

CITY OF KIRKLAND
Fire Station 27
CIP NO. PSC 3007000
JOB NO. 13-22-PW
13118 121ST Way NE, Kirkland WA 98034



PROJECT MANUAL
Volume 2 (Divisions 09-34)

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VOLUME 2 OF 2 (DIVISIONS 09-34)

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END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior Gypsum Board.
2. Backer Board
3. Texture finishes.
4. Sound Attenuation Blankets
5. Sound-Absorbing Panels

B. Related Requirements:

1. Division 1 Section "Submittal Procedures" for submittal requirements.
2. Division 1 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
3. Division 5 Cold Formed Metal Framing
4. Division 6 Section "Sheathing" for Exterior Gypsum Sheathing.

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.
- B. SAA: Sound Absorption Average.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.

1.6 PERFORMANCE REQUIREMENTS

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

- B. **STC-Rated Assemblies:** For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. **Low Emitting Materials:** For ceiling and wall assemblies, provide materials and construction identical to those tested in assembly and complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.7 SUBMITTALS

- A. Submit under provisions of Section 01 3300
- B. **Product Data:** For each type of product listed in Part 2 of this section. Provide performance information as required.
- C. **Sustainable Design Submittals:**
 - 1. **Product Data:** For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.
 - 2. **Product Data:** For gypsum showing CDPH emissions compliance.
 - 3. **Environmental Product Declaration (EPD):**
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
 - 4. **Material Ingredient Reporting:**
 - a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
- D. **Shop Drawings:** For sound-absorbing panel locations and installation.
- E. **Samples:** For each type of product including the following products:
 - 1. **Trim Accessories:** Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
 - 2. **Sound-Absorbing Panel: Samples for Initial Selection:** For each type of fabric facing.
 - a. Include Samples of hardware and accessories involving color or finish selection.

1.8 DELIVERY, STORAGE AND HANDLING

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

1.9 PROJECT CONDITIONS

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

1. Install wall panels only after wall framing moisture content has been verified to be below 19%.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL

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

2.2 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
 1. Georgia-Pacific Gypsum LLC.
 2. USG Corporation
 3. CertainTeed Corp.
 4. National Gypsum Company.
 5. Or approved equal.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M.
 1. Thickness: 5/8 inch (15.9 mm).
 2. Long Edges: Tapered.
- C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 1. Thickness: 5/8 inch (15.9 mm).
 2. Long Edges: Tapered.
- D. Impact-Resistant (High Impact) Gypsum Board: Paper or fiberglass faced meeting the criteria below:
 1. Core: 5/8 inch (15.9 mm), Type X where required for fire resistance.
 2. Long Edges: Tapered.
 3. Mold Resistance: ASTM D 3273, score of 10.
 4. Resistance rating ASTM C 1629/C 1629M
 - a. Resistance to abrasion, **Level 2**
 - b. Indentation, **Level 1**
 - c. Soft-body impact, **Level 3**
 - d. Hard-body impact, **Level 3**
- E. Moisture and Mold-Resistant Gypsum Board: (Water Resistant (W.R.) Gypsum Board) ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 1. Core: 5/8 inch (15.9 mm), regular type (or type 'X' where indicated)

2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

2.3 BACKER BOARD

- A. Glass-Mat, Water-Resistant Backer Board: ASTM C 1178/C 1178M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Georgia-Pacific Gypsum LLC; Dens-Shield Tile Backer.
 - b. USG Corporation; Securock Glass Mat Sheathing.
 - c. CertainTeed Corp.; GlasRoc Tile Backer
 - d. National Gypsum Company; Gold Bond, e(2)XP.
 - e. Or approved equal.
 2. Thickness: 5/8 inch (15.9 mm), Type X where required for fire resistance rating
 3. Mold Resistance: ASTM D 3273, score of 10.

