c. Review Delivery, Storage, and Handling requirements.
d. Review Examination, Preparation, and Application requirements as called out in Part 3 Execution.
e. Review Field Quality Control and Protection requirements as called out in Part 3 Execution.

C. Sequencing:

1. Application OPTION A:

a. Apply termite protection on top of soil base before aggregate base and vapor retarder is installed.

2. Application OPTION B:

a. Install vapor retarder after application of termite protection on top of aggregate base.

b. Increase application rate for volume as per Manufacturer's instruction.
c. Install below-grade vapor retarder on top of soil base or aggregate base.

1.3 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Submit Chemical Manufacturer's printed literature regarding chemical composition, concentration, and rates and method of application.
b. Submit MSDS information.

B. Informational Submittals:

1. Certificates:

a. Provide certificates required by any authorities having jurisdiction (AHJ).

2. Design Data Submittals:

a. Certified Applicator's statement indicating total amount of chemical required for Project to provide required amount of mix solution at specified concentration and application rates.
b. Certified Applicator to submit take-off showing amounts of square foot and lineal foot application at specified application rate. Also indicate total amount of mix solution required for Project.

3. Manufacturers' Instructions:

a. Manufacturer's printed label on product regarding chemical composition, concentration, and rates and method of application.

4. Qualification Submittals:

a. Provide BASF Partner Number and evidence of license from authorities having jurisdiction (AHJ).

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Warranty Documentation:

1) Include copy of final, executed warranty.

b. Record Documentation:

1) Soil Treatment Application Report: After application of termiticide is complete, submit report including the following:

a) Date and time of application.
b) Moisture content of soil before application.
c) Termiticide brand name and batch number of concentrate.
d) Mix rate and quantity of diluted termiticide used.
e) Areas of application.
f) Weather at time of application.
g) Water source for application.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:

1. Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

B. Qualifications:

1. Applicator: Requirements of Section 01 4301 applies but not limited to the following:

a. Applicator shall be licensed pest professional according to regulations of authorities having jurisdiction (AHJ) with Manufacturer's Certification training in correct application methods to apply termite control treatment and products in jurisdiction where Project is located.
b. Applicator should be familiar with trenching, roddlng, short rodding, subslab injection, low-pressure banded surface applications, and foam delivery techniques.

C. Source Limitations:

1. Obtain termite control products from single source from single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery, Storage, and Handling:

1. Certified Applicator responsible for delivery, storage, handling, and dispose of specified products of this section.

B. Storage And Handling Requirements:

1. Storage:

a. Keep containers closed when not in use.
b. Store unused product in original container only, out of reach of children and animals.
c. Do not store near food or feed.
d. Protect from freezing.

2. Spills or leaks:

a. General:

1) In case of spill or leak on floor or paved surfaces, soak up with sand, earth, or synthetic absorbent.
2) Avoid skin contact.
3) Remove residue to chemical waste area.
4) Ensure adequate decontamination of tools and equipment following cleanup.

b. All leaks resulting in application of this product in locations other than those prescribed must be cleaned up prior to leaving application site.

1) DO NOT allow people or pets to contact contaminated areas until cleanup is completed.

C. Packaging Waste Management:

1. Disposal:

a. Dispose of empty containers in accordance with Manufacturer's and regulatory agency's requirements.
b. Do not contaminate water, food, or feed by storage or disposal.

1.6 FIELD CONDITIONS

A. Ambient Conditions

1. Comply with EPA-Registered Label and requirements of authorities having jurisdiction (AHJ) and Manufacturer's written recommendations regarding environmental conditions under which termiticide shall be applied.

B. Environmental Limitations:

1. To ensure penetration, do not treat soil that is water saturated or frozen.
2. Do not treat soil (or aggregate base) while precipitation is occurring or movement from treatment area (site) is likely to occur.
3. Do not treat soil (or aggregate base) while large precipitation is expected to occurring within two to four (2-4) hours after application.

1.7 WARRANTY

A. Manufacturer Warranty:

1. Provide Manufacturer's written warranty:

a. Warranty shall guarantee effectiveness of treatment against subterranean termite infestation for five (5) years minimum from acceptance date of Project and be signed by applicator and Contractor as co-guarantors.
b. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Termiticide:

1. Description:

a. Provide EPA-Registered termiticide, complying with requirements of authorities having jurisdiction (AHJ), in aqueous solution formulated to prevent termite infestation.
b. Provide quantity required for application at label volume and rate for maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

2. Design Criteria:

a. Undetectable:

1) Non-repellent or undetectable chemical technology.

b. Transfer Effect:

1) Slow-acting treatment allowing individual termite's ample time to transfer treatment to other termites as they come in contact within the colony.

c. Service Life of Treatment:

1) Soil treatment termiticide that is effective for not less than five (5) years against infestation of subterranean termites.

3. Mixes:

a. Mix chemicals and water at Manufacturer's recommended printed requirements.

1) To provide maximum control and protection against termite infestation, apply as per Manufacturer printed instructions including but not limited to the following:

a) To maximize termiticide potency, product should be applied in manner to provide continuous treated zone to prevent termites from infesting wood to be protected.
b) Product is labeled for use at 0.06 percent, 0.09 percent or 0.125 percent finished dilution. The 0.06 percent finished dilution should be used for typical control situations. Where severe termite infestations, problem soils, or difficult construction types are encountered, it may be advisable to use either 0.09 percent or 0.125 percent.

4. Category Four Approved Product. See Section 01 6200 for definitions of Categories. (No substitution of specified product or alteration of Manufacturer's application requirements is allowed):

a. Termidor by BASF Professional Pest Control, Research Triangle Park, NC www.termidorhome.com, or www.pestcontrol.basf.us.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Evaluation And Assessment:

1. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
2. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection Of In-Place Conditions:

1. Allow no disturbance of treated soil (aggregate base) between application of solution and placing of concrete. (Disturbed defined as removing fill and/or replacing fill).
2. Protect neighboring property, water sources, and personnel on site from contamination.

a. Use anti-backflow equipment or procedures.
b. Do not treat soil beneath structures that contain wells or cisterns.
c. Take extreme care to avoid runoff. Do not treat soil that is water-saturated or frozen.

3. Maintain, on job site, empirical name of chemical, Manufacturer's precautions, and phone numbers of proper authorities to notify in case of spillage or other accident.

B. General Preparation:

1. Comply with the most stringent requirements of authorities having jurisdiction (AHJ) and with Manufacturer's written instructions for preparation before beginning application of termite control treatment.
2. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, trash, and construction waste wood from soil within and around foundations.
3. Do not apply application of termite control until location of air ducts, vents, water, and sewer lines are known and identified. Take extreme caution to avoid contamination of these structural elements and airways.

C. Soil Treatment Preparation:

1. Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated.
2. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings.

3. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.
4. Fit filling hose connected to water source at site with backflow preventer, complying with requirements of authorities having jurisdiction (AHJ).

3.3 APPLICATION

A. Interface With Other Work:

1. Interior slab-on-grade concrete:

a. Installation of vapor retarder, geomembrane if used, and aggregate base.

B. General:

1. Comply with the most stringent requirements of authorities having jurisdiction (AHJ) and with Manufacturer's EPA-Registered Label for products.

a. Application Restrictions:

1) Do not apply while precipitation is occurring or large precipitation is expected to occurring within two to four (2-4) hours after application'.
2) Do not contaminate water, food or feed. Cover or remove all exposed food, feed and drinking water.
3) Do not apply with 15 feet of bodies of fresh water lakes, reservoirs, rivers, permanent streams, marshes, and natural ponds.
4) Do not allow residents, children, other persons or pets into immediate area during application.
5) Do not allow residents, children, other persons or pets into treated area until sprays have dried. After application, applicator is required to check for leaks resulting in deposition of treatment dilution in locations other than those prescribed.

2. Application OPTION B as specified in Sequencing of this specification in Part 1 General:

a. Increase application rate for volume as per Manufacturer's instruction.

C. Applying Soil Treatment:

1. Mix treatment termiticide solution to a uniform consistency.
2. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
3. If impervious soils make reduction in volume of solution necessary, increase percentage of toxicant used in proportion to insure same amount of insecticide be used per linear or square foot.
4. Apply overall treatment to entire surface to be covered by concrete slab.

D. Pre-Construction Treatment:

1. For Slab-on-Grade Construction:

a. 4 gallons per 10 linear ft along outside of exterior foundation.
b. One gallon per 10 sq ft as overall treatment under slab and attached porches.
c. 4 gallons per 10 linear ft along inside of exterior foundation walls, both sides of interior partition foundation walls, and around utility services and other features that will penetrate slab or where there will be break in concrete (grade changes, zip strips, cold joints, etc.).

3.4 RE-APPLICATION

A. Reapply treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.5 FIELD QUALITY CONTROL

A. Non-Conforming Work. Non-conforming work as covered in the General Conditions applies, but is not limited to the following:

1. Applicator:

a. Substitution of specified product or alteration of Manufacturer's application requirements is considered defective or not complying with Contract Document requirements. Correct such work at no cost to the Owner.

3.6 PROTECTION

A. Allow sufficient time (12 hours minimum) for drying after application before resuming construction activities.

B. Keep off treated areas until completely dry. Do not allow workers or other personnel to enter treatment area until chemical has been absorbed into soil.

C. Protect application areas from precipitation as recommended by Manufacturer.

D. Protect temiticide solution, dispersed in treated soils and fill, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

E. Post signs in areas of application warning of poison application. Remove signs when areas with application are covered by other construction.

END OF SECTION

SECTION 31 6421 - AGGREGATE PIER GROUND IMPROVEMENT

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION

A. Work shall consist of designing, furnishing and installing aggregate pier ground improvement to the lines and grades designated on the project foundation plan and as specified herein. Aggregate pier ground improvement as referenced in this specification shall be constructed by either vibro-replacement stone columns or Rammed Aggregate Pier® systems. The aggregate piers shall be in a columnar-type configuration and shall be used to mitigate liquefaction potential.

1.2 WORK INCLUDED

A. Provision of all equipment, material, labor, and supervision to design and install aggregate piers. Design shall rely on subsurface information presented in the project geotechnical report. Layout of aggregate piers, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is not included.

B. The aggregate pier design and installation shall adhere to all methods and standards described in this Specification.

C. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 1 Specifications, apply to the work in this specification.

1.3 APPROVED INSTALLERS

A. The Aggregate Pier Installer (the Installer) shall be approved by the Owner's Engineer prior to bid opening. Without exception, no alternate installer will be accepted unless approved by the Owner's Engineer at least two (2) weeks prior to bid opening.

B. Installers of aggregate pier foundation systems shall have a minimum of 5 years of experience with the installation of aggregate pier systems and shall have completed at least 50 projects.

C. Installers licensed by the Aggregate Pier system manufacturer will be accepted as approved installers.

1.4 REFERENCE STANDARDS

A. Design Standard

1. "Control of Settlement and Uplift of Structures Using Short Aggregate Piers," by Evert C. Lawton (Assoc. Prof., Dept. of Civil Eng., Univ. of Utah), Nathaniel S. Fox (President, Geopier Foundation Co., Inc.), and Richard L. Handy (Distinguished Prof. Emeritus, Iowa State Univ., Dept. of Civil Eng.), reprinted from IN-SITU DEEP SOIL IMPROVEMENT, Proceedings of sessions sponsored by the Geotechnical Engineering Division/ASCE in conjunction with the ASCE National Convention held October 9-13, 1994, Atlanta, Georgia.
2. "Settlement of Structures Supported on Marginal or Inadequate Soils Stiffened with Short Aggregate Piers," by Evert C. Lawton and Nathaniel S. Fox. Geotechnical Special Publication No. 40: Vertical and Horizontal Deformations of Foundations and Embankments, ASCE, 2, 962-974.
3. "Behavior of Geopier®-Supported Foundation Systems during Seismic Events," by Kord Wissmann, Evert C. Lawton, and Tom Farrell. Geopier Foundation Company, Inc. Blacksburg, VA ©1999.
4. "The design of vibro replacement." H.J. Priebe. Ground Engineering, London. Dec 1995.
5. Standard-of-practice liquefaction susceptibility and evaluation publications.

B. Quality Control Testing

1. ASTM D 1143 - Pile Load Test Procedures
2. ASTM D 1194 - Spread Footing Load Test
3. ASTM D 5778 – Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils (e.g. Cone

Penetration (CPT) probes)

C. Materials and Inspection

1. ASTM D 1241 - Aggregate Quality
2. ASTM D 422 - Gradation of Soils

D. Where specifications and reference documents conflict, the Aggregate Pier Designer shall make the final determination of the applicable document.

1.5 CERTIFICATIONS AND SUBMITTALS

A. Design Calculations - The Installer shall submit detailed design calculations and construction drawings prepared by the Aggregate Pier Designer (the Designer) for review and approval by the Owner or Owner's Engineer. All plans shall be sealed by a Professional Engineer in the State in which the project is constructed.

B. Professional Liability Insurance - The Aggregate Pier Designer shall have Errors and Omissions design insurance for the work. The insurance policy should provide a minimum coverage of $2 million per occurrence.

C. Modulus Test Reports - A modulus test(s), when required, is performed on a non-production Aggregate Pier element as required by the Aggregate Pier Designer to verify the design assumptions. The Installer shall furnish the General Contractor a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer.

D. Daily Aggregate Pier Progress Reports - The Installer shall furnish a complete and accurate record of Aggregate Pier installation to the General Contractor. The record shall indicate the pier location, length, volume of aggregate used or number of lifts, densification forces during installation, and final elevations or depths of the base and top of piers. The record shall also indicate the type and size of the installation equipment used, and the type of aggregate used. The Installer shall immediately report any unusual conditions encountered during installation to the General Contractor, to the Designer and to the Testing Agency.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Basis of Design: Geopier Foundation Company "Rammed Aggregate Piers"; www.geopier.com

B. Alternate systems shall be submitted for review by the Architect and the Structural Engineer prior to the receipt of bids. Alternative systems are subject to all requirements of these specifications. Documentation shall verify compliance with design criteria outlined herein and as shown on the Drawings.

2.2 AGGREGATE

A. Aggregate used by the Aggregate Pier Installer for pier construction shall be pre-approved by the Designer and shall demonstrate suitable performance during modulus testing. Typical aggregate consists of Type 1 Grade B in accordance with ASTM D-1241-68, No. 57 stone, recycled concrete or other graded aggregate approved by the Designer.

B. Potable water or other suitable source shall be used to increase aggregate moisture content where required. The General Contractor shall provide such water to the Installer.

2.3 DESIGN REQUIREMENTS

A. Aggregate Pier Design

1. The design of the Aggregate Pier system shall be based on the service load bearing pressure and the allowable total and differential settlement criteria of all footings indicated by the design team for support by the Aggregate Pier system. The Aggregate Pier system shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications.

a. The design life of the structure shall be 50 years.

b. MCE_R Seismic Design Parameters: $S_S = 1.135$, $S_1 = 0.405$.

2. The design shall meet the following criteria:

a. Maximum Allowable Bearing Pressure for Footings Supported by Aggregate Pier Reinforced Soils 2,000 psf

b. Estimated Total Long-Term Settlement for Footings: less than or equal to 0.5 inch

c. Estimated Long-Term Differential Settlement of Adjacent Footings: less than or equal to 0.5 inch

d. Minimum improvement depth of 15 feet. The Aggregate Pier designer may specify a greater depth in order to maintain the maximum settlement value.

e. Estimated Total Seismic Settlement for Footings: less than or equal to 1 inch

B. Design Submittal

1. The Installer shall submit detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval at least two week(s) prior to the beginning of construction. A detailed explanation of the design parameters for settlement calculations shall be included in the Design Submittal. Additionally, the quality control test program for Aggregate Pier system, meeting these design requirements, shall be submitted. All computer-generated calculations and drawings shall be prepared and sealed by a Professional Engineer, licensed in the State or Province where the piers are to be built. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

PART 3 - EXECUTION

3.1 APPROVED INSTALLATION PROCEDURES

A. The following sections provide general criteria for the construction of the Aggregate Piers. Unless otherwise approved by the Designer, the installation method used for Aggregate Pier construction shall be that as used in the construction of the successful modulus test.

B. Aggregate Piers Installed using augured Rammed Aggregate Pier systems -

1. Augured Rammed Aggregate Pier systems shall be pre-augured using mechanical drilling or excavation equipment.
2. If cave-ins occur during excavation such that the sidewalls of the hole are deemed to be unstable, steel casing shall be used to stabilize the cavity, or a displacement Rammed Aggregate Pier system may be used.
3. Aggregate shall be placed in the augured cavity in compacted lift thicknesses no greater than 24 inches as determined by the Aggregate Pier Designer.
4. Should cave-ins occur on top of a lift of aggregate such that the volume of the caved soil is greater than 10 percent of the volume of the aggregate in the lift, then the aggregate shall be considered contaminated and shall be removed and replaced with uncontaminated aggregate.
5. A specially designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The tamper diameter shall be at least 80% of the pre-augured hole diameter. The apparatus shall apply direct downward impact energy to each lift of aggregate.

C. Aggregate Piers Installed using Vibro-Replacement Stone Columns

1. If vibro-replacement stone column construction is used to construct the Aggregate Piers, the Installer shall use an electric down-hole vibroflot (probe) capable of providing at least 200 HP of rated energy and a centrifugal force of 30 tons. The vibroflot diameter must be at least 60% of the Aggregate Pier design diameter. An appropriate metering device should be provided at such a location that inspection of amperage build-up may be verified during the operation of the equipment. Metering device may be an ammeter directly indicating the performance of the vibroflot tip of the eccentric. Complete equipment specifications should be submitted to the Engineer prior to commencement of the fieldwork.
2. The probe and follower tubes shall be of sufficient length to reach the elevations shown on the installer's approved construction drawings. Pre-augering of each hole is required.
3. The probe shall penetrate into the foundation soil layer to the minimum depths required in the installer's construction

plans. After penetration to the required depth, the probe shall not be withdrawn more than 2 feet at any time unless the stone stops flowing to the bottom of the probe.

4. Redriving the probe into the treated depth shall be attempted at approximately 12 to 18-inch intervals to observe resistance to penetration and amperage build-up. During redriving, the probe tip shall penetrate to within 1 foot of the previous redriving depth.
5. Amperage build-up and backfill quantities will be contingent upon the type of probe used and procedures. Prior to commencement of work, the Contractor shall discuss the equipment capabilities with the Engineer to determine if trial probes will be necessary.
6. The Installer shall provide a full-time quality control technician on-site during the installation process.

D. Displacement Rammed Aggregate Pier Systems

1. Displacement Rammed Aggregate Pier systems shall be constructed by advancing a specially designed mandrel with a minimum 10-ton static force augmented by dynamic vertical ramming energy to the full design depth. The hollow-shaft mandrel, filled with aggregate, is incrementally raised, permitting the aggregate to be released into the cavity, and then lowered by vertically advancing and/or ramming to densify the aggregate and force it laterally into the adjacent soil. The cycle of raising and lowering the mandrel is repeated to the top of pier elevation. The cycle distance shall be determined by the Rammed Aggregate Pier designer.
2. Special high-energy impact densification apparatus shall be employed to vertically densify the Rammed Aggregate Pier elements during installation of each constructed lift of aggregate.
3. Densification shall be performed using a mandrel/tamper. The mandrel/tamper foot is required to adequately increase the lateral earth pressure in the matrix soil during installation.
4. Downward crowd pressure shall be applied to the mandrel during installation.

E. Plan Location and Elevation of Aggregate Piers

1. The as-built center of each pier shall be within 6 inches of the locations indicated on the plans. Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

F. Rejected Aggregate Piers

1. Aggregate Pier elements installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the Designer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction or mislocation.

3.2 QUALITY CONTROL

A. Control Technician

1. The Installer shall have a full-time, on-site Control Technician to verify and report all installation procedures. The Installer shall immediately report any unusual conditions encountered during installation to the Aggregate Pier Designer, the General Contractor, and to the Testing Agency. The quality control procedures shall include the preparation of Aggregate Pier Progress Reports completed during each day of installation containing the following information:

    a. Footing and Aggregate Pier location.
    b. Pre-auger diameter and soil conditions encountered during drilling (if required).
    c. Aggregate Pier length.
    d. Planned and actual Aggregate Pier elevations at the top and bottom of the Aggregate Pier.
    e. Average lift thickness of each Aggregate Pier.
    f. Volume of aggregate used in each Aggregate Pier.
    g. Documentation of any unusual conditions encountered.
    h. Type and size of densification equipment used.

B. Aggregate Pier Modulus Test

1. When authorized, an Aggregate Pier Modulus Test(s) shall be performed at locations agreed upon by the Aggregate Pier

Designer and the Testing Agency to verify or modify Aggregate Pier designs. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143 and ASTM D 1194, as outlined in the Aggregate Pier design submittal. Aggregate Piers shall be tested to 150 percent of the maximum design stress as shown in the aggregate pier design submittal. The modulus tests shall be of the type and installed in a manner specified herein.

2. A telltale shall be installed at the bottom of the test pier so that bottom-of-pier deflections may be determined. Acceptable performance is indicated when the bottom of the pier deflection is no more than 30% of the top of pier deflection at the design stress level.
3. ASTM D-1143 general test procedures shall be used as a guide to establishing load increments, load increment duration, and load decrements. As a minimum, the following loading increments, decrements and duration shall be used.

Increment	Approximate Load (percent design)	Minimum Duration (min)	Maximum Duration (min)
Seat	< 9	0	N/A
1	17	15	60
2	33	15	60
3	50	15	60
4	67	15	60
5	83	15	60
6	100	15	60
7	117	60	120
8	133	15	60
9	150	15	60
10	100	N/A	N/A
11	66	N/A	N/A
12	33	N/A	N/A
13	0	N/A	N/A

C. With the exception of the load increment representing approximately 117% of the design maximum top of Aggregate Pier stress, all load increments shall be held for a minimum of 15 minutes. Loads are then maintained until the rate of deflection reduces to 0.01 inch per hour or for the maximum of 1 hour, whichever is occurs first.

D. The load increment that represents approximately 117% of the design maximum stress on the Aggregate Pier shall be held for a minimum of 15 minutes. Loads are then maintained until the rate of deflection reduces to 0.01 inch per hour or for the maximum of 4 hours, whichever is occurs first.

E. A seating load equal to 5 percent of the total load shall be applied to the loaded steel plate prior to application of load increments and prior to measurement of deflections to compensate for surficial disturbance.

F. Bottom Stabilization Testing (BSTs) / Crowd Stabilization Testing (CSTs)

1. Bottom stabilization testing (BSTs) or Crowd stabilization testing (CSTs) shall be performed by the Control Technician during the installation of the modulus test pier. The tests are performed by applying downward vertical energy to the tamper, mandrel or probe following lift construction and monitoring the amount of additional deflection from the applied energy. Additional testing as required by the Aggregate Pier Designer (typically 10% of the production Aggregate Piers) shall be performed on selected production Aggregate Pier elements to compare results with the modulus test pier.

G. A minimum of XXX (X) Cone Penetration Test probe(s) shall be conducted within improved areas and appropriate calculations shall be provided by the Installer to confirm that the design criteria have been met.

3.3 QUALITY ASSURANCE

A. Independent Engineering Testing Agency (Owner's Quality Assurance)

B. The Aggregate Pier Installer shall provide full-time Quality Control monitoring of Aggregate Pier construction activities. The Owner or General Contractor is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

C. Responsibilities of Independent Engineering Testing Agency

D. The Testing Agency shall monitor the modulus test pier installation and testing. The Installer shall provide and install all dial indicators and other measuring devices.

E. The Testing Agency shall monitor the installation of Aggregate Piers to verify that the production installation practices are similar to those used during the installation of the modulus test elements.

F. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.

G. The Testing Agency shall observe the excavation, compaction and placement of the foundations as described in Section 7.05. Dynamic Cone Penetration testing may be performed to evaluate the footing bottom condition as determined by the Testing Agency.

3.4 RESPONSIBILITIES OF THE GENERAL CONTRACTOR

A. Site Preparation and Protection

1. The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Aggregate Piers.
2. Site grades for aggregate pier installation shall be within 1 foot of the top of footing elevation or finished grade elevation to minimize aggregate pier installation depths. Ground elevations and bottom of footing elevations shall be provided to the Rammed Aggregate Pier Installer in sufficient detail to estimate installation depth elevations to within 3 inches.
3. The General Contractor will provide site access to the Installer, after earthwork in the area has been completed. A working surface shall be established and maintained by the General Contractor to provide wet weather protection of the subgrade and to provide access for efficient operation of the Aggregate Pier installation.
4. Prior to, during and following Aggregate Pier installation, the General Contractor shall provide positive drainage to protect the site from wet weather and surface ponding of water.
5. If spoils are generated by aggregate pier installation, spoil removal from the aggregate pier work area in a timely manner to prevent interruption of aggregate pier installation is required.

B. Aggregate Pier Layout

1. The location of aggregate pier-supported foundations for this project, including layout of individual aggregate pier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

C. Contractor's / Owner's Independent Testing Agency (Owner's Quality Assurance)

1. General Contractor is responsible for acquiring an Independent Testing Agency (Quality Assurance) as required. Testing Agency roles are as described in Part 6 of this specification. The Aggregate Pier Installer will provide Quality Control services as described in Part 5 of this specification.

D. Excavations for Obstructions

1. Should any obstruction be encountered during Aggregate Pier installation, the General Contractor shall be responsible for promptly removing such obstruction, or the pier shall be relocated or abandoned. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., which shall prevent placing the piers to the required depth, or shall cause the pier to drift from the required location.
2. Dense natural rock or weathered rock layers shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials.

E. Utility Excavations

1. The General Contractor shall coordinate all excavations made subsequent to Aggregate Pier installations so that excavations do not encroach on the piers as shown in the Aggregate Pier construction drawings. Protection of completed Aggregate Piers is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Aggregate Piers, the General Contractor shall contact the Aggregate Pier Designer immediately to develop construction solutions to minimize impacts on the installed Aggregate Pier elements.

F. Footing Bottoms

1. Excavation and surface compaction of all footings shall be the responsibility of the General Contractor.
2. Foundation excavations to expose the tops of Aggregate Piers shall be made in a workman-like manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) avoid exposure to water, (2) prevent softening of the matrix soil between and around the Aggregate Piers before pouring structural concrete, and (3) achieve

direct and firm contact between the dense, undisturbed Aggregate Piers and the concrete footing.

3. All excavations for footing bottoms supported by Aggregate Pier foundations shall be prepared in the following manner by the General Contractor. Recommended procedures for achieving these goals are to:

    a. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment).
    b. Compaction of surface soil and top of Aggregate Piers shall be prepared using a motorized impact compactor ("Wacker Packer," "Jumping Jack," or similar). Sled-type tamping devices shall only be used in granular soils and when approved by the designer. Loose or soft surficial soil over the entire footing bottom shall be recompacted or removed, respectively. The surface of the aggregate pier shall be recompacted prior to completing footing bottom preparation.
    c. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on moisture-sensitive soils. If same day placement of footing concrete is not possible, open excavations shall be protected from surface water accumulation. A lean concrete mud-mat may be used to accomplish this. Other methods must be pre-approved by the Designer.

4. The following criteria shall apply, and a written inspection report sealed by the project Testing Agency shall be furnished to the Installer to confirm:

    a. That water has not been allowed to pond in the footing excavation at any time.
    b. That all Aggregate Piers designed for each footing have been exposed in the footing excavation.
    c. That immediately before footing construction, the tops of Aggregate Piers exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment.
    d. That no excavations or drilled shafts (elevator, etc) have been made after installation of Aggregate Pier elements within the excavation limits described in the Aggregate Pier construction drawings, without the written approval of the Installer or Designer.

5. Failure to provide the above inspection and certification by the Testing Agency, which is beyond the responsibility of the Aggregate Pier Installer, may void any written or implied warranty on the performance of the Aggregate Pier system.

3.5 PAYMENT

A. Measurement of the aggregate piers is on a lump sum basis.

B. Payment shall cover design, supply and installation of the aggregate pier foundation system. Excavation of unsuitable materials, delays, re-engineering, and remobilization as documented and approved by the Owner or Owner's Engineer, shall be paid for under separate pay items.

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

32 0118	Asphalt Paving Repair: Full Depth Patch
32 1313	Concrete Paving
32 1723	Pavement Markings
32 8423	Underground Sprinklers
32 8466	Underground Sprinklers – Controllers
32 9001	Common Planting Requirements
32 9120	Topsoil and Placement
32 9122	Topsoil Grading
32 9223	Sodding
32 9300	Plants

SECTION 32 0118 - ASPHALT PAVING REPAIR: FULL DEPTH PATCH

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Remove and replace paving and aggregate base in specific areas as described in Contract Documents and includes:

a. Install new asphalt that conforms to the state's Department of Transportation (DOT) requirements adapted to the location of the project.
b. Apply asphaltic material (tack coat) to existing asphalt concrete or Portland concrete surfaces before asphalt paving patch is placed.

B. Related Requirements:

1. Section 01 0000: 'General Requirements':

a. Section 01 1200: 'Multiple Contract Summary'.
b. Section 01 3100: 'Project Management and Coordination' for pre-installation conference.
c. Section 01 4000: 'Quality Requirements' for administrative and procedural requirements for quality assurance and quality control.
d. Section 01 4301: 'Quality Assurance – Qualifications' establishes minimum qualification levels required.
e. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
f. Section 01 7800: 'Closeout Submittals'.

2. Section 32 0117.01: 'Asphalt Paving Crack Seal'.
3. Section 32 0117.02: 'Asphalt Paving Crack Fill'.
4. Section 32 1713: 'Parking Bumpers'.
5. Section 32 1723: 'Pavement Markings'.

1.2 PRICE AND PAYMENT PROCEDURES

A. Alternates:

1. Provide alternate bid as specified in Section 01 2300: 'Alternates' if Asphalt Reinforcement Fibers will be added to hot asphalt mix:

a. Alternate No. A: 'Asphalt Reinforcement Fibers'.

1.3 REFERENCES

A. Association Publications:

1. Asphalt Institute:

a. MS-2, *'Mix Design Methods'* (7th Edition).

B. Definitions:

1. Aggregate: A hard inert mineral material, such as gravel, crushed rock, slag, or sand.

    a. Coarse Aggregate: Aggregate retained on or above No. 8 (2.36 mm) sieve.
    b. Coarse-Graded Aggregate: Aggregate having predominance of coarse sizes.
    c. Dense-Graded Aggregate: Aggregate that is graded from maximum size down through filler with object of obtaining an asphalt mix with controlled void content and high stability.
    d. Fine Aggregate: Aggregate passing No. 8 (2.36 mm) sieve.
    e. Fine-Graded Aggregate: Aggregate having predominance of fine sizes.
    f. Mineral Filler: Fine mineral product at least 70 percent of which passes a No. 200 (75µm) sieve.

2. Air Voids: Total volume of small air pockets between coated aggregate particles in asphalt cement concrete (ACC); expressed as percentage of bulk volume of compacted paving mixture.
3. Anti-Stripping Agent: Chemicals added to bitumen to improve the adhesion of the bitumen to hydrophilic aggregates
4. Asphalt Binder: Asphalt cement or modified asphalt cement that binds aggregate particles into dense mass.

    a. Asphalt Cement used in paving applications that has been classified according to the Standard Specification for Performance Graded Asphalt Binder, AASHTO Designation MP 320. It can be either unmodified or modified Asphalt Cement, as long as it complies with specifications.

5. Pre-emergent Herbicide: Chemical that is applied before weeds emerge. It acts by killing weed seedlings and /or establishing layer of chemical on or near soil surface that is toxic to germinating seeds and young seedlings. Herbicide are not soil Sterilants that temporarily or permanently prevents growth of all plants and animals.
6. Tack Coat: Very light application of liquid asphalt, or asphalt emulsion diluted with water.

C. Reference Standards:

1. American Association of State and Highway Transportation Officials:

    a. AASHTO T 322-07(2016), 'Standard Method of Test for Determining the Creep Compliance and Strength of Hot-Mix Asphalt (HMA) Using the Indirect Tensile Test Device.

2. ASTM International:

    a. ASTM D1556/D1556M-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method'.
    b. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))'.
    c. ASTM D2167-15, 'Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method'.
    d. ASTM D2172/D2172M-17, 'Standard Test Methods for Quantitative Extraction of Bitumen From Bituminous Paving Mixtures'.
    e. ASTM D2256/ D2256M-10(2015), 'Standard Test Method for Tensile Properties of Yarns by the Single-Strand Method'.
    f. ASTM D6932/D6932M-08(2013), 'Standard Guide for Materials and Construction of Open-Graded Friction Course Plant Mixtures'.
    g. ASTM D6938-17a, 'Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)'.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:

1. Participate in pre-installation conference as specified in Section 01 3100:
2. Schedule paving repair pre-installation conference to be held jointly with any other 'Asphalt Surface Treatment' section that involve asphalt maintenance.
3. In addition to agenda items specified in Section 01 3100, review following:

a. Review pre-emergent herbicide as specified in Section 31 0117.01 'Asphalt Paving Crack Seal' or Section 31 0117.02 'Asphalt Paving Crack Fill' for protection of adjoining property and planting area on site requirements, schedule and application requirements to be applied before asphalt paving patch areas are repaired.
b. Review aggregate base installation requirements.
c. Review asphalt paving repair (full depth patch) schedule.
d. Review asphalt paving repair (full depth patch) mix design.
e. Review safety issues.
f. Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.

1) Review requirements and frequency of testing and inspections.

B. Scheduling: Notify Testing Agency and Architect twenty four (24) hours minimum before placing aggregate base.

1. Notify Testing Agency and Architect twenty four (24) hours minimum before placing asphalt paving / full depth patch.

1.5 SUBMITTALS

A. Informational Submittals:

1. Manufacturer Instructions:

a. Asphalt Paving Patch:

1) Provide mix design.

2. Qualification Statement:

a. Installer:

1) Provide Qualification documentation if requested by Owner's Representative.

B. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Record Documentation:

1) Manufacturer's documentation:

a) Asphalt Manufacturer's product literature.
b) Pre-emergent Herbicide product literature and application documentation.

2) Testing and Inspection Reports:

a) Testing Agency Testing and Inspecting Reports of asphalt paving repair (full depth patch) and aggregate base.

1.6 QUALITY ASSURANCE

A. Qualifications: Requirements of Section 01 4301 applies but not limited to following:

1. Installer:

a. Minimum five (5) years' experience in asphalt surface treatment installations.
b. Minimum five (5) years satisfactorily completed projects of comparable quality, similar size, and complexity in past three (3) years before bidding:

2. Upon request, submit documentation.

B. Testing and Inspection:

1. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
2. Owner will provide Testing and Inspection for asphalt paving repair (full depth patch) and aggregate base:

a. Owner will employ testing agencies to perform testing and inspection for asphalt paving repair (full depth patch) and aggregate base as specified in Field Quality Control in Part 3 of this specification.

1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
2) See Section 01 1200: 'Multiple Contract Summary'.

1.7 FIELD CONDITIONS

A. Ambient Conditions:

1. Tack Coat:

a. Apply only when air and roadbed temperatures in shade are greater than 40 deg F. Temperature restrictions may be waived only upon written authorization from Architect or Civil Engineer.
b. Do not apply to wet surfaces.
c. Do not apply when weather conditions prevent tack coat from adhering properly.

2. Asphalt Paving Patch:

a. Do not perform work during following conditions. Temperature restrictions may be waived only upon written authorization from Owner's Representative:

1) Ambient temperature is below 45 deg For will fall below 45 deg F during placement.
2) Temperature of aggregate base below 50 deg F.
3) Presence of free surface water or weather is unsuitable.
4) Over-saturated aggregate base and subgrade materials.
5) Wind or ground cools mix material before compaction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aggregate Base:

1. Road Base type gravel or crushed stone, graded as follows:

a. Sieve — Percent of Weight Passing

1) 1 inch — 100
2) 3/4 inch — 85 - 100

3) No. 4 45 - 60
4) No. 10 30 - 50
5) No. 200 5 - 10 (non-plastic)

B. Asphaltic Paving Patch:

1. Install new asphalt that conforms to the state's Department of Transportation (DOT) requirements adapted to the area of the project

PART 3 - EXECUTION

3.1 PREPARATION

A. Owner Responsibilities:

1. Remove Scout Trailer(s) if needed.

3.2 PERFORMANCE

A. Repair Of Deteriorated Areas:

1. Cut edges of pavement in rectangular shape and for 1 foot minimum beyond damaged material. Make vertical cuts using pavement saw or cold planer.
2. Subgrade:

a. Repair and recompact damaged subgrades.

3. Aggregate Base:

a. Remove and replace damaged aggregate base and sub-grade. Aggregate base is to be at least6 inches thick when compacted.
b. Compact to ninety five (95) percent minimum density as determined by ASTM D1557.
c. Finished aggregate base course shall be true to line and grade within plus or minus 1/4 inch in 10 feet.

4. Apply tack coat to vertical edges of existing asphalt and curbs.
5. Asphalt Paving Patch:

a. Place full depth patch to match thickness of existing asphalt paving but not less than 3 inches (76 mm), at temperatures between 250 and 325 deg F.
b. Longitudinal bituminous joints shall be vertical and properly tack coated if cold. Transverse joints shall always be tack coated.
c. Compaction:

1) Compact paving to ninety four (94) percent plus three (3) percent minus two (2) percent of theoretical maximum specific gravity.
2) Roll with powered equipment capable of obtaining specified density. Vibratory plate compactor may be used for areas too small for large power equipment.
3) Begin breakdown rolling immediately after asphalt is placed when asphalt temperature is at maximum. Complete breakdown rolling before mix temperature drops below 240 deg F. Complete handwork compaction concurrently with breakdown rolling.
4) Complete intermediate rolling as soon as possible after breakdown rolling and before mix temperature drops below 185 deg F. Do not roll paving for compaction purposes after asphalt temperature falls below 185 deg F.
5) Execute compaction so visibility of joints is minimized. Complete finish rolling to improve asphalt surface as soon as possible after intermediate rolling and while asphalt paving is still warm. Do not use vibration for finish rolling.

6. Lift Thickness:

    a. Preferred Method:

        1) For pavements 3-1/2 inch or thinner apply asphalt paving in single lift.
        2) For pavements greater than 3-1/2 inch, use alternate method below.

    b. Alternate Method:

        1) Asphalt paving may be applied in two (2) lifts, first 2 inches thick minimum and second 1 1/2 inches thick minimum following temperature recommendations of following paragraph.
        2) Surface of first lift shall be clean and provide tack coat between first and second lifts.
        3) Provide not less than 2 times maximum aggregate size in compacted asphalt concrete mixes.

    c. Surface shall be uniform with no 'birdbaths'. Leave finished surfaces clean and smooth. Variations from specified grades shall not exceed 1/2 inch.

3.3 FIELD QUALITY CONTROL

A. Field Tests And Inspections:

1. Civil and structural field tests, laboratory testing, and inspections are provided by Owner's independent Testing Agency as specified in Section 01 4523 'Testing And Inspection Services':

    a. Quality Control is sole responsibility of Contractor:

        1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control:
            a) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.

    b. Provide copies of test reports as required in Section 01 4523 'Testing And Inspection Services' of Division 01 'General Requirements'.

2. Aggregate Base:

    a. Testing Agency shall provide testing and inspection for exterior aggregate base.
    b. Number of tests may vary at discretion of Architect.
    c. Testing Agency will test compaction of base in place according to ASTM D1556, ASTM D2167, and ASTM D6938, as applicable. Tests will be performed at following frequency:
    d. Sitework Areas: One (1) test for every 10,000 sq. ft. or less of exterior pads area but no fewer than three (3) tests.

3. Asphalt Paving Patch:

    a. Testing Agency shall provide full time nuclear density testing and inspection for asphalt paving during asphalt paving operations.
    b. Inspection to include:

        1) Aggregate coating.
        2) Asphalt content.
        3) Compaction control and effort required.
        4) Gradation.
        5) Suitability of spreading and paving equipment.
        6) Temperature of mix as delivered and placed.

c. Field Tests: When tested with 10 foot straight edge, surface of completed work shall not contain irregularities in excess of 1/4 inch.

1) Provide nuclear density testing of asphalt paving at a minimum rate of one (1) per 10,000 sq. ft. Minimum of three (3) tests required.

3.4 CLEANING

A. General:

1. Upon completion of repair operations, clean up and remove debris.

END OF SECTION

SECTION 32 1313 CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Prepare pavement subgrade and aggregate base as described in Contract Documents to receive concrete paving.
2. Furnish and install pavement aggregate base as described in Contract Documents.
3. Furnish and install Portland cement concrete paving, control joints and expansion joints as described in Contract Documents.

B. Related Requirements:

1. Section 01 1200: 'Multiple Contract Summary'.
2. Section 01 4523: 'Testing and Inspecting Services' for testing and inspection, and testing laboratory services for materials, products, and construction methods.
3. Section 03 2116: 'Epoxy-Coated Reinforcement Steel Bars.
4. Section 03 3111: 'Cast-In-Place Structural Concrete' for:
   a. Mix Type concrete mixes and admixtures.
   b. Field Quality Control Testing and Inspection requirements for concrete.
   c. Membrane Concrete Curing application.
   d. Pre-installation conference held jointly with other concrete specifications.
5. Section 03 3517: 'Concrete Sealer Finishing' for application in areas exposed to freeze/thaw cycles and deicing salts.
6. Section 03 3923: 'Membrane Concrete Curing' for quality of curing materials used.
7. Section 07 9213: 'Elastomeric Joint Sealants' for quality of joint sealants including other contractual and installation requirements.
8. Section 31 0501: 'Common Earthwork Requirements' for:
   a. General procedures and requirements for earthwork.

b. Pre-installation conference held jointly with other common earthwork related sections.

9. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.
10. Section 31 2213: 'Rough Grading' for grading requirements and preparation of natural soil subgrades below fill and aggregate base materials.
11. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
12. Section 31 2323: 'Fill' for compaction procedures and tolerances.

1.2 REFERENCES

A. Association Publications:

1. American Concrete Institute, Farmington Hills, MI www.concrete.org. Abstracts of ACI Periodicals and Publications.
   a. ACI 330R-13, '*Guide for the Design and Construction of Concrete Parking Lots*'.
   b. Certifications:
      1) ACI CP-1(13), *'Technical Workbook for ACI Certification of Concrete Field Testing Technician-Grade 1'*.
      2) ACI CP-10(10), *'Craftsman Workbook for ACI Certification of Concrete Flatwork Technician/Finisher'*.
      3) ACI CP-19(13), *'Technical Workbook for ACI Certification of Concrete Strength Testing Technician'*.
      4) ACI CP-43(11), *'Technical Workbook for ACI Certification of Aggregate Base Testing Technician'*.

B. Definitions:

1. Cold Weather, as referred to in this Section, is four (4) hours with ambient temperature below 40 deg F in twenty-four (24) hour period.
2. Hot Weather, as referred to in this Section, is ambient air temperature above 100 deg F or ambient air temperature above 90 deg F with wind velocity 8 mph or greater.

C. Reference Standards:

1. American Concrete Institute:
   a. ACI 301-16, 'Specification for Structural Concrete'.
   b. ACI 305.1-14/ACI 305M-14, 'Specification for Hot Weather Concreting'.
   c. ACI 306.1-90 (R2002), 'Standard Specification for Cold Weather Concreting'.
2. American Association of State and Highway Transportation Officials:
   a. AASHTO M 153-06 (2016), 'Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction'.
3. ASTM International:
   a. ASTM C39/C39M-18, 'Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens'.
   b. ASTM C78/C78M-18, 'Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)'.
   c. ASTM C94/C94M-17a, 'Standard Specification for Ready-Mixed Concrete'.
   d. ASTM D1752-18, 'Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction'.
   e. ASTM D3549/D3549-18, 'Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens'.
4. International Building Code (IBC) (2018 or most recent edition adopted by AHJ):
   a. Chapter 17, 'Structural Tests and Special Inspections'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:

1. Participate in MANDATORY pre-installation conference as specified in Section 03 3111:
   a. In addition to agenda items specified in Section 01 3100 and Section 03 3111, review following:
      1) Review placement, finishing, and curing of concrete including cold and hot weather requirements.
      2) Review approved mix design and use of admixtures requirements.
      3) Review concrete joint layout and joint sealant requirements.

4) Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
a) Review frequency of testing and inspections.

2. Participate in pre-installation conference as specified in Section 31 0501:
a. In addition to agenda items specified in Section 01 3100, Section 03 3111 and Section 31 0501, review following:
1) Review surveying and staking of parking areas and installation of sleeves.
2) Review fill and compaction requirements.
3) Review proposed aggregate base schedule.
4) Review rough grading elevations before placing paving fill.
5) Review fine grading elevations of subgrade before placing aggregate base and paving.
6) Review Section 01 4523 for Testing and Inspection administrative requirements and responsibilities and Field Quality Control tests and inspections required of this section.
a) Review frequency of testing and inspections.

B. Scheduling:
1. Notify Testing Agency and Architect twenty four (24) hours minimum before aggregate base.
2. Notify Testing Agency and Architect twenty four (24) hours minimum before placing concrete paving.

1.4 SUBMITTALS

A. Action Submittals:
1. Shop Drawings:
   a. Joint layout plan for written approval before starting work on this Section.

B. Informational Submittals:
1. Certificates:
   a. Installers:
      1) Certification for National Ready Mixed Concrete Association (NRMCA).
      2) Certification for ACI-certified Flatwork Finishers and Technicians.
2. Design Data:
   a. Mix Design:
      1) Furnish proposed mix design to Architect for review prior to commencement of Work.
         a) Mix design shall show proposed admixtures, amount, usage instructions, and justification for proposed use.
   b. Ready-Mix Supplier:
      1) Require mix plant to furnish delivery ticket for each batch of concrete. Keep delivery tickets at job-site for use of Owner or his representatives. Tickets shall show following:
         a) Name of ready-mix batch plant.
         b) Serial number of ticket.
         c) Date and truck number.
         d) Name of Contractor.
         e) Name and location of Project.
         f) Specific class or designation of concrete conforming to that used in Contract Documents.
         g) Amount of concrete.
         h) Amount and type of cement.
         i) Total water content allowed by mix design.
         j) Amount of water added at plant.
         k) Sizes and weights of sand and aggregate.
         l) Time loaded.
         m) Type, name, manufacturer, and amount of admixtures used.
         n) Design Data.
      2) Provide certificates with supporting testing reports verifying compliance with Contract Document requirements and that materials provided are from single source for following:
         a) Cement.
         b) Aggregate.
         c) Fly Ash.
3. Source Quality Control Submittals:
   a. Concrete mix design. See Section 03 3111 'Normal Weight Structural Concrete' for mix type submittal.
4. Special Procedure Submittals:
   a. Curing plan.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
   a. Record Documentation:
      1) Testing and Inspection Reports:
         a) Testing Agency Testing and Inspecting Reports of concrete paving.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Concrete paving to be installed in strict accordance with original design in accordance with all pertinent codes and regulations and all pertinent portions of Reference Standards.
   2. Obtain all necessary permits and permission to work in public right-of-ways.
   3. All equipment shall conform to all local and state regulations.

B. Qualifications: Requirements of Section 01 4301 applies, but is not limited to following:
   1. Installers And Installation Supervisor:
      a. ACI-certified Flatwork Finishers and Technicians.
   2. Ready-Mix Supplier:
      a. Comply with ASTM C94/C94M requirements and be certified according to NRMCA's 'Certification of Ready Mixed Concrete Production Facilities.'
   3. Testing Agencies:
      a. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technicians, Grade I.
      b. Personnel performing laboratory tests shall be ACI-certified Laboratory Testing Technicians, Grade I, and laboratory supervisor shall be ACI-certified Laboratory Testing Technician, Grade II.

C. Testing and Inspection:
   1. Owner will provide Testing and Inspection for concrete paving:
      a. Owner will employ testing agencies to perform testing and inspection for concrete paving as specified in Field Quality Control in Part 3 of this specification.
         1) Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform the Work in strict accordance with requirements of Contract Documents and perform contractor testing and inspection.
         2) See Section 01 1200: 'Multiple Contract Summary'.
      b. Owner's employment of an independent Testing Agency does not relieve Contractor of Contractor's obligation to perform testing and inspection as part of his Quality Control.
         1) Testing and inspections, if performed by Contractor, will be responsibility of Contractor to be performed by an independent entity.

1.6 FIELD CONDITIONS

A. Ambient Conditions:
   1. Cold Weather Limitations:
      a. Follow requirements of ACI 306 for cold weather concreting.
   2. Hot Weather Limitations:
      a. Follow requirements of ACI 305 for hot weather concreting.
   3. Do not perform work during unfavorable conditions as specified below:
      a. Presence of free surface water.
      b. Over-saturated aggregate base and subgrade materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Design Criteria:
   1. Design life of concrete paving system to be forty (40) years minimum.
   2. Aggregate: Conform to applicable requirements as specified in Section 03 3111 for concrete aggregate.
   3. Concrete: Conform to applicable requirements as specified in Section 03 3111 for mix type concrete mix and admixtures.
   4. Concrete curb and gutter shall be of type and size as shown on Contract Drawings.
   5. Provide wet cut control joints at spaces indicated on Contract Drawings.

B. Aggregate Base: Conform to applicable requirements as specified in Section 03 1123: 'Aggregate Base'.
C. Control Joint Filler Material:
    1. As specified in Section 07 9213 'Elastomeric Joint Sealants'.
D. Expansion Filler Material:
    1. Recycled PVC Joint Filler:
        a. Design Criteria:
            1) Expansion joint filler manufactured from 100 percent recycled vinyl material meeting requirements of ASTM D1752 and AASHTO M 153.
            2) 1/2 inch thick.
            3) Compressive/Recovery:
                a) Meet requirements for ASTM D1752 recover minimum of 90 percent of original thickness.
            4) Light gray color.
        b. Type One Approved Products:
            1) Proflex by Oscoda Plastics Inc, Oscoda, MI www.oscodaplastics.com.
            2) Equal as approved by Architect before bidding. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
    1. Inspect installed work of all other trades and verify that work is complete where installation of concrete paving may properly commence.
    2. Verify elevations of rough grading are correct before paving aggregate base and paving are placed.
    3. Verify grades of existing pavements at connection locations.
    4. Notify Architect of unsuitable conditions or discrepancies in writing.
    5. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
    6. Subgrade preparation may not begin until all utilities have been installed, including underground lighting and sprinkler systems.

3.2 PREPARATION

A. Barricades:
    1. Provide all necessary barricading.

B. Surface Preparation:
    1. Survey and stake parking surfaces to show grading required by Contract Documents.
    2. Subgrade (soil below aggregate base):
        a. Prepare natural soil subgrade as specified in Section 31 2213 'Rough Grading' or prepare fill subgrade as described in Section 31 2216 'Fine Grading'.
    3. Aggregate base:
        a. Finish grade parking surface area to grades required by Contract Documents.
        b. Compact aggregate base as specified in Section 31 1123.
        c. Tolerance:
            1) Aggregate base:
                a) Elevation of aggregate base shall be no more than 1/4 inch above or 1/2 inch below the design grade.
                b) Measure using string line from curb to curb, gutter, flat drainage structure, or grade break.

3.3 INSTALLATION

A. Interface With Other Work:
    1. Section 31 1123: 'Aggregate Base' for compaction of aggregate base.

2. Section 31 2213: 'Rough Grading' for rough grading and preparation of natural soil subgrades below fill and aggregate base materials.
3. Section 31 2216: 'Fine Grading' for grading of subgrade below aggregate base and topsoil.
4. Section 31 2323: 'Fill' for compaction procedures and tolerances.

B. Paving Forming:

1. Forms shall be cleaned and oiled each time they are used.
2. Sufficient forms shall be provided so that they may remain in place twelve (12) hours or longer after concrete has been placed.
3. Forms shall be secured to resist pressure of concrete and any finishing equipment riding on them without springing or settlement.
4. Joint forms neatly and tightly and securely pinned and staked to line and elevation shown.
5. Staked form lines shall be inspected and approved in advance of placing concrete.

C. Manholes And Valves:

1. Adjust manholes and valves in areas of concrete paving after forms have been set.

D. Paving Placement:

1. Place, strike off, and consolidate concrete with mechanical finishing machine or vibrating screed.
    a. Hand finishing methods may be used if approved by Architect.
    b. If screed is used, carry 2 inches of concrete minimum in front of screed for full width of pavement.
    c. Concrete may also be placed with slipform paver designed to spread, consolidate, screed, and float-finish concrete in one pass.
    d. When paving is being laid contiguous to previously finished concrete of the same finish grade elevation or contiguous to previously finished curb, such concrete or curb may be made to serve as side forms and as guide for implements for striking, tamping, and finishing.
2. Bull float surface with magnesium float immediately after screeding:
    a. Steel tools are not allowed.
    b. Surface of concrete must remain open to allow bleed water to pass.
3. Finish float surface with magnesium or wood float after bleed water has evaporated:
    a. Steel tools are not allowed.
4. Finish: Skid-resistant finish made with burlap drag or broom:
    a. Do not finish water into top surface trapping bleed water prior to bleed water evaporating.
5. Curing:
    a. Apply product as specified in Section 03 3923' Membrane Concrete Curing' to concrete paving:
    b. Apply Concrete Sealer Finishing to exterior concrete placed after about September 1st and located in areas exposed to freeze/thaw cycles and deicing salts.
        1) See Section 03 3517 'Concrete Sealer Finishing' for options available.
6. Joints:
    a. Control:
        1) Depth shall be 1/4 slab thickness except 1 inch is acceptable when using early entry saws (soft cut):
            a) Use 1/10 inch to 3/16 inch for unsealed joints.
            b) Use 1/8 inch to 1/4 inch for sealed joints.
        2) Complete before shrinkage cracking occurs.
        3) Make continuous across slab unless interrupted by expansion joint. Extend through adjoining curbs, gutters, and sidewalks.
        4) Space not more than 30 times thickness of slab up to maximum of 12-1/2 feet apart in any direction.
        5) Control Jointing Methods:
            a) Sawing: Begin sawing joints as soon as concrete has hardened enough to permit sawing without raveling.
            b) Hand-Formed: Maximum edge radius shall be 1/4 inch.
            c) Pre-molded joint former.
        6) Do not seal control joints.

b. Expansion:
1) Use to isolate fixed objects abutting or within paved area. Joints shall contain pre-molded joint filler for full depth of slab.
2) Expansion joints shall be installed where shown on the site plans.
3) Clean and seal before opening parking area to traffic.

E. Tolerances:
1. Paving thickness is shown on Contract Drawings.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
1. General:
a. Owner is responsible for Quality Assurance. Quality assurance performed by Owner will be used to validate Quality Control performed by Contractor.
b. Quality Control is sole responsibility of Contractor as specified in Section 01 4523 'Testing And Inspection Services'.
2. Concrete Paving:
a. Testing Agency shall provide testing and inspection for 'Concrete Paving' as specified in Section 03 3111 'Normal Weight Structural Concrete' in Part 3 Field Quality Control for concrete paving.

B. Non-Conforming Work: Non-conforming work as covered in the General Conditions applies, but is not limited to the following:
1. Rejection and Removal of Concrete Paving:
a. Reject concrete paving that does not meet requirements of Section 03 3111.
b. Remove concrete paving found defective after installation and install acceptable product at no additional cost to the Owner.
2. Acceptance:
a. General:
1) Opening paved surface to traffic does not constitute acceptance.
b. Strength:
1) General:
a) Lot is acceptable if strength test deviations are within Pay Factor 1.00 limits.
b) At Project Manager's discretion, after consulting with design team, a Lot with test deviation greater than Reject may stay in place at 50% cost.
2) Compression: ASTM C39/C39M. Lot size - 5,000 sq. ft.:
a) Pay Factor:
(1) 1.00 for 0 psi below 28 day compressive strength required.
(2) 0.90 for 1 psi to 100 psi below 28 day compressive strength required.
(3) 0.80 for 101 psi to 200 psi below 28 day compressive strength required.
(4) 0.70 for 201 psi to 300 psi below 28 day compressive strength required.
(5) 0.60 for 301 psi to 400 psi below 28 day compressive strength required.
(6) Reject for 401 psi or more below 28 day compressive strength required.
3) Flexural: ASTM C78/C78M. Lot size - 5,000 sq. ft.:
a) Pay Factor:
(1) 1.00 for 0 psi less than 28 day flexural strength required.
(2) 0.95 for 1 psi to 29 psi below 28 day flexural strength required.
(3) 0.85 for 30 psi to 60 psi below 28 day flexural strength required.
(4) Reject for 61 psi or more below 28 day flexural strength required.
c. Thickness:
1) General:
a) At Project Manager's discretion, after consulting with design team, payment may be made for areas deficient in thickness by more than 1 inch at 50 percent. If not, remove and replace at no additional cost to the Owner.
2) Paving thickness shall be as indicated in Tolerances above.
3) Grade: 1/8 inch in 10 foot parallel to centerline.

4) Cross Slope: 1/4 inch in 10 foot perpendicular to centerline except at cross section grade breaks.
5) Thickness will be determined on ASTM D3549/D3549 cored or sawed specimens. Acceptance will be based on the average of all Lot thickness tests:
   a) Pay Factor:
      (1) 1.00 for 0.00 inches to 0.25 inches less than specified thickness.
      (2) 0.90 for 0.26 inch to 0.50 inches less than specified thickness.
      (3) 0.70 for 0.51 inches to 0.75 inches less than specified thickness.
      (4) 0.50 for 0.76 inches to 1.00 inches less than specified thickness.
6) When thickness measurement is less than specified by more than 1 inch , actual thickness of pavement will be determined by taking additional cores at intervals less than 10 foot parallel to centerline in each direction from affected location, until in each direction core is found which is not deficient by more than 1 inch. Exploratory cores for deficient thickness will not be used in averages for price adjustments.

3.5 PROTECTION

A. Traffic:
1. Do not open pavement to traffic for three (3) days or until concrete reaches compressive strength of 1800 psi minimum, whichever is longer.
2. Restrict traffic to passenger cars and light trucks for seven (7) days.
3. In all cases, obtain approval from Architect before allowing access to parking area by traffic.

END OF SECTION

SECTION 32 1723 PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish acrylic paint and apply pavement and curb markings as described in Contract Documents including:

1.2 REFERENCES

A. Reference Standards:

1. Federal Specifications and Standards:
   a. FED-STD-595C, 'Federal Standard: Colors Used in Government Procurement' (16 Jan 2008).
   b. FED TT-P-1952F, 'Paint, Traffic and Airfield Marking, Waterborne' (17 Feb 2015).
2. U.S. Department of Transportation Federal Highway Administration:
   a. FHWA MUTCD-10, 'Manual on Uniform Traffic Control Devices'.

1.3 SUBMITTALLS

A. Action Submittal:

1. Product Data:
   1) Manufacturer's published product data and certification that product supplied meets requirements of this specification.

B. Informational Submittal:

1. Test And Evaluation Reports:
    a. Acrylic Paint:
        1) Provide reports showing compliance to FED TT-P-1952F.

C. Closeout Submittals:
1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
    a. Record Documentation:
        1) Manufacturer's Documentation:
            a) Product data.
            b) Specification compliance documentation.
        2) Testing and Inspection Reports:
            a) Reports showing compliance.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
1. Paint must meet requirements of FED TT-P-1952-F and local regulations for VOC.
2. Paint handicap spaces to conform to ADA Standards and local code requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
1. Materials shall be delivered in original, unopened containers with labels intact.
    a. Labels to include:
        1) Manufacturer's name and address.
        2) TT-P-1952F reference.
        3) Classification Type.
        4) Color.

B. Storage And Handling Requirements:
1. Follow Manufacturer's storage and handling requirements.
2. Protect stored material from freezing at temperatures above 35 deg F or above 115 deg F.
3. Do not invert or roll containers.

1.6 FIELD CONDITIONS

A. Ambient Conditions:
1. Acrylic Paint:
    a. Apply only on dry clean surfaces, during favorable weather (not excessively windy, dusty, or foggy), and when damage by rain, fog, or condensation not anticipated.
    b. Paving surface and Ambient temperature shall be minimum 50 deg F and rising.
    c. Temperature shall not drop below 50 deg F within twenty-four (24) hour period following application.
    d. Acetone based paints that are one hundred (100) percent acrylic shall not drop below 32 deg F within twenty-four (24) hour period following application.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Acrylic Paint:
1. Description:
    a. Low VOC, ready-mixed, one- component, acrylic waterborne traffic marking paint suitable for application on concrete, asphalt, sealers, and previously painted areas of these surfaces.
2. Design Criteria:

a. General:
   1) Traffic Paint.
   2) Non-volatile portion of vehicle for all classification types shall be composed of one hundred (100) percent acrylic.
   3) Meet FED TT-P-1952F specification requirements.
   4) Fast drying when applied at ambient conditions requirement.
   5) Low VOC.
   6) Non-Reflectorized.
   7) Traffic paints not intended for use as floor paints. Do not use on pedestrian walkways or large surfaces such as ramps, floors and stairs which may become slippery when wet.

b. Classification:
   1) Type I for use under normal conditions.

c. Composition:
   1) Non-volatile portion for all types shall be composed of one hundred (100) percent acrylic polymer as determined by infrared spectral analysis.
   2) Prohibited material:
      a) Product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolysable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogen.

d. Qualitative Requirements:
   1) Meet FED TT-P-1952F requirements for:
      a) Abrasion resistance.
      b) Accelerated package stability.
      c) Accelerated weathering.
      d) Appearance.
      e) Color requirements:
         (1) Color Match (all colors except white and yellow).
         (2) Daylight directional reflectance.
         (3) Yellow color match.
      f) Condition in container.
      g) Dry-through (early washout) for Type II only.
      h) Flexibility.
      i) Freeze/thaw stability.
      j) Heat-shear stability.
      k) Scrub resistance.
      l) Skinning.
      m) Titanium dioxide content.
      n) Water resistance.

e. Quantitative requirements:
   1) Meet FED TT-P-1952F requirements (Table 1).
   2) Acetone based paints that are one hundred (100) percent acrylic and have exempt status under Federal law are exempt from meeting FED TT-P-1925F requirements.

3. Colors:
   a. General:
      1) Traffic Paint will be furnished in white and any Federal Standard 595 color in accordance to FED-STD-595C:
         a) Yellow: 33538.
         b) Blue: 35180.
         c) Red: 31136.

   b. White (Yellow may be used at Owner Representative's discretion):
      1) Lane lines, edge lines, transverse lines, arrows, words, symbol markings, speed bump markings, parking space markings.

   c. Yellow:
      1) Cross-hatching in medians, cross hatching in safety zones separating opposing traffic flows, crosswalk stripes, safety markings, centerlines, edge lines along left edge of one-way roadway or one-way ramp.

   d. Blue And White:
      1) In parking spaces specifically designated as reserved for disabled.

   e. Red:

1) Fire lanes, no parking zones, special raised pavement markers that are placed to be visible to "wrong-way" drivers.

4. Type Two Acceptable Products:
   a. Any product meeting design criteria of this specification as approved by Architect/Owner's Representative before application. See Section 01 6200.

PART 3 - EXECUTION

3.1 PREPARATION

A. Acrylic Paint:
   1. Asphalt Surfaces:
      a. Do not apply paint until asphalt has cooled.
      b. Allow new seal coated surfaces to cure for at least twenty-four (24) hours before applying paint.
   2. Concrete Surfaces:
      a. Do not apply paint to new concrete surfaces until concrete has cured seven (7) days minimum.
B. Surfaces shall be dry and free of grease and loose dirt particles.
C. Perform layout with chalk or lumber crayon only.

3.2 APPLICATION

A. General:
   1. Mix in accordance and apply as per Manufacturer's instructions.
   2. Apply at locations and to dimensions and spacing as shown on Contract Drawings.
B. Tolerances:
   1. General: Make lines parallel, evenly spaced, and with sharply defined edges.
   2. Line Widths:
      a. Plus or minus 1/4 inch variance on straight segments.
      b. Plus or minus 1/2 inch variance on curved alignments.
C. Coverage:
   1. Paint stripes added to new asphalt and concrete surfaces:
      a. Apply single coat.
   2. Paint stripes applied to existing asphalt and concrete surfaces:
      a. Apply single coat to existing asphalt parking lot where no surface treatments are being applied to asphalt.
      b. .
   3. Apply traffic paint at rate of 13 to 15 mils minimum wet thickness, 8 to 9 mils dry thickness. Application at more than 15 mils may result in extended dry times and may cause lifting or cracking on some asphalt surfaces.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work:
   1. Replace or correct defective material not conforming to requirements of this specification or any work performed that is of inferior quality at no cost to Owner.

3.4 CLEANING

A. General:
   1. Remove drips, overspray, improper markings, and paint material tracked by traffic by sand blasting, wire brushing, or other method approved by Architect/Owner's Representative before performance.
B. Waste Management:

1. Remove debris resulting from work of this Section. Dispose of or recycle all trash and excess material in manner conforming to current EPA regulations and local laws.

END OF SECTION

SECTION 32 8423 - UNDERGROUND SPRINKLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install landscape irrigation system as described in Contract Documents complete with accessories necessary for proper function.

B. Related Requirements:

1. Section 01 4301: 'Quality Assurance – Qualifications'.
2. Section 31 2213: 'Rough Grading'.
3. Section 31 2216: 'Fine Grading'.
4. Section 31 2316: 'Excavation'.
5. Section 31 2323: 'Fill' for trench compaction.
6. Section 32: 8466: 'Underground Sprinklers: Controllers'.
7. Section 32 9001: 'Common Planting Requirements'.

    a. Pre-installation conference held jointly with other common planting related sections.

8. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.
9. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
10. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.
11. Section 32 9223: 'Sodding'.
12. Section 32 9300: 'Plants'.

1.2 REFERENCES

A. Definitions:

1. Dielectric Fittings: Special type of fitting used between dissimilar metals to prevent galvanic action from causing corrosion failure.
2. High Wind Area: As defined in this specification, area with average sustained wind speed of over 7.5 mph (12 km/hr).
3. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
4. Landscape Management Plan (LMP): See Section 32 9001 for definition.
5. Lateral Line: Downstream from electric control valves to application devices, heads and emitters. Piping or tubing is under pressure during flow. In areas where potable or secondary water are used, line shall be white. In areas where non-potable or reclaimed water are used, line shall be purple.
6. Main Line: Downstream from point of connection to electric control valves. Piping is under water-distribution-system pressure when activated by master valve or hydrometer. In areas where potable or secondary water are used, line shall be white. In areas where non-potable or reclaimed water are used, line shall be purple.
7. Peak Flow: Maximum required flow for given month based on six (6) day week, nine (9) hour day watering window to be used for irrigation system design and to be used in hydraulic analysis.
8. Plant Establishment Period: See Section 32 9001 for definition.
9. Point of Connection: Location where water enters irrigation system.
10. Static Water Pressure: Pressure at point of connection when system is not operable.
11. Source Pressure Test: Test to determine water source pressure.

12. System Pressure Test: Test to evaluate system when pressurized.
13. Two-Wire Path: Conducts power to solenoid valves, and also conducts communications signals from Controller to each device on system.
14. Working Pressure: Pressure at point of connection when system is operable.

B. Reference Standards:

1. ASTM International:

a. ASTM D2564-12, 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
b. ASTM F656-15, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Provide Coordination for required tests and inspections as described under Field Quality Control in Part 3 EXECUTION for following:

a. Manufacturer's Field Service: Provide necessary manufacturer's field service.
b. Pressure Test: In presence of Landscape Architect or designated Representative(s), provide pressure test.
c. Substantial Completion Walkthrough: In presence of Landscape Architect or designated Representative(s), plan and provide walk through after completion of irrigation system.
d. Landscape Final Acceptance: Inspection, no less than thirty (30) days following substantial completion, when all work has been completed, demonstrated, and approved by Landscape Architect. Coordinate with Section 32 8466 and Section 32 9000.

B. Pre-Installation Conference:

1. Participate in pre-installation conference as specified in Section 32 9001 held jointly with following sections:

a. Section 32: 8466: 'Underground Sprinklers: Controllers'.

2. Schedule pre-installation conference before irrigation system installation begins:

a. In addition to agenda items specified in Section 01 3100, review following:

1) Review mockup requirements.
2) Review required tests and inspections and submittal requirements.
3) Review Landscape Management Plan (LMP) requirements.

C. Sequencing:

1. Install sleeves and conduit before installation of cast-in-place concrete site elements and paving.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Manufacturer's cut sheets for each element of system.

B. Informational Submittals:

1. Certificates (Coordinate with 32 8466 and 32 9000 Sections):

    a. Irrigation System Approval:

        1) When irrigation system is approved, Landscape Architect will provide signed certificate:

            a) Certificate will include name and signature of Landscape Architect, Landscape Architect's company, Landscape Architect's telephone number, and date of review.
            b) Certificate will state to best of Landscape Architect's knowledge that the system is in full compliance with Contract Documents.

    b. Establishment Period Acknowledgement:

        1) Establishment Period begins at date of Substantial Completion. Landscape Architect will provide certificate acknowledging Establishment Period commencement:

            a) Certificate will include name and signature of Installer, Installer's company, Installer's telephone number, and date.
            b) Certificate will include name and signature of Owner's Representative, Owner's Representative Group name, Owner's Representative Group telephone number, and date.
            c) Certificate will acknowledge date when Establishment Period begins and that it extends one (1) year from that time.

    c. Training Acknowledgement:

        1) Landscape Architect will provide certificate acknowledging training has been performed:

            a) Certificate will include name and signature of Installer, Installer's company, Installer's telephone number, and date.
            b) Certificate will include name and signature of Owner's Representative, Owner's Representative Group name, Owner's Representative Group telephone number, and date.
            c) Certificate will acknowledge Owner's Representative has been trained in operation and maintenance of system.

2. Test And Evaluation Reports:

    a. Provide report for results of system pressure testing before burial of mainline.
    b. Provide following from system pressure test and observation:

        1) Record and submit documentation of system pressure tests, issues, and measure taken to correct problems.

3. Manufacturer Instructions:

    a. Manufacturer's printed literature on operation and maintenance of operating elements of system.
    b. Instruction Manual:

        1) Complete system operation and maintenance directions, including winterizing, controller program worksheet, and irrigation scheduling based on local site-specific conditions.