2.4 TRIM ACCESSORIES

- A. Gypsum Board Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet
 2. Shapes:
 - a. Corner bead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.
 - f. Curved-Edge Corner bead: With notched or flexible flanges.

2.5 JOINT TREATMENT MATERIALS

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

5. Skim Coat: For final coat of Level 5 finish, use fast drying-type, all-purpose compound

D. Water-Resistant Backer Board:

1. A mold and mildew resistant product that is recommended by water resistant backer board unit manufacturer.

2.6 SOUND ATTENUATION BLANKETS

A. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from slag wool, and/or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

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

1. ThermaFiber SAFB 2.5 pcf
2. Roxul AFB 2.8 pcf
3. Fibrex SAFB
4. Or approved equal.

C. Thermal resistance: R-3.7 per inch min.

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

1. Wire insulation support.

2.7 SOUND-ABSORBING PANELS

A. Sound-Absorbing Wall Material: Manufacturer's standard panel construction consisting of non-woven polyester.

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

1. Pyrotek; Sorberpoly 2D
2. Or approved equal.

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

D. Mounting: Back mounted with manufacturer's standard **adhesive, adhesive tape strips, and metal clips or bar hangers**, secured to substrate.

E. Core: Non-woven polyester.

F. Acoustical Performance: Sound absorption **NRC or 0.90 and an SAA 0.93** according to ASTM C423 for **Type A** mounting according to ASTM E795.

G. Nominal Thickness: **2 inches (51 mm)**.

- H. Location: Room 112 Compressor/Sprinkler Riser.

2.8 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."
- D. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

2.9 SURFACE FINISHES

- A. Primer: As recommended by textured finish manufacturer.
- B. Texture: Non-Aggregate, Light spatter (Light Orange Peel), spray texture, subject to Architect's review and approval.
 - 1. Do Not apply where other finish materials are scheduled
 - 2. Flame-Spread Index: 25 or less.
 - 3. Smoke-Developed Index: 450 or less.
 - 4. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; Wall and Ceiling Red Texture.
 - b. Georgia-Pacific Gypsum LLC; ToughRock Wall and Ceiling Textures.
 - c. USG Corporation; SHEETROCK MH Wall and Ceiling Spray Texture.
 - d. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc., except in chases braced internally).
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Metal Framing: Install gypsum panels over metal framing, with floating internal corner construction.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings
 - 2. Type X: Where required for fire-resistance-rated assembly
 - 3. Abuse-Resistant Type: As indicated on Drawings

4. Moisture- and Mold-Resistant Type: As indicated on Drawings
 5. Skim-Coated Type: As indicated on Drawings, and where required for a smooth finish.
- B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Multilayer Application:
1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws

3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings or according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
1. Corner bead: Use at outside corners unless otherwise indicated
 2. LC-Bead: Use at exposed panel edges
 3. L-Bead: Use where indicated
 4. U-Bead: Use at exposed panel edges

3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. General: Provide a light spatter (light orange peel) texture finish throughout.
 2. Provide a Level 4 finish to all exposed surfaces except as noted below.
 3. Provide level 5-finish
 - a. Over backer board where a painted finish is specified
 4. Provide Level 3 finish at locations where a rigid sheet panel finish or other wall covering is specified.
 5. Provide Level 1 finish at ceiling plenum areas, concealed areas, and where indicated.
 6. Primer for painted surfaces and its application to surfaces are specified in other Division 09 Sections.
 - a. Apply Primer, unless otherwise noted, to all surfaces receiving Rigid Sheet Panels.
 - b. See Subsections below for applying primers for the application of wall textures.
- E. Marking and identification. Where there is an accessible concealed floor, floor-ceiling or attic space, fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with signs or stenciling in the concealed space. Such identification shall:
1. Be located within 15 feet (4572 mm) of the end of each wall and at intervals not exceeding 30 feet (9144 mm) measured horizontally along the wall or partition.
 2. Include lettering not less than 3 inches (76 mm) in height with a minimum 3/8-inch (9.5 mm) stroke in a contrasting color incorporating the suggested wording, "FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS," or other wording.