4. Qualification Submittals:

    a. Irrigation Subcontractor:

        1) Provide documentation if requested by Architect.

    b. Irrigation Installer:

1) Provide documentation if requested by Architect.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Submittal Format: Digital format only.
b. Operations And Maintenance Data:

1) Include additional copy for Landscape Management Plan (LMP) of the following information:

a) Provide irrigation system operation and maintenance recommendations.
b) Provide irrigation system operation and maintenance recommendations from manufacturers.
c) Provide irrigation system winterization instructions.
d) Provide plant establishment period watering schedule.
e) Provide post plant establishment period watering schedule.

c. Warranty Documentation (include additional copy for Landscape Management Plan (LMP):

1) Irrigation System Warranty.

d. Record Documentation:

1) Provide manufacturer's printed literature and cut sheets for each element of system.
2) Certificates:

a) Irrigation System Approval.
b) Training Acknowledgement.

3) Testing and Inspection Reports:

a) System Pressure Test.

4) Irrigation Record Drawings. As installation occurs, prepare accurate record drawing to be submitted before final inspection, including:

a) Detail and dimension changes made during construction. Record at time of installation.
b) Significant details and dimensions not shown in original Contract Documents.
c) Field dimensioned locations of valve boxes, manual drains, quick-coupler valves, control wire runs not in mainline ditch and both ends of sleeves.
d) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.
e) Take and record dimensions at time of installation.

5) Photographs: Provide photographs prior to burial of key elements including but not limited to:

a) Valves.
b) Drains.

2. Irrigation Drawings:

a. Irrigation Plan:

1) Laminated reduced size:

a) Size: 11 by 17 inches (275 by 425 mm).
b) Show color key circuits and laminated both sides with 5 mil thick or heavier plastic.

c) Mount on 12 by 18 inch (300 by 450 mm) hard board drilled with two (2) 1/2 inch (13 mm) holes at top of board.
d) Hang on hooks in Custodial Room or location designated by Owner's Representative.

2) Un-Laminated reduced size to be included in Landscape Management Plan (LMP):

a) Size: 11 by 17 inches (275 by 425 mm).
b) Show color key circuits.

3. Landscape Management Plan (LMP):

a. Submittal Format: Digital format and hard copy of each:

1) Irrigation Section: Include additional copies included in Operations and Maintenance Manual of following:

a) Provide irrigation system operation and maintenance recommendations.
b) Provide irrigation system operation and maintenance recommendations from manufacturers.
c) Provide irrigation system winterization instructions.
d) Provide plant establishment period watering schedule.
e) Provide post plant establishment period watering schedule.
f) Provide Warranty Documentation: Irrigation System Warranty.
g) Provide Un-Laminated, Reduced Size Irrigation Plan.

4. Final payment for system will not be authorized until Closeout Submittals are received and accepted by Architect and Landscape Architect.

D. Maintenance Material Submittals:

1. Tools:

a. Furnish following items before Final Closeout Review:

1) One (1) heavy-duty key for stop and waste or main shut-off valve.
2) One (1) quick coupler key with brass hose swivel.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. General:

a. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
b. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:

1. Irrigation Subcontractor:

a. Company specializing in performing work of this section.
b. Minimum five (5) years experience in irrigation sprinkler installations.
c. Minimum five (5) satisfactorily completed irrigation sprinkler installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
d. Use trained personnel familiar with required irrigation sprinkler procedures and with Contract Documents.
e. Foreman or supervisor required to attend pre-installation conference.
f. Upon request, submit documentation.

2. Irrigation Installer:

a. Perform installation under direction of foreman or supervisor.
b. Minimum three (3) years experience in irrigation sprinkler installations similar in size, scope, and complexity.
c. Upon request, submit documentation.

C. Mockups:

1. Provide Mockups of each detail within valve box at staging area for review by Landscape Architect prior to installation of irrigation system.
2. These mockups may be installed with or without solvent weld cement so that they can later be used in field.
3. Mockups shall include complete installation including weed barrier fabric, gravel sump, equipment assembly, and valve box placement and branding in conformance with these specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:

1. Protect materials from damage and prolonged exposure to sunlight.

1.7 WARRANTY

A. Warranty:

1. Irrigation System:

a. In addition to standard one (1) year guarantee stipulated in General Conditions Article 12.2., warranty shall include:

1) Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.

b. Warranty irrigation system for period of one (1) year from date of Substantial Completion. As part of warranty, Installer shall perform following:

1) Filling and repairing depressions and replacing plantings due to settlement of irrigation system trenches.
2) Repairing faulty equipment, wiring and pipe installations.
3) Repairing equipment and pipe not properly winterized.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:

1. Manufacturer Contact List:

a. 3M, Austin, TX www.3m.com/elpd.
b. Action Machining Inc, Bountiful, UT www.actionfilters.com.
c. Amiad Water Systems, LTD., Oxnard CA www.amiad.com
d. Apollo Valves by Conbraco Industries, Matthews, NC www.apollovalves.com.
e. Carson by Oldcastle Enclosure Solutions, Auburn, WA www.oldcastleenclosures.com.
f. Harrington Corporation (Harco), Lynchburg, VA www.harcofittings.com.
g. Hunter Industries, San Marcos, CA www.hunterindustries.com.
h. Hydropoint Data Systems (WeatherTrak), Petaluma, CA www.hydropoint.com
i. King Innovation, St Charles, MO www.kinginovation.com.
j. IPS Corporation, Compton, CA www.ipscorp.com.

k. Leemco, Colton, CA www.leemco.com.
l. Matco-Norca, Inc. Brewster, NY www.matco-norca.com
m. Netafim, Inc. www.netafimusa.com.
n. Nibco Inc, Elkhart, IN www.nibco.com.
o. Northstar Industries, LLC, Riverside, CA www.suresplice.com.
p. Paige Electric, Union, NJ www.paigewire.com.
q. Rain Bird Sprinkler Manufacturing Corp, Glendora, CA www.rainbird.com.
r. T. Christy Enterprises, Inc. (Christy's), Anaheim, CA www.tchristy.com.
s. Wilkins a Zurn Company, Paso Robles, CA www.zurn.com.

B. Materials:

1. Rock-Free Soil:

a. For use as backfill around PVC pipe.

2. Pea Gravel:

a. For use around drains, valves, and quick couplers.
b. 1/2 inch (13 mm) maximum dimension, washed rock.

3. Sand: Fine granular material naturally produced by rock disintegration and free from organic material, mica, loam, clay, and other deleterious substances. To be used as bedding of all mainlines and lateral lines.
4. Native Material: Soil native to project site free of wood and other deleterious materials and rocks over 1-1/2 inches (38 mm).
5. Topsoil:

a. Use soil as described in Section 32 9120, Section 32 9121, and Section 32 9122.
b. Achieve depths as described in Section 32 9122.

6. Pipe, Pipe Fittings, And Connections:

a. General:

1) Pipe shall be continuously and permanently marked with Manufacturer's name, size, schedule, type, and working pressure.
2) Pipe sizes shown on Contract Drawings are minimum. Larger sizes may be substituted at no additional cost to Owner.

b. Piping:

1) Main Line: Schedule 40 PVC.
2) Lateral Lines: Schedule 40 PVC.
3) Quick Coupler Piping: Galvanized steel.

c. Fittings: Same material as pipe, except where detailed otherwise.

1) Fittings 3 inch (76 mm) or larger: Harco or Leemco of matching size.
2) Use dielectric union fittings between dissimilar metal pipes and fittings.

d. Sleeves:

1) Under Parking Area And Driveway Paving: Schedule 40 PVC Pipe.
2) All Other: Class 200 PVC Pipe.
3) Sleeve diameter shall be two (2) times larger than pipe installed in sleeve.

7. Sprinkler Heads:

   a. Each type of head shall be product of single manufacturer.
   b. Spray Heads in Lawn Areas:

      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

         a) Refer to Irrigation Schedule on plans.

   c. Rotary Stream Heads in Lawn and Shrub Areas:

      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

         a) Refer to Irrigation Schedule on plans.

   d. Rotor Pop-ups:

      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

         a) None.

8. Sprinkler Risers:

   a. Spray Heads (Pre-Manufactured Swing Assemblies):

      1) Type Two Acceptable Products:

         a) Hunter: SJ-512 (12 inch (305 mm) x 1/2 inch (12.7 mm)) thread) or SJ-7512 (12 inch (305 mm) x 3/4 inch (19 mm) x 1/2 inch (12.7 mm)) thread).
         b) Rain Bird model SA125050.
         c) Equal as approved by Architect before use. See Section 01 6200.

   b. Spray Heads (Field Manufactured Assemblies:

      1) Three (3) schedule 40 street ells or Marlex street ells connected to lateral tee to form an adjustable riser or pop-up riser as detailed.
      2) Risers for sprinkler heads 14 inches (355 mm) long minimum and 24 inches (610 mm) maximum.

         a) Type Two Acceptable Products:
            (1) Hunter: FLEXsg tubing with HSBE spiral barbed fittings.
            (2) Rainbird: Swing Pipe with barbed fittings.
            (3) Equal as approved by Architect before installation. See Section 01 6200.

   c. Rotor Pop-Up Sprinklers (Pre-Manufactured Assemblies):

      1) Type Two Acceptable Products:

         a) 3/4 inch (19 mm) rotor pop-up sprinklers shall have an adjustable pre-assembled swing assembly riser. Swing assemblies shall be 3/4 inch x 12 inch (19 mm x 300 mm) and shall be threaded both ends. Swing assemblies shall be:
            (1) Rain Bird: Model TSJ-12075.
            (2) Hunter: SJ-712 12 inch (305 mm) thread.

         b) 1 inch (25 mm) inlet rotor pop-up sprinklers shall have an adjustable pre-assembled double swing joint riser. Swing joints shall be 1 inch x 12 inch (25 mm x 300 mm) and shall be threaded both ends. Swing joint riser shall be:

(1) Rain Bird: Model TSJ-12075.

2) Equal as approved by Architect before installation:

d. Rotor Pop-Up Sprinkler Heads (Field Manufactured Assemblies):

1) Pop-up rotor sprinkler heads shall have adjustable riser assembly, three (3) ell swing joint assembly, unless detailed otherwise on Contract Drawings:

a) These swing joint fittings shall be of schedule 40 PVC plastic and nipples schedule 80 gray PVC unless otherwise designated on Contract Drawings.
b) Horizontal nipple parallel to side of lateral line shall be 8 inches (200 mm) long minimum.
c) All other nipples on swing joint riser shall be of length required for proper installation of sprinkler heads.

9. Control Wiring:

a. Control Wiring:

1) Wiring:

a) Traditional control wire shall be UF-UL listed, color coded PE insulated copper conductor direct burial size 14. For wire runs exceeding 3,300 feet (1 005.84 meter), use 12 AWG wire. Do not use green color-coded wire.

2) Waterproof Wire Connectors:

a) Control wire connections shall consist of properly-sized wire nut inserted in waterproof grease cap:
b) Type Two Acceptable Products:
(1) DBY or DBR by 3M.
(2) 'One Step' 20111SP by King Innovation.
(3) DB 57905, 57505 by Orbit.
(4) Equal as approved by Architect before installation. See Section 01 6200.

b. Conduit:

1) Exterior applications or inside mechanical shed:

a) Galvanized IMC. Where in contact with earth or concrete, wrap galvanized IMC conduit and fittings completely with vinyl tape.

2) Controller grounding wire conduit: commercial grade PVC Sch. 40 grey conduit.
3) In-ground: commercial grade grey conduit.
4) Size conduit as follows:
5) Traditional Wiring:

Galvanized IMC Conduit						
Wire Size (AWG)	Number of Wires					
14	7	13	22	32	47	67
12	6	8	18	25	38	59

Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
PVC Sch. 40 Conduit						
Wire Size (AWG)	Number of Wires					
14	6	11	20	29	43	61
12	5	7	17	23	35	54
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)
PVC Sch. 80 Conduit						
Wire Size (AWG)	Number of Wires					
14	5	9	17	24	39	55
12	4	6	14	19	32	49
Conduit Size	3/4 inch (19 mm)	1 inch (25 mm)	1 1/4 inch (32 mm)	1 1/2 inch (38 mm)	2 inch (50 mm)	2 1/2 inch (64 mm)

10. Valves:

    a. Manual Drain Valves:

        1) Brass ball valve with 'T' handle on main lines and in valve boxes on lateral lines.
        2) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

            a) Apollo Valves: 78-621-01 Series ball valve, 3/4 inch (19 mm).

    b. Automatic Valves:

        1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

            a) Refer to Irrigation Schedule on plans.

    c. Isolation Valves:

        1) Non-rising stem gate valve, size to match pipe size.
        2) Class Two Quality Standards. See Section 01 6200:

            a) Nibco: T-113 (cold, northern climates).

11. Valve Accessories:

    a. Valve manifolds:

1) Type Two Acceptable Products.

a) Refer to Details Sheets.
b) Equals as approved by Architect before use. See Section 01 6200.

b. Valve Boxes And Extensions:

1) Lid Colors:

a) Green: Lawn areas (potable and secondary water).
b) Tan: Bare soil and rock areas (potable and secondary water).
c) Purple: Reclaimed water.

2) Type Two Acceptable Products:

a) Carson:
(1) 12 Inch (300 mm) Model 1324-12.
(2) 12 Inch (300 mm) Model 1419-12.
(3) 10 Inch (255 mm) Model 0910.
b) Equal as approved by Architect before use. See Section 01 6200.

c. Valve ID tags:

1) Type Two Acceptable Products:

a) Christy's: Stamped ID tag: 2.25"x2.7" yellow plastic tag with alpha-numeric labeling matching zone. Contact Christy's for local supplier.
b) Equal as approved by Architect before use. See Section 01 6200.

d. Valve Box Supports:

1) Standard size fired clay paving bricks without holes (See Details).
2) Standard size 6 inch x 8 inch x 16 inch (150 mm x 200 mm x 400 mm) CMU Block (See Details).

12. Drip System:

a. Drip Valve Assembly:

1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Refer to Irrigation Schedule on plans.

b. Distribution Tubing (from lateral lines to emitter):

1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Rainbird: SPX swing pipe with barbed fittings.
b) Hunter: SJ Series with barbed fittings.

c. Drip Emitters:

1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Refer to Irrigation Schedule on plans.

d. Indicator Emitter:

1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Tree drip indicator:
(1) Rainbird: XB-10PC with barbed fittings, DBC-025 diffuser cap, TS-025 stake, and XQ 1/4 inch (6.4 mm) tubing.

e. Distribution Tubing (from lateral lines to in-line emitter tubing).

1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Flexible polyethylene pipe.

f. In-Line Emitter Tubing:

1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Netafim: Techline CV tubing, flush valves, and fittings.

g. Valve Boxes and Extensions:

1) Lid Colors:

a) Green: Lawn areas (potable and secondary water).
b) Tan: Bare soil and rock areas (potable and secondary water).
c) Purple: Reclaimed water.

2) Type Two Acceptable Products:

a) Carson:
(1) 12 Inch (300 mm) Model 1324-12.
(2) 12 Inch (300 mm) Model 1220-12.
(3) 12 Inch (300 mm) Model 1419-12.
(4) 10 Inch (255 mm) Model 0910.

b) Equal as approved by Architect before use. See Section 01 6200.

h. Valve ID Tags:

1) Type Two Acceptable Products:

a) Christy's: Stamped ID tag: 2.25"x2.7" yellow plastic tag with alpha-numeric labeling matching zone. Contact Christy's for local supplier.
b) Equal as approved by Architect before use. See Section 01 6200.

i. Valve Box Supports:

1) Standard size fired clay paving bricks without holes (See Details).
2) Standard size 6 inch x 8 inch x 16 inch (150 mm x 200 mm x 400 mm) CMU Block (See Details).

13. Solvent Cement:

a. Category Four Approved Products. See Section 01 6200 for definitions of Categories:

1) Primer:

a) Meet ASTM F656 standard and applicable sections of latest edition of *'Uniform Plumbing Code'.*
b) Meet NSF/ANSI standard for use on potable water applications.
c) Low VOC emissions and compliant with LEED.
d) Product: Weld-On P-70 primer by IPS.

2) PVC Solvent Cement:

a) Heavy bodied, medium setting, high strength:
(1) Meet ASTM D2564 standard and applicable sections of latest edition of *'Uniform Plumbing Code'.*
(2) Meet NSF/ANSI standard for use on potable water applications.
(3) Meet CSA standards for use in pressure and non-pressure potable water applications.
(4) Low VOC emissions and compliant with LEED.
(5) Product: Weld-On 711 Low VOC PVC Cement by IPS.

14. Other Components:

a. Weed Barrier:

1) Type Two Acceptable Products:

b. Recommended by Manufacturer and subject to Architect's review and approval before installation.
c. Provide components necessary to complete system and make operational.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Irrigation System Installers:

1. Star Landscaping
2. Schramm Landscaping
3. Western Meadows
4. Terrafirma
5. Intermountain Plantings
6. Erickson Landscaping
7. Equal approved by Architect and/or Landscape Architect before bidding. See Section 01 4301.

3.2 EXAMINATION

A. Verification Of Conditions:

1. Perform source pressure test at stub-out on main water line provided for irrigation system, or at near-by fire hydrant.
2. Notify Architect if pressures over 80 psi (480 kPA) or under 70 psi (379 kPA) are found to determine if some re-design of system is necessary before beginning work on system.

3.3 PREPARATION

A. Protection:

1. Protection Of In-Place Conditions:

a. Repair or replace work damaged during course of Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.

b. Do not cut existing tree roots measuring over 2 inches (50 mm) in diameter in order to install irrigation lines.

B. Surface Preparation:

1. Layout of Irrigation Heads:

a. Location of heads and piping shown on Contract Drawings is approximate. Actual placement may vary slightly as is required to achieve full, even coverage without spraying onto buildings, sidewalks, fences, etc.

b. During layout, consult with Architect to verify proper placement and make recommendations, where revisions are advisable.

c. Minor adjustments in system layout will be permitted to avoid existing fixed obstructions.

d. Make certain changes from Contract Documents are shown on Record Drawings.

3.4 INSTALLATION

A. Trenching And Backfilling:

1. Pulling of pipe is not permitted.
2. Excavate trenches to specified depth. Remove rocks larger than 1-1/2 inch (38 mm) in any direction from bottom of trench. Separate out rocks larger than 1-1/2 inch (38 mm) in any direction uncovered in trenching operation from excavated material and remove from areas to receive landscaping.
3. Cover pipe both top and sides with 2 inches (50 mm) of sand as specified under PART 2 PRODUCTS. Remainder of backfill to topsoil depth as specified in Section 32 9122 using native material as specified under PART 2 PRODUCTS and topsoil as specified in Section 32 9120, Section 32 9121 and Section 32 9122.
4. Do not cover pressure main, irrigation pipe, or fittings until Architect has inspected and approved system.

B. Sleeving:

1. Sleeve water lines and control wires under walks and paving. Extend sleeves 6 inches (150 mm) minimum beyond walk or pavement edge. Cover sleeve ends until pipes and wires are installed to keep sleeve clean and free of dirt and debris.
2. Position sleeves with respect to buildings and other obstructions so pipe can be easily removed.

C. Grades And Draining:

1. In localities where winterization is required, grade piping so system can be completely drained or blown out with compressed air. If system is not designed to be blown out with compressed air:

a. Slope pipe to drain to control valve box where possible.

b. Where this is not possible, slope pipe to minimum number of low points. At these low points, install:

1) 3/4 inch (19 mm) brass ball valve for manual drain. Do not use automatic drain valves.
2) Install 2 inch (50 mm) Class 200 PVC pipe over top of drain and cut at finish grade.
3) Provide rubber valve cap marker.
4) Provide one cu ft (0.03 cu m) pea gravel sump at outlet of each drain.

c. Slope pipes under parking areas or driveways to drain outside these areas.

d. Provide and install quick-coupling valve or valves in location for easy blowout of entire system. Install quick coupler valves with 2 lineal feet (0.60 m) minimum of galvanized pipe between valve and main line.

D. Installation of Pipe:

1. Install pipe in manner to provide for expansion and contraction as recommended by Manufacturer.
2. Unless otherwise indicated on Contract Drawings, install main lines with minimum cover of 18 inches (450 mm) based on finished grade. Install lateral lines, including those connecting drip tubing, with minimum of 12 inches (300 mm) of cover based on finish grade.
3. Install pipe and wires under driveways or parking areas in specified sleeves 18 inches (450 mm) below finish grade or as shown on Contract Drawings.
4. Locate pipe so no sprinkler head will be closer than 12 inches (300 mm) from building foundation.

5. Cut plastic pipe square. Remove burrs at cut ends before installation so unobstructed flow will result.
6. Make solvent weld joints as follows:

    a. Do not make solvent weld joints if ambient temperature is below 35 deg F (2 deg C).
    b. Clean mating pipe and fitting with clean, dry cloth and apply one (1) coat of primer to each surface.
    c. Apply uniform coat of solvent cement to outside of pipe.
    d. Apply solvent cement to fitting in similar manner.
    e. Insert pipe completely into fitting.
    f. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
    g. Allow joints to set at least twenty-four (24) hours before applying pressure to PVC pipe.

7. Tape threaded connections with teflon tape.
8. Isolation Valves:

    a. Install as detailed and per Manufacturers recommendations.

9. If pipe is larger than 3 inches (75 mm), install joint restraints wherever change of direction occurs on PVC main lines.

E. Control Valves And Control Valve Wiring:

1. Install valves in plastic boxes with reinforced heavy-duty plastic covers. Locate valve boxes within 12 inches (300 mm) to 24 inches (600 mm) of sidewalks and shrub bed edges with tops at finish grade. Do not install more than one (1) valve in single box.
2. Install equipment for ease of removal.
3. Place 3 inches (75 mm) minimum of pea gravel below bricks supporting valve boxes to drain box. Set valve boxes over valve so all parts of valve can be reached for service. Set cover of valve box even with finish grade. Valve box cavity shall be reasonably free from dirt and debris.
4. Wiring:

    a. Use waterproof wire connectors consisting of properly-sized wire nut and grease cap at splices and locate all splices within valve boxes.
    b. Traditional Wiring:

        1) Tape control wire to side of main line every 10 feet (3.050 m). Where control wire leaves main or lateral line, enclose it in gray conduit:
        2) Use white or gray color for common wire and other colors for all other wire. Each common wire may serve only one (1) controller.
        3) Run one (1) spare control wire from panel continuously from valve to valve throughout system similar to common wire for use as replacement if wire fails:

            a) Run spare wire to each branch of system.
            b) Spare wire shall be different color than other wires. Use of green wire is not acceptable.
            c) Mark spare control wire visibly within valve box as an 'Un-Connected Wire'. Extend spare control wires 24 inches (600 mm) and leave coiled in each valve box. Mark spare wire visibly within controller as 'Un-Connected Wire'.

F. Sprinkler Heads And Rotor Pop-ups:

1. Set sprinkler heads and quick-coupling valves perpendicular to finish grade.
2. Do not install sprinklers using side inlets. Install using base inlets only.
3. Heads immediately adjacent to mow strips, walks, or curbs shall be one inch (25 mm) below top of mow strip, walk, or curb and have one inch (25 mm) to 3 inch (75 mm) clearance between head and mow strip, walk, or curb.
4. Set sprinkler heads at consistent distance from walks, curbs, and other paved areas and to grade by using specified components or other method demonstrated in Pre-Construction Conference.

G. Drip Assembly:

1. Install pipe providing for expansion and contraction as recommended by Manufacturer.
2. Cut tubing square and remove burrs at cut ends.
3. Distribution tubing shall be between 14 inches (350 mm) minimum and 48 inches (1 200 mm) maximum long. Layout PVC lateral lines as necessary to keep distribution tubing lengths within specified tolerances.
4. Locate drip emitter on uphill side of plant within rootball zone.
5. Layout in-line tubing for trees as indicated on Contract Drawings. Layout in-line tubing for shrubs and groundcovers so plants receive water within rootball zones.
6. Locate in-line tubing on top of soil but under bark/rock mulch and weed barrier fabric.
7. Staple in-line tubing to ground at 3 foot (900 mm) to 5 foot (1 500 mm) maximum intervals (sand = 3 foot (900 mm), loam = 4 foot (1 200 mm), clay = 5 foot (1 500 mm) and within 12 inches (300 mm) of ends and intersections.
8. Assembly Using Solvent Weld Joints:

    a. Do not make solvent weld joint if ambient temperature is below 35 deg F (2 deg C).
    b. Clean mating pipe and fitting with clean, dry cloth.
    c. Apply uniform coat of PVC solvent cement to outside of pipe and inside socket of fitting.
    d. Insert pipe completely into fitting.
    e. Give pipe or fitting quarter turn to insure even distribution of solvent and make sure pipe is inserted to full depth of fitting socket.
    f. Allow joints to set twenty-four (24) hours minimum before applying pressure to pipe.

9. Assembly Using 'Funny Pipe' Type Joints:

    a. Connect distribution tubing to lateral line using barbed ell fitting.
    b. Connect fitting to distribution tubing using straight barbed fitting with 1/2 inch (13 mm) threaded end.

H. Arrange valve stations to operate in an easy-to-view progressive sequence around building. Tag valves with waterproof labels showing final sequence station assignments.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections:

1. Irrigation System:

    a. System Pressure Test:

        1) Notify Landscape Architect two (2) working days minimum before conducting test.
        2) In presence of Landscape Architect, pressure test main line with all valves installed.
        3) Test pressure at 100 psi (690 kPA) minimum for two (2) hours minimum.
        4) Verify there are no leaks.
        5) Receive Landscape Architect approval to proceed prior to backfilling.

    b. Test report:

        1) Following pressure test, create pressure test report. Document pressure test results through providing photos, listing processes used, issues encountered, and measures taken to correct problems.

2. Substantial Completion Walkthrough:

    a. Landscape Architect or designated representative(s) will inspect site and create list of non-conforming items to be resolved prior to Landscape Final Acceptance. Date on this list will act as date of Landscape Substantial Completion.
    b. Installations completed after water source has been turned off for season, as determined by Landscape Architect, will be inspected following spring after system can be checked for proper operation.

3. Irrigation Approval:

    a. Irrigation will be approved when all non-conforming work is brought into conformance.

B. Non-Conforming Work: Non-conforming work as covered in General Conditions applies, but is not limited to following:

1. Underground Sprinkler System:

    a. Correct any work found defective or not complying with Contract Document requirements at no additional cost to Owner.

3.6 ADJUSTING

A. Sprinkler Heads:

1. Adjust sprinkler heads to proper grade when turf is sufficiently established to allow walking on it without appreciable harm. Such lowering and raising of sprinkler heads shall be part of original contract with no additional cost to Owner.
2. Adjust sprinkler heads for proper distribution and trim so spray does not fall on building.

B. Watering Time:

1. Adjust watering time of valves to provide proper amounts of water to plants.

3.7 CLOSEOUT ACTIVITIES

A. Training:

1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures using Landscape Management Plan (LMP).

    a. Describe difference between plant establishment schedule and long-term maintenance schedule.
    b. Describe annual and regular filter maintenance.

B. Winterization and Spring Start-Up:

1. During first year of operation, Installer shall shut-down irrigation system prior to freezing temperatures:

    a. Winter Shut-Down is intended to remove all potentially damaging water from irrigation system. Perform following as well as any other efforts necessary to properly winterize system:

        1) Turn off water source at point of connection.
        2) Blow out system with pressurized air, turning on each valve until water is cleared out of system. Run through system twice. Only blow out components suitable to receive pressurized air. Hydrometers, for instance, should not be blown out. Do not use excessive air pressure that will damage pipes and parts.
        3) Turn controller off.
        4) Open all manual drain valves.
        5) Drain and remove pumps for Owner's Representative storage.
        6) Drain filters using manufacturer's recommendations.
        7) Check sprinkler heads to make sure they are below sidewalk and curb levels and not vulnerable to snowplow damage. Lower heads to proper elevation.
        8) Notify Owner's Representative when system has been turned off.

END OF SECTION

SECTION 32 8466 - UNDERGROUND SPRINKLERS - CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install irrigation controllers as described in Contract Documents complete with accessories necessary for proper function.

B. Related Requirements:

1. Section 01 4301: 'Quality Assurance – Qualifications'.
2. Section 32: 8423: Underground Sprinklers' for:

   a. Certified Water Audit if required by AHJ.
   b. Landscape Management Plan (LMP).
   c. Plant Establishment Period.
   d. Pre-installation conference held jointly sprinkler controllers.

3. Section 32: 9001: 'Common Planting Requirements' for:

   a. Pre-installation conference held jointly with sprinkler controllers.

4. Division 26: Power to controller.

1.2 REFERENCES

A. Definitions:

1. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
2. Landscape Management Plan (LMP): See Section 32 9001 for definition.
3. Plant Establishment Period: See Section 32 9001 for definition.
4. Smart Controller: Irrigation clocks that automatically adjust irrigation run times in response to environmental changes using sensors and weather information to manage watering times and frequency.
5. Two Wire Path: Conducts power to solenoid valves, and also conducts communications signals from Controller to each device on system.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Provide Coordination for required tests and inspections as described under Field Quality Control in Part 3 EXECUTION for following:

   a. Substantial Completion Walkthrough: See Section 32 8423.
   b. Irrigation Final Approval: See Section 32 8423.

B. Pre-Installation Conference:

1. Participate in pre-installation conference as specified in Section 32 9001 and Section 32 8423:

a. In addition to agenda items specified in Section 32 8423, review following:

1) Review smart controller and submittal requirements.
2) Review 'Smart Controller Installation Checklist' Attachment included with this specification.
3) Review Training Certificate requirements for operation of smart controller.
4) Review Tests and Reports for smart controllers.

1.4 SUBMITTALS

A. Action Submittals:

1. Product Data:

a. Manufacturer's cut sheets for each element of system.

B. Informational Submittals:

1. Certificates (Coordinate with 32 8423 and 32900 Sections):

a. Training Acknowledgement:

1) Landscape Architect will provide certificate acknowledging training has been performed:

a) Certificate will include name and signature of Installer, Installer's company, Installer's telephone number, and date.
b) Certificate will include name and signature of Owner's Representative, Owner's Representative Group name, Owner's Representative Group telephone number, and date.
c) Certificate will acknowledge Owner's Representative has been trained in operation of smart controller.

2. Manufacturer Instructions:

a. Manufacturer's printed literature on operation and maintenance of operating elements of system.
b. Instruction Manual:

1) Complete system operation and maintenance directions, including winterizing, controller program worksheet, and irrigation scheduling based on local site-specific conditions.
2) Provide plant establishment schedule and long term maintenance establishment schedule specified in Section 32 8423.

3. Special Procedure Submittals:

a. Manufacturer's Smart Controller Approved Distributor Installer:

1) Complete and sign 'Smart Controller Installation Checklist' provided in Attachment of this specification to be given to Landscape Architect.
2) Signed 'Smart Controller Installation Checklist' to be included in Closeout Submittals.

4. Qualification Submittals:

a. Smart Controller Installer:

1) Provide documentation if requested by Architect.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Submittal Format: Digital format only.
b. Maintenance Contracts:

1) Smart Controller:

a) HydroPoint Weather TRAK:

(1) One (1) year ET subscription.

c. Operations And Maintenance Data:

1) Include additional copy for Landscape Management Plan (LMP) of information specified in Section 32 8423.

d. Warranty Documentation (include additional copy for Landscape Management Plan (LMP):

1) Smart Controller Warranty:

a) Manufacturer's extended Warranty for smart controller.

e. Record Documentation:

1) Testing and Inspection Reports:

a) Completed 'Smart Controller Installation Checklist'.

2. Landscape Management Plan (LMP) specified in Section 32 8423:
3. Final payment for system authorized as per Section 32 8423.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. General:

a. Submittal Format: Digital format only.
b. Work and materials shall be in accordance with latest rules and regulations, and other applicable state or local laws.
c. Nothing in Contract Documents is to be construed to permit work not conforming to these codes.

B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:

1. Smart Controller Installer:

a. Manufacture approved certified installers familiar with required irrigation system and smart controller installation procedures:

1) Agree to follow requirements as described under Installers in PART 3 EXECUTION.
2) Agree to complete reporting documents.
3) Agree to instruct Owner's designated personnel in complete operation and maintenance of smart controller.
4) Agree to assist Landscape Architect in completing Watering Schedule for Landscape Management Plan (LMP).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:

1. Protect materials from damage and prolonged exposure to sunlight.

1.7 WARRANTY

A. Warranty:

1. Smart Controller:

a. Provide Manufacturer's extended warranty for five (5) years to be free of design, materials and workmanship defects.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:

1. Manufacturer Contact List:

a. HydroPoint Data Systems, Inc., Petaluma, CA www.hydropoint.com.

B. Category Three Approved Manufacturer. See Section 01 6200 for definitions of Categories:

1. Design Criteria:

a. Provide smart controller and all components from same Approved Distributor only.

2. HydroPoint Data Systems, Inc. (Weather/TRAK) Petaluma, CA www.hydropoint.com.

a. Approved Distributor Contact Information.

1) Utah Contact:

a) Sprinkler Supply - West Jordan, UT, Joe Jackson (801) 404-1371 (801) 566-8172 joe@sprinklersupplyco.com.

C. Materials:

1. Automatic Controller:

a) HydroPoint WeatherTRAK:

(1) Traditional Wiring:
(2) Inspection of system.
(3) Vandal resistant powder coated steel finish suitable for either indoor or outdoor environments. Provide stainless steel where outdoor conditions require non-corrosive material.
(4) Wall mounted enclosure assembly.
(5) Key-Lock.
(6) Low Profile Antenna.
(7) Universal Radio remote interface.
(8) One (1) year ET subscription.
(9) On-site post-installation controller inspection and start-up by authorized service provider.
(10) Site consultation.
(11) All other components required for complete and operational system.

b. Automatic Rain Sensors (supplied by Approved Distributor or Approved Manufacturer):

1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:

a) Refer to Irrigation Schedule on plans.

2. Other Components:

    a. Recommended by Manufacturer and subject to Architect's review and approval before installation.
    b. Provide components necessary to complete system and make operational.

PART 3 - EXECUTION

3.1 INSTALLERS

A. Approved Irrigation System Installers:

1. Star Landscaping.
2. Schramm Landscaping.
3. Western Meadows
4. Terrafirma.
5. Intermountain Plantings
6. Erickson Landscaping
7. Equal approved by Architect and/or Landscape Architect before bidding. See Section 01 4301.

B. Category Three Approved Smart Controller Installers. See Section 01 6200 for definitions of Categories:

1. Provide Qualification documentation as described under Informational Submittals in Part 1 GENERAL:

    a. WeatherTRAK: Factory approved installer having completed WeatherTRAK certified contractor training (see www.weathertrak.com for details.

3.2 PREPARATION

A. Protection:

1. Protection Of In-Place Conditions:

    a. Repair or replace work damaged during course of Work at no additional cost to Owner. If damaged work is new, installer of original work shall perform repair or replacement.
    b. Do not cut existing tree roots measuring over 2 inches (50 mm) in diameter in order to install irrigation lines.

3.3 INSTALLATION

A. Controllers:

1. Install as detailed and as per manufacturer's recommendations.
2. Install smart controller as per Controller Manufacturer's details and installation recommendations
3. In hot climates, install out of sun exposure.
4. Install grounding as per Manufacturer's recommendations:

    a. Note: if controller is mounted within building, coordinate grounding with Electrical Engineer.

5. Install automatic rain sensor as per Manufacturer's recommendations.
6. Provide sticker with Facility Manager's Contact information inside Controller, but in plain view.

B. Smart Controller:

1. Fill out 'Smart Controller Installation Checklist' provided in Attachment of this specification during installation of Controller.
2. Install smart controller as per Controller Manufacturer's details and installation recommendations.

3. In hot climates, install out of sun exposure.
4. Install grounding as per Manufacturer's recommendations:

    a. Note: if controller is mounted within building, coordinate grounding with Electrical Engineer.

5. Install automatic rain sensor as per Manufacturer's recommendations.
6. Provide sticker with Facility Manager's Contact information inside Controller, but in plain view.
7. Install communication connections as required: Wireless and/or ethernet.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections:

1. Smart Controller Testing:

    a. Use 'Smart Controller Installation Checklist' or 'Manufacturer's Operational Report' to test system to verify following:

        1) Verify all aspects of smart controller installation checklist or 'Manufacturer's Operational Report' are complete.
        2) Verify controller is installed correctly and will automatically adjust irrigation run times in response to environmental changes using sensor and weather information to manage watering times and frequency.
        3) Sign 'Smart Controller Installation Checklist' to be included in Closeout Submittals.

B. Non-Conforming Work: Non-conforming work as covered in General Conditions applies, but is not limited to following:

1. Underground Sprinkler System:

    a. Correct any work found defective or not complying with Contract Document requirements at no additional cost to Owner.

3.5 ADJUSTING

A. Watering Time:

1. Adjust watering time of valves to provide proper amounts of water to plants.

3.6 CLOSEOUT ACTIVITIES

A. Training:

1. After system is installed and approved, instruct Owner's designated personnel in complete operation and maintenance procedures using Landscape Management Plan (LMP).

    a. Describe difference between plant establishment schedule and long-term maintenance schedule.
    b. Describe annual and regular filter maintenance.

2. Smart Controller Training:

    a. Manufacturer's approved Distributor to instruct Owner's designated personnel in complete operation and maintenance of smart controller.
    b. Manufacturer's approved Distributor to review terms of Warranty, Maintenance procedures and contact information with Owner's Representative.

END OF SECTION

ATTACHMENTS

SECTION 32 9001 - COMMON PLANTING REQUIREMENTS

PART 1 - GENERAL

SUMMARY

Includes But Not Limited To:

1. Common procedures and requirements for landscaping work.
2. Provide maintenance for new landscaping as described in Contract Documents.

Related Requirements:

3. Pre-Installation conferences held jointly with Section 32 9001 as described in Administrative Requirements on Part 1 of this specification section:
4. Section 01 4301: 'Quality Assurance – Qualifications'.
5. Section 31 0501: 'Common Earthwork Requirements'.
6. Section 31 1100: 'Clearing and Grubbing'.
7. Section 31 1413: 'Topsoil Stripping And Stockpiling'.
8. Section 31 2213: 'Rough Grading'.
9. Section 31 2216: 'Fine Grading'.
10. Section 31 2316: 'Excavation'.
11. Section 31 2323: 'Fill'.
12. Section 32 8423: 'Underground Sprinklers'.
13. Section 32 9120: 'Topsoil And Placement'.
14. Section 32 9122: 'Topsoil Grading'.
15. Section 32 9223: 'Sodding'.
16. Section 32 9300: 'Plants'.
17. Section 32 9413: 'Landscape Edging'.

REFERENCES

Definitions:

18. Landscape Management Plan (LMP): LMP is an Owner's Representative's quick reference maintenance document. It is a combination of Irrigation Sections from 32 8000 and Planting Sections from 32 9000. The LMP document is created from Operations and Maintenance Data, Warranty Documentation, and Record Documentation
19. Landscape Final Acceptance: Inspection, no less than (30) days following substantial completion, when all work has been completed, demonstrated, and approved by the Landscape Architect. Coordinate with Sections 32 8423 and Sections under 32 9000 'Planting'.
20. Plant Establishment Period: Time required for plants to successfully develop root systems into surrounding soil. Following this period, irrigation run times are typically modified. For purposes of this contract, the plant establishment period is assumed to be one (1) year from date of Substantial Completion.

ADMINISTRATIVE REQUIREMENTS

Pre-Installation Conference:

21. Participate in MANDATORY pre-installation conference and held jointly with following sections:
    a. Section 32 8423: 'Underground Sprinklers'.
    b. Section 32 9120: 'Topsoil And Placement'.

c. Section 32 9122: 'Topsoil Grading'.
d. Section 32 9223: 'Sodding'.
e. Section 32 9300: 'Plants'.

22. In addition to agenda items specified in Section 01 3100, review the following:

    a. Site Visits:

        1) Landscape Architect to visit site five (5) times during project construction.
        2) If site conditions necessitate additional visits, Landscape Architect can schedule addition site visits with approval from Architect prior to bid.
        3) During construction, addition site visits may be approved in writing by Architect or Owner for special considerations before commencement.
        4) Site visits caused by lack of work progress by Landscape Subcontractor shall reimburse Landscape Architect amount determined by Architect or Owner for additional site visits.

    b. Coordination:

        1) Landscape Subcontractor and Landscape Architect to coordinate site visits and include Architect and General Contractor in communications.

    c. Landscape Maintenance:

        1) Establish responsibility for maintenance of new landscaping during all phases of construction period.

    d. Percolation Test:

        1) Prepare two (2) typical landscape planting excavations and conduct percolation test to verify that water drains away within two (2) hours.
        2) Discuss results of percolation tests with Architect and Owner's Representative.

    e. Review additional agenda items as specified in related sections listed above.

23. Approved Site Visits:

    a. Site Visit No. 1:

        1) Description:

            a) Landscape pre-installation Conference.

        2) Schedule: Conduct pre-installation conference after completion of Fine Grading specified in Section 31 2216, but one (1) week minimum before beginning landscape work.

        3) Required Attendees:

            a) Project Manager, Facilities Manager, Architect, General Contractor, Landscape Subcontractor, Excavator, and Landscape Architect.
            b) Include Landscaping Subcontractor Foreman and those responsible for installation of landscaping to be in attendance.

        4) Related Sections:

            a) Section 31 0501: 'Common Earthwork Requirements'.
            b) Section 32 8423: 'Underground Sprinklers'.
            c) Section 32 9120: 'Topsoil And Placement'.

d) Section 32 9121: 'Topsoil Physical Preparation' (section included based on Topsoil Testing Report).
e) Section 32 9122: 'Topsoil Grading'.
f) Section 32 9219: 'Seeding'.
g) Section 32 9222: 'Hydro-Seeding'.
h) Section 32 9223: 'Sodding'.
i) Section 32 9300: 'Plants'.

5) Notes:

a) Verify project site conditions and review scope of work before installation begins.
b) Verify appropriate sub-grades have been established.

6) Description:

a) Irrigation system pressure test compliance, main line inspection, valve inspection.

7) Schedule: Conduct site visit one (1) week minimum after notification before beginning irrigation system pressure test.

8) Required Attendees:

a) General Contractor, Landscape Subcontractor, Landscape Architect.

9) Recommended Attendees:

a) Project Manager, Facilities Manager.

10) Related Sections:

a) Section 32 8423: 'Underground Sprinklers'.
b) Section 32 9120: 'Topsoil And Placement'.
c) Section 32 9122: 'Topsoil Grading'.

11) Notes:

a) Verify finish grading in preparation for planting.

b. Site Visit No. 2:

1) Description:

a) Inspect and approve plant quality, plant quantity, plant pits, plant pit backfill, planting depths, and removal of packaging/distribution materials, wire, and ties.

2) Required Attendees:

a) General Contractor, Landscape Subcontractor, Landscape Architect.

3) Recommended Attendees:

a) Project Manager, Facilities Manager.

4) Related Sections:

a) Section 32 9300: 'Plants'.

5) Notes:

a) Inspect irrigation system installation, inspect weed barrier fabric.

c. Site Visit No. 3:

1) Description:

a) Comprehensive Substantial Completion inspection prior to beginning thirty (30) day Landscape Subcontractor maintenance period.

2) Required Attendees:

a) Project Manager, Facilities Manager, Architect, General Contractor, Landscape Subcontractor, Landscape Architect.

3) Related Sections:

a) Section 32 8423: 'Underground Sprinklers'.
b) Section 32 9300: 'Plants'.

4) Notes:

a) Verify contract requirements have been followed including but not limited to: planting compliance, irrigation system coverage and irrigation system operation.

d. Site Visit No. 4:

1) Description:

a) At the end of thirty (30) day Landscape Subcontractor maintenance period, verify deficient items have been corrected and verify no others exist.

2) Schedule: Conduct site visit one (1) week minimum after notification before beginning site visit no. 4.

3) Required Attendees:

a) Project Manager, Facilities Manager, Architect, General Contractor, Excavation Subcontractor, Landscape Subcontractor, Landscape Architect.

4) Related Sections:

a) Section 32 8423: 'Underground Sprinklers'.
b) Section 32 9300: 'Plants'.

5) Notes:

a) Review Landscape Management Plan (LMP) with Owner's Representative. Provide landscape maintenance training.

SUBMITTALS

Informational Submittals:

24. Certificates:

a. Landscape Architect will provide certificate acknowledging 'Plant Establishment Period' commencement:

1) Certificate will include name and signature of Contractor, Contractor's company, Contractor's telephone number, and date.
2) Certificate will include name and signature of Owner's Representative, Owner's Representative's Group name, Owner's Representative Group telephone number, and date.
3) Certificate will acknowledge date when Establishment Period begins and that it extends one (1) year from that time.

25. Special Procedure Submittals:

a. Installer to provide two (2) copies of following recommendations to be included in Closeout Submittals:

1) Landscape maintenance recommendations.
2) Individual landscape maintenance recommendations.
3) Plant establishment maintenance recommendations.
4) Post-plant establishment maintenance recommendations.

26. Qualification Statement:

a. Landscape Subcontractor:

1) Provide Qualification documentation if requested by Landscape Architect or Owner.

b. Installer:

1) Provide Qualification documentation if requested by Landscape Architect or Owner.

Closeout Submittals:

27. Include following in Operations And Maintenance Manual specified in Section 01 7800 (combine with sections of 32 8000 and sections of 32 9000 if applicable):

a. Record Documentation:

1) Submit one (1) copy certificate for 'Plant Establishment Period' acknowledgement.
2) Submit one (1) copy of recommendations specified in Special Procedure Submittals.
3) Record Drawings:

a) As installation occurs, prepare accurate record drawings. Submit one (1) full size copy prior to final inspection. Drawing shall include:

(1) Detail and dimension changes made during construction.
(2) Take dimensions from permanent constructed surfaces or edges located at or above finish grade.

b. Landscape Management Plan (LMP):

1) Landscape Section:

a) Submit one (1) copy certificate for 'Plant Establishment Period' acknowledgement.
b) Submit one (1) copy of recommendations specified in Special Procedure Submittals.

QUALITY ASSURANCE

Regulatory Agency Sustainability Approvals:

28. Herbicides:

a. Products shall be recognized for intended use by AHJ.

29. Invasive and Non-native plants:

a. Comply with all applicable laws governing invasive and non-native plants.

Qualifications:

30. Landscape Subcontractor. Requirements of Section 01 4301 applies, but not limited to following:

a. Company specializing in performing work of this section.
b. Minimum five (5) years' experience in landscaping installations.
c. Minimum five (5) satisfactorily completed installations in past three (3) years of projects similar in size, scope, and complexity required for this project before bidding.
d. Upon request, submit documentation.

31. Installer:

a. Planting shall be performed under direction of foreman or supervisor with minimum three (3) years' experience in landscape installations similar in size, scope, and complexity.
b. Foreman or supervisor required to attend pre-installation conference.
c. Use trained personnel familiar with required planting procedures and with Contract Documents.
d. Upon request, submit documentation.

DELIVERY, STORAGE, AND HANDLING

Storage And Handling Requirements:

32. Deliver packaged materials in containers showing weight, analysis, and name of Manufacturer.
33. Deliver sod, plants, trees, and shrubs in healthy and vigorous condition.
34. Protect materials from deterioration during delivery.