3.6 APPLYING TEXTURE FINISHES

- A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
- B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture free of starved spots or other evidence of thin application or of application patterns.
- C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.7 EXAMINATION OF SOUND-ABSORBING PANELS

- A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.8 INSTALLATION OF SOUND-ABSORBING PANELS

- A. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.9 INSTALLATION TOLERANCES OF SOUND-ABSORBING PANELS

- A. Variation from Plumb and Level: Plus or minus **1/16 inch (1.6 mm)** in 48 inches (1200 mm), noncumulative.
- B. Variation of Joint Width: Not more than **1/16-inch (1.6-mm)** variation from **hairline** in 48 inches (1200 mm), noncumulative.

3.10 CLEANING OF SOUND-ABSORBING PANELS

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
 - 1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation. Coordinate review with pre-scheduled weekly project meetings.
 - 2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of ceiling support framing.

3.12 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

- C. Remove and replace panels that are wet, moisture damaged, or have indications of the presence of mold.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels have indications of mold include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Ceramic and Porcelain tile.
- B. Related Requirements:
 - 1. Section 01 81 13, Sustainable Design Requirements, for applicable Guiding Principle Compliance Requirements as assessed through GBCI-NC 2009 Compliance Path.
 - 2. Section 07 92 00, Joint Sealants, for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
 - 3. Section Plumbing for linear floor drain channel body, grate assembly, coverplate and strainer

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
 - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.6 SUBMITTALS

- A. Comply with requirements of Section 01 33 00.
- B. Product Data: For each type of product.
- C. Sustainable Design Submittals:
 - 1. Product Data: For adhesives and sealers, indicating VOC content.
 - 2. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.
 - 3. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
 - 4. Material Ingredient Reporting:
 - a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
- D. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- E. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- F. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.
 - 2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 , but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
 - 3. Metal edge strips in 6-inch (150-mm) lengths.
- G. Qualification Data: For Installer whom is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors Association of America.
- H. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

- I. Product Certificates: For each type of product.
- J. Product Test Reports: For tile-setting and grouting products and certified porcelain tile.
- K. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified portland cement and aggregate, from single manufacturer.
 2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
1. Waterproof membrane.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Dal-tile, <http://www.daltile.com>.
 2. American Marazzi Tile, Inc
 3. American Olean Corporation
 4. Or approved equal.
- B. Ceramic Tile Type (CT-01): Glazed wall tile
1. Basis of design: Dal-tile: "Color Wheel Collection – Linear", glazed ceramic, semi gloss
 2. Module Size: 4"x8" (10.91 cm by 21.82 cm)
 3. Face Size Variation: Rectified