Storage And Handling Requirements:

35. Store in location on site where they will not be endangered and where they can be adequately watered and kept in healthy and vigorous condition.
36. Protect materials from deterioration while stored at site.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

INSTALLERS

Acceptable Installers:

1. Star Landscaping.
2. Schramm Landscaping.
3. Western Meadows
4. Terrafirma.
5. Intermountain Plantings
6. Erickson Landscaping
7. Equal approved by Architect and / or Landscape Architect before bidding. See Section 01 4301.

EXAMINATION

Verification Of Conditions:

8. Inspect site and Contract Documents to become thoroughly acquainted with locations of irrigation, ground lighting, and utilities.

PREPARATION

Before proceeding with work, verify dimensions and quantities. Report variations between Drawings and site to Architect before proceeding with landscape work.

9. Plant totals are for convenience of Contractor only and are not guaranteed. Verify amounts shown on Drawings.
10. All planting indicated on Contract Documents is required unless indicated otherwise.

Protection:

11. Take care in performing landscaping work to avoid conditions that will create hazards. Post signs or barriers as required.
12. Provide adequate means for protection from damage through excessive erosion, flooding, heavy rains, etc. Repair or replace damaged areas.
13. Keep site well drained and landscape excavations dry.

INSTALLATION

Interface With Other Work:

14. Do not plant trees and shrubs until major construction operations are completed. Do not commence landscaping work until work of Section 31 2216 and Section 32 8423 has been completed and approved.

Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

Hand excavate as required.

Maintain grade stakes until parties concerned mutually agree upon removal.

When conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions, notify Architect before planting.

FIELD QUALITY CONTROL

Field Inspection:

15. Landscape Architect will inspect landscaping installation for Substantial Completion.

Non-Conforming Work. Non-conforming work as covered in the General Conditions applies, but is not limited to the following:

16. Replace damaged plantings within (10) days of notification at no additional cost to Owner.
17. Repair damage to irrigation, ground lighting, utilities, paving, concrete curb and gutters and other items adjacent to landscaping caused by work of this Section or replace at no additional cost to Owner.

CLEANING

Waste Management:

18. Immediately clean up soil or debris spilled onto pavement and dispose of deleterious materials.

CLOSEOUT ACTIVITIES

Instruction to Owner:

19. Include following training:

    a. Review Landscape Management Plan (LMP):

        1) Review maintenance recommendations.

    b. Review Maintenance as specified at the end of this specification.

20. Establishment Period Acknowledgement (coordinate with 32 8000 section):

    a. Landscape Architect will acknowledge Establishment Period commencement.

PROTECTION

Protect planted areas against traffic or other use immediately after planting is completed by placing adequate warning signs and barricades.

Provide adequate protection of planted areas against trespassing, erosion, and damage of any kind. Remove this protection after Architect has accepted planted areas.

MAINTENANCE

General:

21. Before beginning maintenance period, plants shall be in at least as sound, healthy, vigorous, and in approved condition as when delivered to site, unless accepted by Architect in writing at final landscape inspection.
22. Maintain landscaping for thirty (30) continuous days minimum after Substantial Completion. If maintenance period is interrupted by non-growing season or irrigation winter shut-down, begin maintenance period after start of growing season as agreed with Architect, and continue one (1) continuous month therefrom.
23. Replace landscaping that is dead or appears unhealthy or non-vigorous as directed by Architect before end of maintenance period. Make replacements within ten (10) days of notification. Lawn being replaced shall be guaranteed and maintained an additional thirty (30) days from date of replacement.

Sodded Lawn:

24. Maintain sodded lawn areas until lawn complies with specified requirements and throughout maintenance period.
25. Water sodded areas in sufficient quantities and at required frequency to maintain sub-soil immediately under sod continuously moist 3 to 4 inches (75 to 100 mm) deep.
26. Cut grass first time when it reaches 3 inches (75 mm) high. Continue to mow at least once each week throughout maintenance period. Remove clippings.
27. Apply herbicide as necessary to maintain weed-free lawn. Apply herbicide in accordance with manufacturer's instructions during calm weather when air temperature is between 50 and 80 deg F (10 and 27 deg C).
28. At end of thirty (30) day maintenance period, fertilize lawns as recommended in Section 32 9122.

Trees, Shrubs, And Plants:

29. Maintain by pruning, cultivating, and weeding as required for healthy growth.
30. Restore planting basins.
31. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical positions as required.

32. Spray as required to keep trees and shrubs free of insects and disease.
33. Provide supplemental water by hand as needed in addition to water from sprinkling system.

END OF SECTION

SECTION 32 9120 - TOPSOIL AND PLACEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Perform topsoil evaluation and placement required prior to topsoil grading as described in Contract Documents.

B. Related Requirements:

1. Section 31 0501: 'Common Earthwork Requirements':
2. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
3. Section 31 2216: 'Fine Grading' for landscaping and planting areas.
4. Section 32 9001: 'Common Planting Requirements':

    a. Pre-installation conference held jointly with other common planting related sections.

5. Section 32 9121: 'Topsoil Physical Preparation' for physical preparation of topsoil (section included based on Topsoil Testing Report).
6. Section 32 9122: 'Topsoil Grading' for preparation of topsoil and addition of amendments prior to landscaping.

1.2 REFERENCES

A. Reference Standards:

1. ASTM International:

    a. ASTM D1557-12, 'Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3))'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.
2. In addition to agenda items specified in Section 01 3100 and Section 32 9001, review following:

    a. Review finish grade elevation and tolerance requirements.
    b. Review surface preparation requirements including disking, tilling, ripping, or aerating.
    c. Review Attachment 'Topsoil Testing Report' including:

        1) Landscape Architect, Contractor, Testing, and Soil Testing Laboratory Instructions.

    d. Review Field Quality Control testing requirements for 'Topsoil Testing Report' including:

        1) Corrections required for topsoil not meeting requirements of this specification.
        2) Approval requirement of 'Topsoil Testing Report' by Landscape Architect.
        3) Submittals required as identified in Closeout Submittals.

1.4 SUBMITTALS

A. Informational Submittals:

1. Testing And Evaluation Reports:

    a. Use 'Topsoil Testing Report' attachment to this specification for Topsoil Testing as specified in 'Field Quality Control' in Part 3 of this specification for imported and site topsoil and account of recent use:

        1) Owner will pay for one (1) final test.
        2) Additional test(s) if necessary will be paid by Contractor.
        3) Submit two (2) copies of Final 'Topsoil Testing Report' approved by Landscape Architect to be included with Closeout Submittals.

2. Field Quality Control Submittals:

    a. Submit report stating location of source of imported topsoil and account of recent use.
    b. Submit delivery slips indicating amount of physical amendments delivered to Project site.

B. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

    a. Record Documentation:

        1) Submit one (1) copy Final approved 'Topsoil Testing Report'.
        2) Provide report stating location of source of imported topsoil and account of recent use.

    b. Landscape Management Plan (LMP):

        1) Landscape Section:

            a) Submit one (1) copy in LMP Landscape Section Final approved 'Topsoil Testing Report'.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil:

1. Design Criteria:

    a. Topsoil used in landscaped areas, whether imported, stockpiled, or in place, shall be weed free, fertile, loose, friable soil meeting following criteria:

        1) Chemical Characteristics:

            a) pH 5.5 to 8.0.
            b) Soluble Salts: less than 3.0 mmhos/cm.
            c) Sodium Absorption Ratio (SAR): less than 6.0.
            d) Organic Matter: greater than one percent.

        2) Physical Characteristics:

            a) Gradation as defined by USDA triangle of physical characteristics as measured by hydrometer.
                (1) Sand: 15 to 60 percent.
                (2) Silt: 10 to 60 percent.
                (3) Clay: 5 to 30 percent.

            b) Clean and free from toxic minerals and chemicals, noxious weeds, rocks larger than or equal to 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.

c) Soil (Coordinate screening as specified in Section 31 1413 'Topsoil Stripping And Stockpiling' to meet these characteristics):

(1) Soil shall not contain more than five (5) percent by volume of rocks measuring over 1/4 inch (6 mm) in largest size.
(2) Soil shall be topsoil in nature.
(3) Soil resembling road base or other like materials are not acceptable.

2. Project Topsoil Requirements:

a. It is anticipated that following percentages of material will be required to meet topsoil requirements of Project site:

1) Imported Topsoil: 100 percent of landscape area:

a) Lawn Areas: 60 percent of imported topsoil.
b) Shrub / Tree Areas: 40 percent of imported topsoil.
c) Native Grass / Shrub / Tree Areas: 0 percent of imported topsoil.

2) Stockpiled Topsoil: 0 percent of landscape area:

a) Lawn Areas: 0 percent of stockpiled topsoil.
b) Shrub / Tree Areas: 0 percent of stockpiled topsoil.
c) Native Grass / Shrub / Tree Areas: 0 percent of stockpiled topsoil.

3) In-Place Topsoil: 0 percent of landscape area:

a) Lawn Areas: 0 percent of in-place topsoil.
b) Shrub / Tree Areas: 0 percent of in-place topsoil.
c) Native Grass / Shrub / Tree Areas: 0 percent of in-place topsoil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:

1. Do not commence work of this Section until grading tolerances specified in Section 31 2216 are met.
2. Do not commence work of this Section until coordination with Section 32 9121 'Physical Preparation' and Section 32 9122 'Topsoil Grading' and if required by these specifications prior to placement.
3. Receive approval from Landscape Architect of subgrade elevations prior to commencement of this Work.

3.2 PREPARATION

A. Protection Of In-Place Conditions:

1. Protect utilities and site elements from damage.

B. Surface Preparation:

1. Surfaces to receive Imported and Stockpiled Topsoil:

a. Disk, till, rip, or aerate with approved agricultural aerator to depth of 6 inches (150 mm).
b. Place specified and approved topsoil on prepared surface.

3.3 PERFORMANCE

A. General:

1. After Surface Preparation requirements are completed, limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
2. Do not expose or damage existing shrub or tree roots.

B. Topsoil Depth/Quantity:

1. Total topsoil (existing / in-place) depth of 5 inches (125 mm) minimum in lawn and groundcover planting areas.
2. Total topsoil (imported) depth of 12 inches is required over entire tree and shrub planting areas.
3. Sand to be installed to a depth of 9" in the area designated as infield mix.
4. Provide no less than quantity required to achieve tolerance described in Section 32 9122 'Topsoil Grading' along with additional soil amendments required in Section 32 9121 'Topsoil Physical Preparation' and in Section 32 9122 'Topsoil Grading'. Installer of this section responsible for providing sufficient topsoil material.

C. Imported Topsoil:

1. Place tested and approved topsoil:

   a. Before placing topsoil, remove organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.
   b. Do not place topsoil whose moisture content makes it prone to compaction during placement process.
   c. Do not place topsoil when subgrade is either wet or frozen enough to cause clodding.

D. Grading:

1. Slope grade away from building for 12 feet (3.60 m) minimum from walls at slope of 1/2 inch in 12 inches (13 mm in 300 mm) minimum unless otherwise noted.

   a. High point of finish grade at building foundation shall be 6 inches (150 mm) minimum below finish floor level.
   b. Direct surface drainage in manner indicated on Contract Documents by molding surface to facilitate natural run-off of water.
   c. Fill low spots and pockets with topsoil and grade to drain properly.

3.4 FIELD QUALITY CONTROL

A. Testing And Inspections:

1. Topsoil Testing:

   a. Test topsoil for project suitability using Owner supplied 'Topsoil Testing Report,' attachment to this specification:

      1) Testing requirements:

         a) If testing report shows topsoil does not meet topsoil Design Criteria and 'Topsoil Testing Report: Soil Test Data' requirements, topsoil is non-conforming. Corrections and re-testing are required until topsoil meets requirements.
         b) Use new 'Topsoil Testing Report', each time topsoil is tested.
         c) After topsoil testing is approved by Landscape Architect, submit two (2) copies of Final 'Topsoil Testing Report as specified in Part 1 'Submittals' of this specification.

B. Non-Conforming Work:

1. If topsoil does not meet topsoil Design Criteria and 'Topsoil Testing Report: Soil Test Data' requirements topsoil will be re-tested at no cost to Owner.

    a. Correction procedures:

        1) Topsoil not meeting specified physical characteristics of sand, silt, and clay shall be removed from site.
        2) Topsoil not meeting specified organic or fertility specifications may be amended in place with materials recommended in Topsoil Testing Report.
        3) If amendments are necessary, submit proposed amendments and application rates required to bring topsoil up to minimum specified requirements.
        4) Re-test topsoil and remove and amend as required until it meets minimum specified requirements.

    b. Submit report to Landscape Architect for approval.

    c. Receive approval from Landscape Architect prior to planting.

END OF SECTION

ATTACHMENTS

Topsoil Testing Report

Project	Name		Property Number
	Site Street Address, City, State/Province		
Person Submitting Test	Name	Date Requested	Phone
	Address, City, State/Province		Fax
Soil Testing Laboratory	Name	Date Submitted	Phone
	Address, City, State/Province		Fax

General

1. Owner will pay for pre-bid testing and one (1) final topsoil test.

Landscape Architect Instructions

1. Landscape Architect shall determine by investigation quality and quantity of topsoil on site before landscape design. Add physical and fertility recommendations from laboratory recommendations to relevant Church specifications.

Contractor Instructions

1. Test installed topsoil. Installed topsoil shall comply with Project Specifications.
2. If installed topsoil does not comply, Contractor will enhance and test at no cost to Owner until installed topsoil complies with Project Specifications.

Testing Instructions

1. Collect at least two (2) samples of on-site topsoil and each anticipated topsoil source. If site soil profile or borrow pit are not uniform, additional samples shall be taken. Uniform composite samples may also be used if properly acquired and documented.
2. Submit required soil samples to soil testing laboratory along with all required (for this report and laboratory) information.

Soil Testing Laboratory Instructions

1. This report must be completely filled out and provide soil interpretation and amendment, fertilizer, and soil conditioner recommendations for use by Landscape Architect. These recommendations should consider lawn areas, tree and shrub areas, and native plant areas.
2. Provide appropriate times for fertilizing.
3. Return completed Topsoil Testing Report to person submitting the test.

SOIL SAMPLE LOG

Soil Sample No.	Description of location where sample was taken	History of use of the soil

Existing Conditions Test Report ("Acceptable Levels" refers to the allowable soil specifications prior to being amended)

SOIL TEST DATA

Sample No.	pH(1)	EC(1) Mmhos/cm	SAR(1)	% Sand	% Silt	% Clay	Text(2) Class	%(3) OM	NO3-N(4) ppm	P(5) ppm	K(5) ppm	Fe(5) Ppm
Acceptable Level(s)	5.5 - 8.4	<3.0	<6.0	15-60	10-60	5-30	(2)	>1.0	>20	>11	>130	>10

(1) Saturated soil paste 1:1 soil:water method (please Indicate)
(2) Hydrometer method (Acceptable soil- sand:15-60 percent, silt:10-60 percent, clay-5-30 percent)
(3) Potassium dichromate method (Walkey-Black) or loss of ignition
(4) Chromotropic acid method
(5) AB-DTPA method
If other methods are used for NO3-N, P, K, and Fe, then note.

ROCKS (Coarse Fragments)		
Sample No.	Percent > 1/4 inch (6.4 mm)	Rocks Present ≥ 1.5 inch (38 mm) Indicate as present or not present
	percent	
	percent	
Acceptable Level	≤ 5.0 percent	< 1.5 inch (38 mm)

Landscape Area Description

Lawn Areas: Receive 5 inch (125 mm) topsoil plus recommended amendments and fertilizers.
Shrub/Tree Areas: Unless otherwise indicated, plant pits are to be backfilled with three (3) parts native soil and one part compost or other recommended amendments. Additionally, contractor will add recommended fertilizer.
Native Grass/Shrub/Tree Areas: Planting to receive minimum recommended amendments and fertilizers for establishment.

Documented Infiltration rate of test sample(s) based on texture at 90 percent relative density (to nearest 1/10th of an inch)	
Sample No.	Rate
	Inches/Hour
	Inches/Hour

Interpretation Summary of Test Results:

Soil Amendments, Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas
Shrub/Tree Areas
Native Grass/Shrub/Tree Areas

Long Term (5 Year) Fertilizer and Soil Conditioner – Recommendations:

Lawn Areas
Shrub/Tree Areas
Native Grass/Shrub/Tree Areas

SECTION 32 9122 - TOPSOIL GRADING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Perform topsoil grading required to prepare site for installation of landscaping as described in Contract Documents.
2. Perform topsoil placement and finish grading work required to prepare site for installation of landscaping as described in Contract Documents.
3. Furnish and apply soil amendments as described in Contract Documents.

B. Related Requirements:

1. Section 31 0501: 'Common Earthwork Requirements':
2. Section 31 1413: 'Topsoil Stripping And Stockpiling' for stripping and storing of existing topsoil.
3. Section 31 2216: 'Fine Grading' for landscaping and planting areas.
4. Section 32 9001: 'Common Planting Requirements':

    a. Pre-installation conference held jointly with other common planting related sections.

5. Section 32 9120: 'Topsoil And Placement' for topsoil evaluation and placement required for topsoil grading.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.
2. In addition to agenda items specified in Section 01 3100, review the following:

    a. Review compost requirements to be within acceptable range as per Attachment 'Compost Quality Guidelines For Landscaping' and 'Compost Verification Report' in this specification.
    b. Review soil fertility amendments and fertilizer requirements as per Attachment 'Topsoil Testing Report' in Section 32 9120.

1.3 SUBMITTALS

A. Action Submittals:

1. Material Data:

    a. Soil Amendments and Fertilizer:

        1) Product literature and chemical / nutrient analysis of soil amendments and fertilizers.
        2) Proposed application rates necessary to bring topsoil up to specified requirements.
        3) Source location of products.
        4) Submit to Landscape Architect for approval prior to installation.

2. Samples:

    a. Soil Fertility Amendments and Fertilizer:

        1) Soil conditioner sample for approval before delivery to site.

2) Product analysis.

B. Informational Submittals:

1. Testing And Evaluation Reports:

a. 'Compost Verification Report':

1) Provide signed copy certifying that compost meets requirements of this specification.

2. Field Quality Control Submittals:

a. Soil Fertility Amendments and Fertilizer:

1) Delivery slips indicating amount of soil amendments, compost, conditioner, and fertilizer delivered to Project site.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Record Documentation:

1) Submit 'Compost Verification Report'.
2) Submit delivery slips indicating amount of physical amendments delivered to Project site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Soil Amendments:

1. Incorporate following soil amendments into topsoil used for Project:

a. Acceptable Soil Amendments, Soil Conditioners, And Application Rates.

1) 'Soil Pep' from Miller Companies, Hyrum, Utah: 5 cu yds / 1000 s.f. in lawn areas only. Other than the specified backfill in tree and shrub plantings, no other conditioner is required.
2) In addition to required Soil Pep, contractor to install Gro-Power Plus at label rates. Gro-Power Plus to be installed in all shrub beds and lawn areas.
3) Equals as approved by Architect before use. See Section 01 6200.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:

1. Do not commence work of this Section until imported, stockpiled and in place topsoil are placed as specified in Section 32 9120 'Topsoil And Placement'.

3.2 PREPARATION

A. Protection Of In-Place Conditions:

1. Protect utilities and site elements from damage.

B. Surface Preparation:

1. Surfaces that meet specified topsoil elevations.

a. Seven (7) days maximum before beginning seeding and planting:

1) Loosen topsoil 6 inch (150 mm) deep, dampen thoroughly, and cultivate to properly break up clods and lumps.
2) Rake area to remove clods, rocks, weeds, roots, debris or other material 1-1/2 inches (38 mm) or more in any dimension.
3) Grade and shape landscape area to bring surface to true uniform planes free from irregularities and to provide drainage and proper slope to catch basins.

2. Addition of Soil Amendments:

a. Add specified soil amendments at specified rates to topsoil as directed by Topsoil Testing Report found in Section 32 9120 'Topsoil And Placement'.
b. Add specified fertilizers at specified rates into topsoil as directed by Soil Testing Laboratory.
c. Roto-till or otherwise mix soil amendments evenly into topsoil.

3.3 PERFORMANCE

A. General:

1. Limit use of heavy equipment to areas no closer than 6 feet (1.80 meter) from building or other permanent structures. Use hand held tillers for preparation of subsoil in areas closer than 6 feet (1.80 m).
2. Do not expose or damage existing shrub or tree roots.

B. Finish Grade Tolerances (As shown on General Planting Details in Contract Documents):

1. Finish topsoil grade of planting areas before planting and after addition of soil additives shall be specified distances below top of adjacent pavement of any kind:

a. Sodded Areas: 2 inches (50 mm) below.
b. Tree and Shrub Areas (not individual trees): 4 inches (100 mm) below.

C. Placed Topsoil:

1. At locations where topsoil has been placed as per Section 32 9120 'Topsoil And Placement', perform the following:

a. Remove existing vegetation as required in preparation for new landscaping.
b. Remove organic material, rocks and clods greater than 1-1/2 inch (38 mm) in any dimension, and other objectionable materials.

D. Grading:

1. Coordinate grading as described in Section 32 9120 'Topsoil And Placement'.

E. Immediately before planting lawn and with topsoil in semi-dry condition, roll areas that are to receive lawn in two directions at approximately right angles with water ballast roller weighing 100 to 300 lbs (45 to 135 kg), depending on soil type.

F. Rake or scarify and cut or fill irregularities that develop as required until area is true and uniform, free from lumps, depressions, and irregularities.

3.4 PROTECTION

A. After landscape areas have been prepared, take no heavy objects over them except lawn rollers.

END OF SECTION

ATTACHMENT

COMPOST QUALITY GUIDELINES FOR LANDSCAPING

[Source: Von Isaman MS, President of QA Consulting and Testing LLC, Dr. Rich Koenig, USU Cooperative Extension Soils Specialist, and Dr. Teresa Cerny, USU Cooperative Extension Horticulturalist, 3 March 2003]

Category	pH[a]	Soluble Salts[a] dS/m or mmho/cm	Sodium Adsorption Ratio[a] (SAR)	Carbon Nitrogen Ratio[b] (C:N)	Percent Moisture[c]	≥ 98 percent Coarse Material Passing (dry wt basis)
Ideal	6 to 8	≤ 5	< 10	≤ 20:1	25 to 35	3/8 inch (9.5 mm)
Acceptable	5-6, 8-9	≤ 10	≤ 20	21:1 to 30:1	< 25, > 35	3/4 inch (19 mm)
Suspect	< 5, > 9	> 10	> 20	<10:1, > 30:1	< 20, > 50	< 98 percent 3/4 inch (19 mm)

[a] 1.5 Compost: Water Slurry on Coarse Material passing 3/8 inch (9.5 mm).
[b] on Coarse Material passing 3/8 inch (9.5 mm).
[c] on Total Sample

For composts with biosolid feedstocks, biosolids must meet EPA 503 Class A standard.

Acceptable level Soluble Salts and/or SAR composts should not exceed 3 cu yds (2.29 cu m) /1,000 sq ft (93 sq m) for every 3 inches (76 mm) of soil depth.

COMPOST VERIFICATION REPORT

	pH[a]	Soluble Salts[a] dS/m or mmho/cm	Sodium Adsorption Ratio[a] (SAR)	Carbon Nitrogen Ratio[b] (C:N)	Percent Moisture[c]	≥ 98 percent Coarse Material Passing (dry wt basis)
Results						

See Compost Quality Guidelines for Landscaping for footnote references.

I hereby certify that the Compost meets Ideal or Acceptable requirements as set forth in COMPOST QUALITY GUIDELINES FOR LANDSCAPING as listed with the COMPOST VERIFICATION STATEMENT. If Compost does not fall within this range, explain why and justify.

_____

_____

_____

_____

Signature: _____ Printed Signature: _____

Date: _____

SECTION 32 9223 - SODDING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install sodded lawn as described in Contract Documents.

B. Related Requirements:

1. Section 32 8423: Irrigation system.
2. Section 32 9001: Common Planting Requirements:

    a. Pre-installation conference held jointly with other common planting related sections.

3. Section 32 9120: 'Topsoil And Placement'.
4. Section 32 9122: 'Topsoil Grading'.

1.2 REFERENCES

A. Definitions:

1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. The crop coefficient is a dimensionless number (between 0 and 1.2) that is multiplied by the ETo value to arrive at a plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
2. Eco-Region Irrigation Design: A bio-regional approach to irrigation and planting design that is relevant to the geographic area for which the planting plan and irrigation system is designed. These geographic areas are defined by the Environmental Protection Agency and have been modified by the LDS church into 15 geographical areas throughout North America, and the Hawaiian Islands.
3. Hardiness Zone: A hardiness zone is a more precisely geographically-defined zone within an Eco-Region in which a specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand the minimum temperatures of the zone. Hardiness Zones may be defined by one of two sources:

    a. Sunset Western Garden Book Maps.
    b. USDA Hardiness Zone Map.

    Plant Hardiness zone sources shall be listed by the architect through the planting and irrigation design process.

4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
5. Reference Evapotranspriation (ETo): The total water lost from the soil (evaporation) and from the plant surface (transpiration) over some period.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in pre-installation conference as specified in Section 32 9001.

1.4 SUBMITTALS

A. Informational Submittals:

1. Certificates:

a. Written certification confirming sod seed mix and quality:

1) Include all species used.
2) Include name and contact information of supplier.

B. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

a. Record Documentation:

1) Submit one (1) copy certificate for sod seed quality and mix.

b. Landscape Management Plan (LMP):

1) Landscape Section:

a) Submit one (1) copy certificate for sod seed quality and mix.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Approval Requirements:

1. Harvest, deliver, store, and handle sod in accordance with requirements of Turfgrass Producers International (TPI) (formally American Sod Producers Association) Specifications for Turfgrass Sod Materials and Transplanting / Installing.
2. Schedule deliveries to coincide with topsoil operations and laying. Keep storage at job site to minimum without causing delays.

a. Deliver, unload, and store sod on pallets within 24 hours of being lifted.
b. Do not deliver small, irregular, or broken pieces of sod.

B. Storage And Handling Requirements:

1. Cut sod in pieces approximately 3/4 to one inch (19 to 25 mm) thick. Roll or fold sod so it may be lifted and handled without breaking or tearing and without loss of soil.
2. During wet weather, allow sod to dry sufficiently to prevent tearing during lifting and handling.
3. During dry weather, protect sod from drying before installation. Water as necessary to insure vitality and to prevent excess loss of soil in handling. Sod that dries out before installation will be rejected.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Description:

1. Superior sod grown from certified, high quality, seed of known origin or from plantings of certified grass seedlings or stolons:

a. Assure satisfactory genetic identity and purity.
b. Assure over-all high quality and freedom from noxious weeds or an excessive amount of other crop and weedy plants at time of harvest.

2. Sod shall be composed of three varieties minimum of Kentucky Bluegrass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Interface With Other Work:

1. Do not commence work of this Section until work of Sections 32 9122 and 32 9300 has been completed and approved.

B. Tolerances:

1. Final grade of soil after sodding of lawn areas is complete shall be one inch (25 mm below top of adjacent pavement of any kind.

C. Laying of Sod:

1. Lay sod during growing season and within 48 hours of being lifted.
2. Lay sod while top 6 inches (150 mm) of soil is damp, but not muddy. Sodding during freezing temperatures or over frozen soil is not acceptable.
3. Lay sod in rows perpendicular to slope with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with a sharp knife.
4. Lay sod flush with adjoining existing sodded surfaces.
5. Do not sod slopes steeper than 3:1. Consult with Architect for alternate treatment.

D. After Laying of Sod Is Complete:

1. Roll horizontal surface areas in two directions perpendicular to each other.
2. Repair and re-roll areas with depressions, lumps, or other irregularities. Heavy rolling to correct irregularities in grade will not be permitted.
3. Water sodded areas immediately after laying sod to obtain moisture penetration through sod into top 6 inches (150 mm) of topsoil.

3.2 FIELD QUALITY CONTROL

A. Field Inspection:

1. Sodded areas will be accepted at Project closeout if:

   a. Sodded areas are properly established.
   b. Sod is free of bare and dead spots and is without weeds.
   c. No surface soil is visible when grass has been cut to height of 2 inches (50 mm).

2. Sodded areas have been mowed a minimum of twice.

END OF SECTION

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SECTION 32 9300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Furnish and install landscaping plants as described in Contract Documents.

B. Related Requirements:

1. Section 32 8423: 'Underground Sprinklers' for irrigation system.
2. Section 32 9001: 'Common Planting Requirements' for:

    a. Pre-installation conference held jointly with other common planting related sections.

3. Section 32 9120: 'Topsoil And Placement'.
4. Section 32 9122: 'Topsoil Grading'.
5. Section 32 9219: 'Seeding'.
6. Section 32 9222: 'Hydro-Seeding'.
7. Section 32 9223: 'Sodding'.

1.2 REFERENCES

A. Definitions:

1. Crop Coefficients and Hydro-Zones: Crop coefficients (Kc) are used with ETo to estimate specific plant evapotranspiration rates. Crop coefficient is dimensionless number (between 0 and 1.2) that is multiplied by ETo value to arrive at plant ET (ETc) estimate. Plants grouped by water needs, organized into one irrigation zone.
2. Eco-Region Irrigation Design: Bio-regional approach to irrigation and planting design that is relevant to geographic area for which planting plan and irrigation system is designed. These geographic areas are defined by Environmental Protection Agency and have been modified by the Church into 15 geographical areas throughout North America, and Hawaiian Islands.
3. Hardiness Zone: Hardiness zone is more precisely geographically-defined zone within an Eco-Region in which specific category of plant life is capable of growing, as defined by temperature hardiness, or ability to withstand minimum temperatures of zone. Hardiness Zones may be defined by one of two sources:

    a. Sunset Western Garden Book Maps.
    b. USDA Hardiness Zone Map.

    Plant Hardiness zone sources shall be listed by Landscape Architect through planting and irrigation design process.

4. Hydro-Zone: Plants grouped by water needs (similar Crop Coefficients (Kc), organized into one irrigation zone.
5. Landscape Management Plan (LMP): See Section 32 9001 for definition.
6. Plant Establishment Period: See Section 32 9001 for definition.
7. Reference Evapotranspriation (ETo): Total water lost from the soil (evaporation) and from plant surface (transpiration) over some period.

B. Reference Standards:

1. American Nursery & Landscape Association / American National Standards Institute:

    a. ANLA / ANSI Z60.1-2004, 'American Standard for Nursery Stock'.

2. American National Standard Institute / Tree Care Industry Association (TCIA):

    a. ANSI A300 (Part 1)-2017 Pruning, 'American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices (Pruning)'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:

1. Participate in MANDATORY pre-installation conference as specified in Section 32 9001.

1.4 SUBMITTALS

A. Action Submittals:

1. Samples:

    a. Mulch for approval before delivery to site.

B. Informational Submittals:

1. Special Procedural Submittals:

    a. Installer to provide written instructions covering Owner maintenance requirements during 'Plant Establishment Period'.

C. Closeout Submittals:

1. Include following in Operations And Maintenance Manual specified in Section 01 7800:

    a. Operations And Maintenance Data:

        1) Submit one (1) copy of recommendations specified in Special Procedure Submittals.

    b. Warranty Documentation:

        1) Include written warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery And Acceptance Requirements:

1. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately.
2. Do not prune before delivery, except as approved by Landscape Architect.
3. Protect bark, branches, and root systems from sun scald, drying, whipping, and other handling and tying damage.
4. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape.
5. Provide protective covering during delivery.

B. Storage And Handling Requirements;

1. Handle balled stock by root ball or container. Do not drop trees and shrubs during delivery.
2. If planting is delayed more than six hours after delivery, set planting materials in shade and protect from weather and mechanical damage.
3. Set balled stock on ground and cover ball with soil, saw dust, or other acceptable material approved by Landscape Architect.
4. Do not remove container-grown stock from containers before time of planting.
5. Do not store plant material on pavement.

6. Water root systems of trees and shrubs stored on site with fine spray. Water as often as necessary to maintain root systems in moist condition. Do not allow plant foliage to dry out.

1.6 WARRANTY

A. Special Warranty:

1. Provide written warranties as follows:

a. Warranty will extend thirty (30) continuous days minimum after Substantial Completion. If a continuous first thirty (30) days of the warranty period is interrupted by non-growing season or irrigation winter shut-down, begin warranty period after start of growing season as agreed on with Architect. Thereafter, continue warranty per the period described herein.

b. Warranty shrubs, ground covers, and vines to live and remain in strong, vigorous, and healthy condition for 90 days minimum from date of Substantial Completion and meet or exceed material standards set forth in Materials heading of Part 2 of this specification.

c. Warranty trees to live and remain in strong, vigorous, and healthy condition and meet or exceed material standards set forth in Materials heading of Part 2 of this specification for one year from date of Substantial Completion.

d. When trees are completely accepted at end of warranty period, remove staking.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Plants:

1. Conform to requirements of Plant List and Key on Contract Documents and to ANLA / ANSI Z60.1.
2. Nomenclature:

a. Plant names used in Plant List conform to 'Standardized Plant Names' by American Joint Committee on Horticultural Nomenclature except in cases not covered. In these instances, follow custom of nursery trade. Plants shall bear tag showing genus, species, and variety of at least 10 percent of each species delivered to site.

3. Quality:

a. Plants shall be sound, healthy, vigorous, free from plant disease, insect pests or their eggs, noxious weeds, and have healthy, normal root systems. Container stock shall be well established and free of excessive root-bound conditions.

b. Do not prune plants or top trees prior to delivery.

c. Plant materials shall be subject to approval by Landscape Architect as to size, health, quality, and character.

d. Bare root trees are not acceptable.

e. Provide plant materials from licensed nursery or grower.

4. Measurements:

a. Measure height and spread of specimen plant materials with branches in their normal position as indicated on Contract Documents or Plant List.

b. Measurement should be average of plant, not greatest diameter. For example, plant measuring 15 inches (375 mm) in widest direction and 9 inches (225 mm) in narrowest would be classified as 12 inch (300 mm) stock.

c. Plants properly trimmed and transplanted should measure same in every direction.

d. Measure caliper of trees 6 inches (150 mm) above surface of ground.

e. Where caliper or other dimensions of plant materials are omitted from Plant List, plant materials shall be normal stock for type listed.

f. Plant materials larger than those specified may be supplied, with prior written approval of Landscape Architect, and:

1) If complying with Contract Document requirements in all other respects.
2) If at no additional cost to Owner.
3) If sizes of roots or balls are increased proportionately.

5. Shape and Form:

a. Plant materials shall be symmetrical or typical for variety and species and conform to measurements specified in Plant List.
b. Well grown material will generally have height equal to or greater than spread. However, spread shall not be less than 2/3's of height.

2.2 ACCESSORIES

A. Planting Mix:

1. Mixture of three (3) parts excavated soil and one part well rotted composted manure, approved commercial mix, or other amendment recommended in 'Topsoil Testing Report'.

B. Fertilizer:

1. Fertilizer as recommended on 'Topsoil Testing Report'.

C. Tree Stakes:

1. Type Two Acceptable Products:

a. 2 inch (50 mm) diameter Lodgepole Pine, Douglas Fir, White Fir, or Hemlock Fir.
b. Equal as approved by Landscape Architect before installation. See Section 01 6200.

D. Tree Staking Ties:

1. Type Two Acceptable Products:

a. Flex-Strap tree ties by Hummert International, Earth City, MO www.hummert.com.
b. Equal as approved by Landscape Architect before installation. See Section 01 6200.

E. Pre-Emergent Herbicide:

1. Category Four Approved Products. See Section 01 6200 for definitions of Categories.

a. Chipco Dimension Granular by The Andersons Inc, Maumee, IL www.andersonsinc.com.
b. Elanco XL2G granular by Crop Data Management Systems, Marysville, CA www.cdms.net.
c. Ronstar G granular by Bayer Crop Science, Monheim, Germany www.bayercropscience.com.
d. Surflan AS liquid by United Phosphorous Inc, Trenton, NJ www.upi-usa.com.
e. Oryzalin 4 A.S. liquid by FarmSaver, Seattle, WA www.farmsaver.com.

F. Weed Barrier:

1. Type Two Acceptable Products:

a. DeWitt 5 oz (116 g) 20 year woven polypropylene weed barrier.
b. Equal as approved by Landscape Architect before bidding. See Section 01 6200.

G. Rock Mulch:

1. Type Two Acceptable Products:

a. Refer to Planting Plan Miscellaneous Schedule.

1) Size:

a) No rock s
b) For slopes 5:1 or less 3/4 inch (19 mm) to 1-1/2 inches (38 mm).
c) For steep slopes greater than 5:1: 4 inches (38 mm) to 8" (76 mm)

2) Equal as approved by Landscape Architect before installation. See Section 01 6200.

b. Infield Mix – See Infield Mix Spec Section

PART 3 - EXECUTION

3.1 EXAMINATION

A. Evaluation And Assessment:

1. Before proceeding with work, check and verify dimensions and quantities. Report variations between Drawings and site to Landscape Architect before proceeding with work of this Section.
2. Plant totals are for convenience only and are not guaranteed. Verify amounts shown on Contract Documents. All planting indicated on Contract Documents is required unless indicated otherwise.
3. Do not commence with this Work until all work including grading tolerances specified in Section 32 9122 'Topsoil Grading' are completed and approved.

3.2 PREPARATION

A. Plant Approval:

1. Compliance:

a. Prior to any plant installation, evaluate plants for compliance with material standards.
b. Remove plants from site that do not comply.

2. Inspection:

a. Prior to any tree installation, inspect one (1) extra deciduous tree and one (1) extra evergreen tree for root health.
b. In presence of Landscape Architect or by video recording, remove root container/packing material and inspect root balls for soil depth, firmness and root structure by washing soil off of roots.
c. If delivered plants exhibit soil 1 inch (25 mm) or more above root collar, demonstrate that all trees have had excess soil removed prior to planting or that they meet standard.
d. Remove and replace tree plant material if roots are loose, significantly circling, significantly asymmetrical or damaged.
e. Continue inspection process until trees meet standard.

B. Layout individual tree and shrub locations and areas for multiple plantings:

1. Stake locations and outline areas.
2. Secure Landscape Architect's approval before planting.
3. Make minor adjustments as may be requested.

3.3 INSTALLATION

A. Excavation:

1. If underground construction work or obstructions are encountered in excavation of planting holes, Landscape Architect will select alternate locations.
2. Plant Excavation Size:

a. Diameter: Twice diameter of root ball or container minimum.
b. Depth: Equal to container or rootball depth.

3. Unless excavated material meets topsoil requirements as specified in Section 32 9120, remove from landscape areas and do not use for landscaping purposes.
4. Roughen sides and bottoms of excavations.
5. With approval of Landscape Architect, select five (5) typical planting excavations throughout site for drainage testing.

a. Fill selected excavations with water and verify that water drains away at rate of 3 inches (75 mm) per hour minimum. Inform Landscape Architect in writing of excavations where water does not drain properly.
b. Select three (3) excavations approximately 5 feet (1 500 mm) away from each non-draining excavation and repeat tests. Continue testing process until non-draining areas have been identified.
c. In excavations located in identified non-draining areas, auger 6 inch (150 mm) diameter hole 4 feet (1 200 mm) deep in low point of each excavation and fill with tamped planting mix.
d. Do not plant trees or shrubs in holes that do not properly drain.

B. Planting:

1. Removing Binders And Containers:

a. Remove top one / third of wire basket and burlap binders.
b. Remove plastic and twine binders from around root ball and tree trunk.
c. Remove plastic containers.
d. Remove wood boxes from around root ball. Remove box bottoms before positioning plant in hole. After plant is partially planted, remove remainder of box without injuring root ball.

2. Plant immediately after removing binding material and containers:

a. Place tree and shrub root balls on undisturbed soil.
b. After watering and settling, top of tree root balls shall be approximately two inches (50 mm) higher than finished grade and trunk flare is visible.
c. Shrub root balls shall be approximately one inch (25 mm) higher than finished grade.

3. Properly cut off broken or frayed roots.
4. Center plant in hole, remove remaining wire basket and burlap taking care not do damage root ball:

a. Replace damaged material.
b. Backfill with specified planting mix.
c. Except in heavy clay soils, make ring of mounded soil around hole perimeter to form watering basin.

5. Add fertilizer in plant pit as per 'Topsoil Testing Report' and during proper season.
6. Fill landscape excavations with tamped planting mix and recommended fertilizer:

a. Compact in 6 inch (150 mm) lifts.
b. Settle by watering to ensure top of root ball is 2 inches (50 mm) higher for trees and one inch (25 mm) higher for shrubs than surrounding soil following compaction and settling.

7. Do not use muddy soil for backfilling.
8. Make adjustments in positions of plants as directed by Landscape Architect.
9. Thoroughly water trees and shrubs immediately after planting.
10. At base of each tree, leave 36 inch (900 mm) diameter circle free of any grass.

C. Tree and Shrub Pruning:

1. Prune trees and shrubs to remove dead, broken, and split branches in conformance with ANSI A300 (Part 1) Pruning.

D. Supports for New Trees:

1. Provide new supports for trees noted on Contract Documents to be staked.

a. Remove nursery stakes delivered with and attached to trees.
b. Support shall consist of at least two (2) tree stakes driven into hole base before backfill so roots are not damaged. Place stakes vertically and run parallel to tree trunk. Install stakes so 3 feet (900 mm) of stake length is below finish grade.
c. Deciduous Trees:

1) Place tree ties 6 to 12 inches (150 to 300 mm) below crotch of main tree canopy. Second set of tree ties may be required 18 to 24 inches (450 to 600 mm) above finish grade, if directed by Landscape Architect.
2) Remove tops of tree stakes so top of stake is 6 inches (150 mm) below main tree canopy to prevent damage to tree branches and canopy growth.

d. Evergreen Trees:

1) Place tree ties 2/3's of height of tree up from root ball.

2. Provide root guying kits to support 24 inch (600 mm) box, 3 inch (75 mm) caliper and larger trees.
3. Staking and guying should allow some tree movement.

E. Vines:

1. Remove from stakes, untie, and securely fasten to wall or fence next to which they are planted.

F. Ground Covers:

1. Container-grown unless otherwise specified on Contract Documents. Space evenly to produce a uniform effect, staggered in rows and intervals shown.

G. Post Planting Weed Control:

1. Apply specified pre-emergent herbicide to shrub and ground cover planting areas and grass-free areas at tree bases after completion of planting.
2. Areas shall be weed free prior to Landscape Final Acceptance.

H. Weed Barrier Fabric:

1. After planting and application or herbicide in shrub beds, apply covering of specified weed barrier fabric.
2. Achieve 100 percent coverage over ground areas while allowing space for growth from root ball.
3. Overlap seams 6 inches (150 mm) minimum.
4. Staple at 5 feet (1500 mm) on center each way and within 3 inches (75 mm) of edge of shrub bed, with two (2) at each corner.

I. Mulching:

1. After application of herbicide, mulch shrub and ground cover planting areas with 3 inches (75 mm) deep layer of ¾ inch to 1 ½ inch specified rock mulch or 6 inches deep layer of 4 inch to 8 inch rock mulch.
2. Cover grass-free area at tree bases with 3 inches (75 mm) of organic mulch (soil pep) where applicable.
3. Place mulch to uniform depth and rake to neat finished appearance.

END OF SECTION

DIVISION 33 – UTILITIES

33 1116	Site Water Utility Distribution Piping
33 1119	Fire Suppression Utility Water Distribution Piping
33 3313	Sanitary Utility Sewerage
33 4116	Site Storm Utility Drainage Piping
33 5100	Natural-Gas Distribution

SECTION 33 1116 SITE WATER UTILITY DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform trenching and backfilling required for work of this Section.
   2. Water meter not installed in building:
      a. Furnish and install piping for domestic water supply from water main to within 5 feet of building as described in Contract Documents complete with meter, shut-off valve, and connections.

B. Related Requirements:
   1. Section 31 2316: 'Excavation' for criteria for performance of excavation.
   2. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.
   3. Section 33 1119: 'Fire Suppression Utility Water Distribution Piping' for fire suppression piping.

1.2 REFERENCES

A. Reference Standards:
   1. American Welding Society:
      a. AWS A5.8M/A5.8:2011-AMD 1 An American National Standard, 'Specification for Filler Metals for Brazing and Braze Welding'.
   2. ASTM International:
      a. ASTM B88-16, 'Standard Specification for Seamless Copper Water Tube'.
   3. ASTM International (Standard Specifications for Polyethylene (PE) pipe):
      a. ASTM D2239-12a, 'Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter'.
      b. ASTM D2737-12a, 'Standard Specification for Polyethylene (PE) Plastic Tubing'.
      c. ASTM D3035-15, 'Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter'.

4. NSF International Standard / American National Standards Institute:
    a. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.
    b. NSF/ANSI 372-2016, 'Drinking Water System Components - Lead Content'.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Thermoplastic Plastic Piping:
    1. Manufacturers Contact List:
        a. PP-R Aquatherm, Inc., Lindon, UT www.aquathermpipe.com.
        b. PP-RCT Prestan North America, Titusville, PA www.pestampipes.com.
    2. Materials:
        a. Pipe: HDPE DR9 meeting ASTM and NSF requirements.
        b. Pipe: PP-R SDR 7.4 Greenpipe faser by Aquatherm.
        c. PP-RCT SDR 7.4 Red Stripe fiber core by Prestan.

B. Copper Pipe:
   1. Type K copper meeting requirements of ASTM B88 with wrought copper, brazed fittings
   2. Brazing Rods In accordance with AWS A5.8M/A5.8:
      a. Classification BCuP-4 Copper Phosphorus (6 percent silver).
      b. Classification BCuP-5 Copper Phosphorus (15 percent silver).
      c. Classification BAg-5 Silver (45 percent silver).
      d. Do not use rods containing Cadmium.
   3. Flux:
      a. Type Two Acceptable Products:
         1) Stay-Silv white brazing flux by J W Harris Co, Cincinnati, OH www.jwharris.com.
         2) High quality silver solder flux by Handy & Harman, Fairfield, CT www.handyharman.com.
         3) Equal as approved by Architect before use. See Section 01 6200.
C. Water Meter: As required by local agency furnishing water.
D. Connection Material:
   1. Thermoplastic Plastic Piping:
      a. Factory approved fusion only.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Contract Drawings.
   2. Excavate to required depth.
   3. Bottom of trenches shall be hard. Tamp as required.
   4. Remove debris from trench before laying pipe.
   5. Do not cut trenches near footings without consulting Architect.
   6. Excavate trenches so outside pipe will be at least 12 inches minimum below frost line or 24 inches minimum below finish grade, whichever is deeper.
   7. Backfill only after pipe lines have been tested and inspected, and approved by Architect.
B. Install piping system so it may contract and expand freely. Eliminate completely cross connections, backflow, and water hammer.
C. Install shut-off valve at meter.

3.2 FIELD QUALITY CONTROL

A. Field Tests

1. Sterilization And Negative Bacteriological Test:
    a. Sterilize potable water system with solution containing 200 parts per million minimum of available chlorine and maintaining a pH of 7.5 minimum. Introduce chlorinating materials into system in manner approved by Architect. Allow sterilization solution to remain for twenty-four (24) hours and open and close valves and faucets several times during that time.
    b. After sterilization, flush solution from system with clean water until residual chlorine content is less than 0.2 parts per million.
    c. Water system will not be accepted until negative bacteriological test is made on water taken from system. Repeat dosing as necessary until such negative test is accomplished.
2. Pressure Test: Before covering pipes, test system in presence of Architect or governing agency at 100 psi hydrostatic pressure for two (2) hours and show no leaks.