4. Thickness: 5/16" (7.9 mm)
 5. Face: Plain with square edges
 6. Finish: Semi-gloss
 7. Tile Color and Pattern: Allow for 2 colors as selected by Architect from manufacturer's full range and as pattern as shown in drawings.
 8. Grout Color: As selected by Architect from manufacturer's full range
 9. Mounting: Factory, back mounted
 10. Trim Units:
 - a. Base: Bullnose, module size 4x8 (10.16cm by 20.32 cm)
 - b. Wainscot Cap/ External Corners:
 - 1) Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a) Schluter Systems, LP
 - b) Or Approved Equal
 - 2) Basis of Design: Schluter- QUADec
 - a) Description: Profile with square visible surface, integrated trapezoidal-perforated anchoring leg and integrated grout spacer
 - b) Material and Finish: EB – Brushed Stainless Steel Type 304 = V24
 - c) Height: Verify required height with thickness of corresponding type and mortar setting
 - c. Internal Corners: Field-buttet square corners. For covered base and cap use angle pieces designed to fit with stretcher shapes.
- C. Ceramic Tile Type (CT-02): Factory Mounted, glazed ceramic mosaic tile for shower floor.
1. Basis of design: Dal-tile: "Color Wheel Collection – Mosaic", glazed ceramic, semi gloss
 2. Module Size: 2"x2" (50.8 by 50.8 mm)
 3. Thickness: 1/4" (6.4 mm)
 4. Face: Plain w/ cushion edges
 5. Surface: Slip resistant with abrasice admixture
 6. Dynamic Coefficient of Friction: Not less than 0.42.
 7. Finish: Semi-gloss
 8. Tile Color and Pattern: As selected by Architect from manufacturer's full range and as pattern as shown in drawings.
 9. Grout Color: As selected by Architect from manufacturer's full range
 10. Trim Units:
 - a. Perimeter Shower Profiles
 - 1) Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a) Schluter Systems, LP
 - b) Or Approved Equal
 - 2) Basis of Design: Schluter – SHOWERPROFILE-S
 - a) Description: Two-part profile with an exposed brushed stainless steel tapered edge and recycled PVC support section with integrated trapezoid-perforated anchoring led for lateral transition between sloped shower floor and walls
 - b) Profile Height: As required to coordinate with tile selection and tile setting system selected
 - c) Profile Length: As required
- D. Porcelain Tile Type (PT-01): Glazed wall tile with epoxy grout

1. Basis of design: Dal-tile: "Portfolio- Colorbody Porcelain", glazed porcelain, semi gloss
2. Module Size: 12"x24" (29.56 cm by 59.44 cm)
3. Face Size Variation: Rectified
4. Thickness: 3/8" (9.53 cm)
5. Face: Plain with square edges
6. Finish: Semi-gloss
7. Tile Color and Pattern: As selected by Architect from manufacturer's full range. Provide 2 colors with pattern as shown in drawings.
8. Grout Color: As selected by Architect from manufacturer's full range
9. Mounting: Factory, back mounted
10. Trim Units:
 - a. Base: Cove, module size 6x12 (15.24 cm by 29.56 cm)
 - b. Wainscot Cap/ External Corners:
 - 1) Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a) Schluter Systems, LP
 - b) Or Approved Equal
 - 2) Basis of Design: Schluter- QUADDEC
 - a) Description: Profile with square visible surface, integrated trapezoidal-perforated anchoring leg and integrated grout spacer
 - b) Material and Finish: EB – Brushed Stainless Steel Type 304 = V24
 - c) Height: Verify required height with thickness of corresponding type and mortar setting
 - c. Internal Corners: Field-buttet square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.4 THRESHOLD

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
 1. Schluter Systems, LP
 2. Or Approved Equal
- B. Basis of Design: Schluter – SHOWERPROFILE-WSK
- C. Description: Two-part splash guard with a 2 1/16" (52 mm) wide x 5/16" (8mm) tall anodized aluminum support section and PVC insert:
 1. Splashguard Insert: Collapsible straight lip.

2.5 WALL SHELF

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
 1. Schluter Systems, LP
 2. Approved Equal
- B. Basis of Design: Schluter-SHELF-E Quadrilateral Corner Shelf; SES3 D10EB

1. Description: 4/53" (4 mm) thick shelf for installation with tile on walls surfaces
2. Configuration and Size: 2 7/16" (620 mm) by 11 5/8" (295mm) by 6 1/16" (154 mm)
3. Design: Wave
4. Material and Finish: EB- Brushed Stainless Steel Type 304 = V2A
5. Quantity: 9 total; 1 at room 111 and 2 each in shower at rooms 214, 215, 216 and 218.