3.3 CLEANING

A. Remove excess earth from site or place as directed by Architect.

END OF SECTION

SECTION 33 1119 FIRE SUPPRESSION UTILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:

1. Perform excavation and backfill required for installation of work of this Section.
2. Furnish and install fire water system as described in Contract Documents.
3. Furnish and install connection to water main.

B. Related Requirements:

1. Section 03 1113: 'Structural Cast-In-Place Concrete Forming' for installation of sleeve where piping penetrates slab.
2. Section 03 3111: 'Cast-In-Place Structural Concrete' for:
   a. Mix Type concrete mixes and admixtures.
   b. Pre-installation conference held jointly with other concrete specifications.
3. Section 21 1313: 'Wet-Pipe Sprinkler Systems'.
4. Section 31 2316: 'Excavation' for procedures and quality of excavating.
5. Section 31 2323: 'Fill' for procedures and quality of backfilling and compacting.

1.2 REFERENCES

A. Association Publications:

1. American Water Works Association:
    a. AWWA M41, 'Ductile-Iron Pipe Fittings' (Manual) (3rd Edition 2009).

B. Reference Standards:
1. American Water Works Association:
    a. AWWA C110/A21.10-12, 'Ductile-Iron and Gray-Iron Fittings'.
    b. AWWA C111/A21.11-12, 'Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings'.
    c. AWWA C150-A21.50-14, 'Thickness Design of Ductile-Iron Pipe'.
    d. AWWA C151/A21.51-09, 'Ductile-Iron Pipe, Centrifugally Cast'.
    e. AWWA C502-14 'Dry-Barrel Fire Hydrants'.
    f. AWWA C606-10, 'Installation of Ductile-Iron Water Mains and Their Appurtenance'.
    g. AWWA C900-07, 'Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. for Water Transmission and Distribution'.
2. ASTM International:
    a. ASTM A126-04(2014), 'Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings'.
    b. ASTM A197/A197M-00(2015), 'Standard Specification for Cupola Malleable Iron'.
    c. ASTM A307-14, 'Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength'.
    d. ASTM A506-16, 'Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled'.
    e. ASTM A575-96(2018), 'Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades'.
3. National Fire Protection Association:
    a. NFPA 13: 'Standard for the Installation of Sprinkler Systems' (2019 or most recent edition adopted by AHJ).
        1) Contractor's Material & Test Certification for Underground Piping'.
    b. NFPA 24 'Standard for the Installation of Private Fire Service Mains and Their Appurtenances' (2019 or most recent edition adopted by AHJ).

4. NSF International Standard / American National Standards Institute:
    a. NSF/ANSI 61-2017, 'Drinking Water System Components - Health Effects'.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conference:
    1. Participate in pre-installation conference as specified in Section 03 3111.

1.4 SUBMITTALS

A. Informational Submittals:
    1. Certificates:
        a. Provide one (1) copy of completed NFPA 13 'Contractor's Material and Test Certification for Underground Piping' as specified in 'Field Quality Control' in Part 3 of this specification:
B. Closeout Submittals:
    1. Include following in Operations And Maintenance Manual specified in Section 01 7800:
        a. Record Documentation:
            1) Signed NFPA 13 'Contractor's Material and Test Certification for Underground Piping' with 'In-Building Riser' information included.

1.5 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
    1. Install exterior fire water system according to NFPA 13, NFPA 24, and AWWA Manual M41, 'Ductile-Iron Pipe and Fittings' procedures unless specified otherwise below.
    2. Install hydrant in accordance with AWWA C502.
    3. Install exterior fire water system up to and including pipe flange 12 inches above floor inside building.
    4. Bury fire service mains at least 6 inch deeper than municipal water works piping. Additional depth of cover is necessary because of lack of water circulation in fire service mains.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Manufacturers:
    1. Manufacturer Contact List:
        a. Ames Fire & Waterworks (A Watts Brand), Woodland, CA www.amesfirewater.com.
        b. Ipex Inc, Englewood, CO www.ipexinc.com.
        c. Mueller Company, Decatur, IL www.muellerflo.com.
        d. Nibco Inc, Elkhart, IN www.nibco.com.
        e. Potter Electric Signal Company, St Louis, MO www.pottersignal.com.
        f. Potter-Roemer, Santa Ana, CA www.potterroemer.com.
B. Materials:
    1. Pipe:
        a. PVC meeting AWWA C900 requirements:
            1) Blue-Brut by Ipex Inc.
            2) Blue Brute by JM Eagle.
        b. Fittings: Ductile iron pipe fitting in accordance with AWWA C110 and rubber gaskets joints in accordance with AWWA C111/A21.11.

2. Hydrants:
    a. Dry-barrel fire hydrant (base valve type) complying with AWWA C150-A21.50, with 150 psi working pressure with two 2-1/2 inch hose connections and one 4-1/2 inch pumper connection with caps and chains.
    b. Nozzle cap nuts to match operating stem nuts.
    c. Minimum 6 inch supply pipe.
    d. Class Two Quality Standard. See Section 01 6200:
        1) Hydrants accepted by Taylor West Weber Water are approved, which are "Super Centurion" by Mueller or "Medallion" by Clow.
3. Gate Valves:
    a. Cast iron body with bolted bonnet.
    b. Indicator post pattern.
    c. Non-rising stem.
    d. 175 psi working pressure.
    e. Category Four Approved Products. See Section 01 6200 for definition of Categories:
        1) Nibco:
            a) Model M-609 with mechanical connection.
            b) Model F-609 with flanged connection.
        2) Mueller:
            a) Model A-2052-5 with mechanical connection.
            b) Model A-2052-6 with flanged connection.
4. Tamper Switch:
    a. UL/ULC listed and FM approved.
    b. Weather and tamper resistant.
    c. Single Pole Double Throw Switch.
    d. Category Four Approved Products. See Section 01 6200 for definition of Categories:
        1) Potter Electric Signal: Model PCVS.
5. Anchorages:
    a. Provide anchorages for tees, plugs, caps, bends, and hydrants in accordance with NFPA 24.
    b. Miscellaneous Fittings:
        1) Clamps, Straps, And Washers: Steel, meeting requirements of ASTM A506.
        2) Rods: Steel, meeting requirements of ASTM A575.
        3) Rod Couplings: Malleable iron, meeting requirements of ASTM A197/A197M.
        4) Bolts: Steel, meeting requirements of ASTM A307.
        5) Cast Iron Washers: Meeting requirements of ASTM A126, Class A.
        6) Thrust Block: 2500 psi concrete.
6. In-Building Riser:
    a. Meet NSF International Standards for Lead Free, NSF 61-G certified, 200 psi maximum pressure and one piece.
    b. UL/ULC listed and FM approved.
    c. AWWA C900 Inlet/DIP and AWWA C606 Outlet.
    d. Corrosion resistant stainless steel construction, type 304.
    e. Includes test cap and coupler.
    f. Category Four Approved Products. See Section 01 6200 for definition of Categories:
        1) In-Building Riser (Series IBC) by Ames:
            a) Size to match project requirements.
7. Pipe Sleeve at slab penetration:
    a. Class Two Quality Standard. See Section 01 6200:
        1) Any material rigid enough to resist deformation when concrete poured.
        2) Size: Provide 2 inch minimum space between piping assembly and sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Before installation, inspect pipe for defects and cracks. Do not use defective, damaged, or unsound pipe.

3.2 PREPARATION

A. Excavate and backfill as specified in Sections 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Contract Documents.
   2. Excavate to required depth:
      a. Depth at least 12 inches deeper than frost line.
   3. Grade to obtain fall required.
   4. Bottom of trenches shall be hard and smooth. Tamp as required.
   5. Remove debris from trench prior to laying of pipe.
   6. Do not cut trenches near footings without consulting Architect.
   7. Excavate trenches so outside pipe will be 48 inches minimum below finish grade.
   8. Cover pipe only after testing is complete and accepted by Architect.

3.3 INSTALLATION

A. General:
   1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
   2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.

B. Placing And Laying of Underground Pipe:
   1. Install top of Fire Suppression Utility Water Distribution piping at least 6 inches below frost line (protects from freezing due to water not moving).
   2. Deflections from straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed 6/D inches per linear foot of pipe where D represents nominal diameter of pipe expressed in inches.
   3. Deflections to be determined between center lines extended of two connecting pipes.
   4. If alignment requires deflection in excess of these limitations, provide special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Architect.
   5. Laying:
      a. Place 18 gage yellow tracer wire along side when installing C900 pipe:
         1) Tracer wire shall run from water main isolation valve to and past all connections, to PIV and each fire hydrant and fire riser.
      b. Shape trench bottom to give substantially uniform circumferential support to lower third of each pipe.
      c. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.
      d. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.
      e. Support fittings at bends in pipe line by concrete thrust blocks firmly wedged against vertical face of trench. Blocks shall be at least two cu ft in size.
      f. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.

C. Make joints between ductile iron and cast iron pipe and other types of pipe with standard manufactured cast-iron adapters and fittings.

D. Provide cast iron valve box for fire protection valve. Encase valve box in concrete.

E. Install In-Building Riser:
   1. Connect vertical leg must extend 12 inches above finished floor.

2. Horizontal leg must extend at least 3 feet out from foundation.
3. Provide 2 inch minimum clearance around pipe at penetration through floor.
4. Fill clearance with mastic.

F. Make joints between ductile iron and other types of pipe with standard manufactured adapters and fittings. Make connections between new work and existing mains using specials fittings to suit actual conditions.

G. Incidental Items of Work:
1. Valve, plug, or cap, as directed by Architect, where pipe ends are left for future connections.
2. Make key for unlocking valve handle identical to key used to open doors to building.

H. Fire Hydrant Color-Code:
1. Laps and Nozzle caps should be painted IAW NFPA 24:
a. Less ten 500 gpm: Red
b. 500 to 999 gpm: Orange
c. 1000 to 1499 gpm: Green
d. 1500 gpm and above Light Blue

3.4 FIELD QUALITY CONTROL

A. Field Tests:
1. Test system according to NFPA 13 (2010, 2013, and 2016), figure 10.10.1, 'Contractor's Material and Test Certification for Underground Piping':
a. Provide signed copy of certificate with field test information with Closeout Submittals:
1) Certificate to include following information in 'Additional explanation and notes' area of certificate with following:
a) In-Building Riser: Manufacturer brand, size, material and size of trust blocking.

END OF SECTION

SECTION 33 3313 SANITARY UTILITY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavating and backfilling required for work of this Section.
   2. Furnish and install sanitary sewage system as described in Contract Documents beginning at 5 feet from where it enters building and connecting to serving sewer system.

B. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for:
      a. Pre-installation conference held jointly with concrete specifications.
   2. Section 22 1313: 'Facility Sanitary Sewers' for sanitary sewage system within building and within 5 feet of building.
   3. Section 31 0501: 'Common Earthwork Requirements' for:
      a. Pre-installation conference held jointly with other common earthwork related sections.
   4. Section 31 2316: 'Excavation' for criteria for performance of excavation.
   5. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Conferences:
   1. Participate in pre-installation conference as specified in Section 03 3111.
   2. Participate in pre-installation conference as specified in Section 31 0501.

1.3 REFERENCES

A. Reference Standards:

1. ASTM International:
   a. ASTM A74-17, 'Standard Specification for Cast Iron Soil Pipe and Fittings'.
   b. ASTM A888-18a, 'Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications'.
   c. ASTM C564-14, 'Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings'.
   d. ASTM C1277-18, 'Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings'.
   e. ASTM D2235-04(2016), 'Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings'.
   f. ASTM D2321-18, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
   g. ASTM D2564-12(2018), 'Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems'.
   h. ASTM D2661-14, 'Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings'.
   i. ASTM D2665-14, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings'.
   j. ASTM D3034-16, 'Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
   k. ASTM F656-15, 'Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings'.
2. Cast Iron Soil Pipe Institute:
   a. CISPI 301-12, 'Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
   b. CISPI 310-12, 'Standard Specification for Couplings for use in connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
   c. CISPI Handbook. 'Cast Iron Soil Pipe and Fittings Handbook' (2018).
3. International Code Council:
   a. ICC IPC-2018, 'International Plumbing Code'.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals

1. Install cleanouts in accordance with local governing authority and State codes.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. ABS:

1. ABS Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D2661 joined with pipe cement meeting requirements of ASTM D2235.

B. Cast Iron Soil Pipe And Fittings:

1. Meet requirements of ASTM A74, Service Grade:
   a. Cast iron for bell and spigot fittings.
   b. Cast iron for no-hub joints.
2. Approved Joint Material And Manufacturers:
   a. For Bell And Spigot Pipe: Rubber gaskets meeting requirements of ASTM C564 and compatible with pipe used.
   b. For No-Hub Pipe:
      1) Category Four Approved Products. See Section 01 6200 for definitions of Categories:
         a) SuperGrip 304 American Brass & Iron (AB&I), Oakland, CA www.abifoundry.com.

b) Husky SD 4000 coupling by Anaco-Husky, Corona, CA www.anaco-husky.com.
c) Neoprene gaskets with type 304 stainless steel clamp and 24 ga type 304 stainless steel housing by Clamp-All Corp, Haverhill, MA www.clampall.com.
d) MG Coupling by MG Piping Products Co, Stanton, CA www.mgcoupling.com.

C. PVC:
1. Schedule 40 solid wall plastic pipe and fittings meeting requirements of ASTM D2665 joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
2. Gasket joint gravity sewer pipe and fittings meeting requirements of ASTM D3034. Joints shall be integral wall and elastomeric gasket.

D. PVC:
1. PVC Schedule 40 solid wall plastic pipe and fittings meeting requirements of CSA B182.2, SDC 28 joined using cement primer meeting requirements of ASTM F656 and pipe cement meeting requirements of ASTM D2564.
2. Under areas subject to vehicular travel, use Blue Brute pipe and fittings by Ipex Inc, Englewood, CO www.ipexinc.com.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification Of Conditions:
1. Before installation, inspect pipe for defects and cracks.
2. Do not use defective, damaged, or unsound pipe.

3.2 PREPARATION

A. Excavate and backfill as specified in Sections 31 2316 and Section 31 2323 with following additional requirements:
1. Runs shall be as close as possible to those shown on Contract Drawings.
2. Excavate to required depth and grade to obtain fall required.
3. Bottom of trenches shall be hard. Tamp as required.
4. Remove debris from trench before laying pipe.
5. Do not cut trenches near footings without consulting Architect/Engineer.
6. Excavate trenches so outside pipe will be 36 inches minimum below finish grade.

3.3 INSTALLATION

A. General:
1. When work is not in progress, close open ends of pipe and fittings so no trench water, soil, or other substances will enter pipes or fittings.
2. Keep trenches free from water until pipe jointing material has set. Do not lay pipe when condition of trench or weather is unsuitable for such work.
3. Trench width at top of pipe:
a. Minimum: 18 inches or diameter of pipe plus one foot , whichever is greater.
b. Maximum: Outside diameter of pipe plus two feet.

B. Placing And Laying of Underground Pipe:
1. Deflections from straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall not exceed 6/D inches per linear foot of pipe where D represents nominal diameter of pipe expressed in inches
2. Deflections to be determined between center lines extended of two connecting pipes.
3. If alignment requires deflection in excess of these limitations, provide special bends or sufficient number of shorter lengths of pipe to provide angular deflections within limits approved by Architect.
4. Laying:
a. Pipe laying shall proceed up-grade with spigot ends of bell-and-spigot pipe pointing in direction of flow.

b. Lay each pipe true to line and grade and in such manner as to form close concentric joint with adjoining pipe and to prevent sudden offsets of flow line.

c. As work progresses, clear interior of pipe of dirt and superfluous materials. Where cleaning after laying is difficult because of small pipe, keep suitable swab or drag in pipe and pull forward past each joint immediately after jointing has been completed.

5. Make joints between cast iron pipe and other types of pipe with standard manufactured cast-iron adapters and fittings.
6. Valve, plug, or cap, as directed by Architect, where pipe ends are left for future connections.

C. Cast Iron Pipe And Fittings:
1. Shape trench bottom to give substantially uniform circumferential support to lower third of each pipe. Provide depression under bell of each joint to maintain even bearing of sewer pipe.
2. Connect to street main as required by local authorities.
3. Use jacks to make-up gasketed joints.

D. Thermoplastic Pipe And Fittings:
1. Install in accordance with Manufacturer's recommendations and ASTM D2321.
2. Stabilize unstable trench bottoms.
3. Bed pipe true to line and grade with continuous support from firm base.
   a. Bedding depth: 4 to 6 inches.
   b. Material and compaction to meet ASTM standard noted above.
4. Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
5. Piping and joints shall be clean and installed according to Manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
6. Do not use back hoe or power equipment to assemble pipe.
7. Initial backfill shall be 12 inches above top of pipe with material specified in referenced ASTM standard.
8. Minimum cover over top of pipe:
   a. 36 inches before allowing vehicular traffic over pipe.
   b. 48 inches before use of compaction equipment other than hand or impact tampers.

3.4 FIELD QUALITY CONTROL

A. Non-Conforming Work:
1. Failure to install joints properly shall be cause for rejection and replacement of piping system at no additional cost to Owner.

END OF SECTION

SECTION 33 4116 SITE STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavating and backfilling required for work of this Section.
   2. Furnish and install storm drainage system using concrete pipe or PVC Polyethylene Pipe and fittings as described in Contract Documents from point of water collection to terminating point.

B. Related Requirements:
   1. Section 31 2316: 'Excavation' for criteria for performance of excavation.
   2. Section 31 2323: 'Fill' for criteria for performance of backfill and compaction.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM D2321-18, 'Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications'.
      b. ASTM D3034-16, 'Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings'.
      c. ASTM D3212-07(2013), 'Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals'.
      d. ASTM F794-03(2014), 'Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter'.
      e. ASTM F1336-15, 'Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings'.
   2. International Code Council:

a. ICC IPC, '2015 International Plumbing Code'.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Materials:
   1. Bedding Material: 3/8 inch crushed gravel.
   2. Catch Basins, Curb Inlets, Etc:
      a. Concrete:
         1) Construct of 5000 psi minimum concrete.
         2) Include cover inlet with cast iron frame and grate as shown on Drawings.
      b. PVC:
         1) Comply with requirements of ASTM D3212, ASTM F794, and ASTM F1336.
         2) Metal grates, Frames, and hoods shall comply with ASTM A536, Grade 70-50-05.
         3) Type One Acceptable Products:
            a) Nyloplast-ADS, Buford, GA (866) 888-8479. www.nyloplast-us.com.
            b) Equal as approved by Architect before bidding. See Section 01 6200.
   3. PVC Pipe And Fittings:
      a. Meet requirements of ASTM D3034, SDR 35.
      b. Fittings: Slip Joint type with elastomeric seals.

PART 3 - EXECUTION

3.1 PREPARATION

A. Excavate and backfill as specified in Section 31 2316 and Section 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Contract Documents.
   2. Excavate to required depth.
   3. Grade to obtain fall required.
   4. Remove debris from trench before laying bedding and pipe.
   5. Do not cut trenches near footings without consulting Architect.
   6. Backfill only after pipe lines have been tested, inspected, and approved by Architect/Engineer.

3.2 INSTALLATION

A. PVC / Polyethylene Pipe:
   1. Install in accordance with ASTM D2321.
   2. Minimum cover for corrugated polyethylene pipe and fittings shall be 12 inches for H-20 load.
B. Use jacks to make-up gasketed joints.

3.3 FIELD QUALITY CONTROL

A. Non-Conforming Work:
   1. Failure to install joints properly shall be cause for rejection and replacement of piping system at no additional cost to Owner.

3.4 CLEANING

A. Remove excess earth from site or place as directed by Architect.

END OF SECTION

SECTION 33 5100 NATURAL-GAS DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Includes But Not Limited To:
   1. Perform excavation and backfill required for work of this Section.
   2. Furnish and install gas piping and fittings as described in Contract Documents from gas main to meter.
   3. Provide, make necessary arrangements for, and pay necessary fees to local gas utility company for gas service lines and proper size gas meter.

B. Related Requirements:
   1. Section 03 3111: 'Cast-In-Place Structural Concrete' for concrete meter base.
   2. Section 05 0523: 'Metal Fastening' for welding standards and requirements.
   3. Section 31 2316: 'Excavation' for procedure and quality of excavating.
   4. Section 31 2323: 'Fill' for procedure and quality of backfilling and compacting.

1.2 REFERENCES

A. Reference Standards:
   1. ASTM International:
      a. ASTM A53/A53M-18, 'Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless'.
      b. ASTM A234/A234-18a, 'Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service'.
      c. ASTM D2513-18a, 'Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings'.

1.3 SUBMITTALS

A. Informational Submittals:
   1. Certificates:
      a. Welder certificates certifying welders comply with requirements specified under Quality Assurance Article of this Section.

1.4 QUALITY ASSURANCE

A. Regulatory Agency Sustainability Approvals:
   1. Lay underground pipe in accordance with federal pipeline safety regulations and local gas utility company regulations and specifications.
B. Qualifications: Requirements of Section 01 4301 applies, but not limited to following:
   1. Polyethylene Pipe Installers:
      a. Properly trained and certified in procedure for joining polyethylene pipe.
   2. Welders:
      a. Certified and bear evidence of certification 30 days before commencing work on project.
      b. If there is doubt as to proficiency of welder, Owner's Representative may require welder to take another test.
      c. This shall be done at no cost to Owner.
      d. Certification shall be by Pittsburgh Testing Laboratories or other approved authority.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage And Handling Requirements:
   1. Do not store polyethylene pipe so it is exposed to sunlight.

PART 2 - PRODUCTS

2.1 COMPONENTS

A. Above-Ground Pipe And Fittings:
   1. Black carbon steel, butt welded, Schedule 40 pipe meeting requirements of ASTM A53/A53M.
   2. Welded forged steel fittings meeting requirements of ASTM A234/A234M.
B. Below-Ground Pipe And Fittings:
   1. Polyethylene pipe and fittings meeting requirements of ASTM D2513 with No. 14 coated copper tracer wire.
C. Valves:
   1. Iron body, 125 psi square head cock, with bronze plug.
   2. Class One Quality Standard: Powell No. 2200:
      a. Crane Valves, Long Beach, CA www.cranevalve.com or Crane Canada Inc, Plumbing Div, Montreal, QB (514) 735-3592.
      b. The Powell Co, Cincinnati, OH www.powellvalves.com.
      c. Stockham Valve, Birmingham. AL www.stockham.com.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Excavate and backfill as specified in Section 31 2316 and 31 2323 with following additional requirements:
   1. Runs shall be as close as possible to those shown on Contract Drawings.
   2. Excavate to required depth.
   3. Bottom of trenches shall be hard. Tamp as required.

4. Remove debris from trench before laying pipe.
5. Do not cut trenches near footings without consulting Architect.
6. Place 4 inches of sand around pipe before trench is backfilled.
7. Bury outside pipe 12 inches minimum below frost line or 18 inches minimum below finish grade, whichever is deeper.
8. Backfill only after pipe lines have been tested, inspected, and approved by Architect.

B. General installation shall be as specified in Division 23:
   1. Steel pipe 2-1/2 inches and larger shall have welded fittings and joints.
   2. Provide 24 inch minimum steel pipe between vertical rise of riser and end of polyethylene line if anode-less riser is not used. Use plastic-to-steel transition or compression fitting between end of service line and steel meter riser. Provide cathodic protection for steel riser or use anode-less riser.
   3. Place tracer wire along side of polyethylene pipe from meter to main.

C. Set meter on concrete base.

3.2 PROTECTION

A. Provide necessary protection against damage for meter.

END OF SECTION