2.6 TILE BACKING PANELS:

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C-Cure; C-Cure Board 990.
 - b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; ProTEC Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
 - e. Or Approved Equal
 2. Thickness: 5/8 inch (15.9 mm)

2.7 WATERPROOFING MEMBRANE

- A. Manufacturers: Subject to compliance with requirements, provide one of the following:
1. Schluter Systems, LP
 2. Or Approved Equal
- B. Basis of Design: Schluter-KERDI
1. Description: 0.008" (8mil) this, orange polyurethane membrane with polypropylene fleece laminated on both sides. Meets and exceed requirements of the "American nation standard specification for load bearing, bonded, waterproof membrane for thin-set ceramic tile and dimension stone installation A118.10"
 2. Waterproofing seaming membrane:
 - a. Schluter- KERDI BAND: 0.004" (4mil) thick, orange polytheylen membrane with polypropylene fleece laminated on both sides.
 3. Waterproofing Accessories:
 - a. Schluter - KERDI-SEAL for missing valve seals
 - b. Schluter – KERDI-SEAL for pipe seals
 - c. Schluter – KERDI-KERECK-F for inside and outside 90 deg. corners
 - d. Schluter – KERDI-KERS for sealing floor to wall show base connections in curbless shower application where linear drain is installed adjacent to the wall.
 - e. Schluter – KERDI-BAND in 10" (25 cm) widths for sealing butt joints or corner joints
 - f. Schluter – KERDI-FLEX in 10" (25 cm) widths for seal expansion joints or flexible edge joints.

2.8 PREFABRICATED SHOWER COMPONENTS

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

1. Schluter Systems, LP
2. Or Approved Equal

B. Shower Tray:

1. Basis of Design: Schluter – KERDI-Shower LTS
2. Description: Trapezoid-imprinted, prefabricated, sloped tiles shower tray base, made of 2.75lb/ft³ (44 kg/m³) density, self-extinguishing (HF-1 rating per UL 94) expanded polystyrene, with removable recessed section and bonded with 0.008 inch (0.2 mm) waterproofing membrane which meets or exceeds requirements of the American National Standard Specification for load bearing, bonded, waterproof membranes for thin-etch ceramic tile and dimension stone installation A118.10 and listed by cUPC. Meeting ANSI A118.0 as referenced in method B422 of the Tile Council of North America Handbook for Ceramic Tile Installation
3. Tray for Wall or Entrance Linear Drain Placement
 - a. Size: Site verify required size of tray.

2.9 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ARDEX Americas; ARDEX FL™ Rapid Set, Flexible, Sanded Grout, <http://www.ardex.com>.
 - b. Boiardi Products Corporation; an QEP Company, <http://www.biordiproducts.com>.
 - c. Bonsal American, an Oldcastle Company, <http://www.bonsal.com>.
 - d. Bostik, Inc., <http://www.bostik.com>.
 - e. Or approved equal.

B. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 degrees F and 212 degrees F (60 degrees C and 100 degrees C), respectively, and certified by manufacturer for intended use.

2.10 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

- B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- C. Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Bonsal American, an Oldcastle Company; Grout Sealer, <http://www.bonsal.com>.
 - b. Or approved equal.

2.11 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors in wet areas.
 - b. Tile floors consisting of tiles 8 inches by 8 inches (200 mm by 200 mm) or larger.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Provide sealant at all transitions to other wall finishes
- F. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

- G. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

- H. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Tile: 1/4 inch (6.4 mm).

- I. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

- J. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

- K. Floor Sealer: Apply floor sealer to grout joints according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

- A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

- B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.6 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES

- A. Reference Standards: Current edition at date of Bid
- B. American Society of Civil Engineers (ASCE) and Structural Engineering Institute (SEI):
 - 1. ASCE/SEI 7 - Minimum Design Loads for Buildings and Other Structures.
- C. American Society for Testing and Materials (ASTM) International:
 - 1. ASTM A153- Specifications for Zinc-Coating (Hot-Dip) on iron and Steel Hardware.
 - 2. ASTM A641- Specifications for Zinc-Coated (Galvanized) Steel Wire.
 - 3. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical tile and Lay-in Panel Ceilings.
 - 4. ASTM C636 - Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 5. ASTM A653- Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
- D. Ceiling and Interior Systems Contractors Association (CISCA): Conform to applicable publications. www.cisca.org
 - 1. CISCA - Acoustical Ceiling Use and Practice.
 - 2. CISCA - Ceiling Systems Handbook.
 - 3. CISCA - Guidelines for Seismic Restraint for Direct-hung Suspended Ceiling Assemblies – Seismic Zones 3 & 4.
- E. Northwest Wall and Ceiling Bureau (NWCB), www.nwcb.org
 - 1. NWCB 400-101 - Ceiling Systems
 - 2. NWCB 400-102 - Suspended Ceiling Systems
 - 3. NWCB 400-401 - Suspension Systems for Acoustical Lay-In Ceilings

1.3 SUMMARY

- A. This Section includes acoustical panels for ceilings and the following:
 - 1. Ceilings consisting of acoustical panels and concealed suspension system assemblies.
- B. Related Sections include the following:
 - 1. Division 01 Section “Sustainable Design Requirements” for applicable Sustainability requirements.
 - 2. Division 06 Section “Architectural Woodwork” for Linear Wood acoustical panels system.
 - 3. Division 07 - Joint Sealants for Acoustical Sealants.
 - 4. Division 21 - Fire Suppression Systems

5. Division 22 - Plumbing
6. Division 23 - Heating, Ventilating, and Air-conditioning
7. Division 26 - Electrical

1.4 DEFINITIONS

- A. AC: Articulation Class. Measure of material preventing reflection of sound.
- B. CAC: Ceiling Attenuation Class. Ability of material to block sound transmission.
- C. LR: Light-Reflectance coefficient. The percentage of light reflected from a surface
- D. NRC: Noise Reduction Coefficient. Measures percentage of sound reaching a surface that will be absorbed.
- E. STC: Sound Transmission Class: Measurement of how well sound is prevented from transmitting from one side of a wall to the other.

1.5 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.6 SUBMITTALS

- A. Submit under provisions of Section 01 33 00
- B. Product Data: For each type of product indicated.
- C. Sustainable Design Submittals:
 1. Comply with requirements of Section 01 81 13
 2. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
 3. Material Ingredient Reporting:
 - a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
 4. Product Data: For sealants, documentation including printed statement of VOC content.
 5. Laboratory Test Reports: For ceiling systems and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Samples for Initial Selection: For components with factory-applied color finishes.
- E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Six inch square samples of each type, color, pattern, and texture.
 2. Concealed Suspension System Members: 12-inch- (300-mm-) long Sample of each type.
 3. Exposed Moldings and Trim: Set of 12-inch- (300-mm-) long Samples of each type and color.
- F. Qualification Data: For Installer
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling. See also part 3.4 Field Quality Control of this specification.
1. Indicate separate compliance with International Building Code (IBC) and State of Washington supplemental codes for suspended ceiling systems.
- H. Research/Evaluation Reports: For acoustical panel ceiling, ceiling components, anchors and fastener types.
- I. Design Data: Submit calculations defining conformance with seismic bracing requirements of current edition of IBC. Design is required to bear stamp of Structural Engineer licensed in Washington State.
- J. Maintenance Data: For finishes to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Installer Qualifications: Engage an experienced installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
1. Installer to have documented experience with acoustical panel ceiling suspension system installation and coordination with special inspection requirements using seismic bracing requirements per this specification and specifically for part 1.6 E Quality Assurance for Seismic Standards.
- C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or ITS/Warnock Hersey's "Directory of Listed Products"
 - b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per surface burning characteristics ASTM E 84:
 - a. Smoke-Developed Index: 25 or less.
 - b. Flame Spread Rating: 25 or less.

- E. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
 1. Conform to IBC Section 1613 including ASCE/SEI 7 Section 9.6.2.6 for 2 inch closure angle with one end of ceiling grid attached to angle and the other end with $\frac{3}{4}$ inch clearance of grid to wall and with freedom to slide on closure angle. Other designs, as accepted by Regulatory Authority having local jurisdiction.
 2. Conform to IBC Section 803.10 "Stability" and ASCE/SEI 7 Section 9.6.2.6.2.2, including requirement for independent support from structure above for light fixture and mechanical services installed into acoustical lay-in panel ceiling systems.
 3. Conform to ASCE/SEI 7 Section 13.5.6.2.2.d for ceiling areas exceeding 2,500 square feet. Provide a seismic separation joint or structural analysis.
 4. Seismic design. Use category D.
 5. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM C 636 and ASTM E 580
 6. IBC 2012 Section 808 Acoustical Ceiling Systems
 7. Minimum Design Components: Meet or exceed NWCB 400-401 and CISCA Guidelines for Zones 3&4 for Seismic Design Category D (also Category E or F) as defined by Structural Notes.
 8. Runners and Cross Runners Pull out Tension minimum 180 pounds or twice the actual load whichever is greater, conforming to CISCA Guidelines for Seismic Zones 3&4.

- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

- B. Before installing acoustical panels, permit them to reach room temperature and stabilized moisture content.

- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.
 1. Damaged panels are not to be installed. Panels damaged after installation are to be replaced with new undamaged panels.
 2. Minor flaws in the panel can be repaired with same color paint at architect and owners sole discretion. If there is any doubt about the ability of the panel to be repaired that panel is to be replaced with a new panel.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.10 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including but not limited to the buildings exposed and unexposed structural components, light fixtures, HVAC equipment, suspended and unsuspended heaters and ductwork, fire-suppression system, partition assemblies and other ceiling mounted equipment and devices.
- B. Insure all lighting, vents, soffits and other construction work of other trades will fit within and around ceiling panel grid layout prior to installation. Any discrepancies with other trades are to be brought to the Architects attention prior to the installation of the panel and grid work. Discrepancies with the suspended ceiling system discovered after installation are to be repaired or modified at contractor's expense with approval for any modification by Architect and Owner.

1.11 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2.0 percent of quantity installed.
 - a. Repair or replacement of damaged panels through no fault of the Owner during construction and prior to final completion are not to be replaced with units from extra stock.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectance, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL CEILINGS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Basis of Design: USG Mars Clima Plus, for suspended acoustical ceilings.
 - 2. Armstrong World Industries, Inc.; Ultima
 - 3. Or Approved Equal.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
 - 1. Mineral Fiber.
 - 2. Modular Size: 24 inch by 24 inch.
 - 3. Texture: Fine
 - 4. Pattern: non-perforated and non-fissured
- C. Color: White
- D. LR: Not less than 0.80
- E. NRC: Not less than 0.50
- F. CAC: Not less than 35
- G. Edge/Joint Detail: Beveled, Tegular
- H. Thickness: 3/4 inch (19 mm) (5/8 inch thickness for panels is acceptable as provided by manufacturer's standard units if approved by architect. Use same thickness for all panels).

2.3 ACOUSTICAL WOOD PANELS

- A. Acoustical Wood Panels per Section 06 40 23 "Architectural Woodwork".
- B. Suspension System:
 - 1. Suspension Style: Metal T-Grid Suspension System
 - a. Heavy Duty 15/16"
 - b. Provide full suspension system required to support wood ceiling
 - 2. Finish: As selected by the Architect from manufacturer's full range.
 - a. Color: Stain to match architects control sample.
 - 3. Installation shall meet all local seismic requirements.
 - 4. Provide Acoustical Wood Panels as well as all required installation and hanging hardware.
 - a. All visible hardware to be painted black.

2.4 ACOUSTIC CLOUD CEILING AND WALL PANELS

- A. Product: FSorb by FSorb Acoustic Wall and Ceiling Panels - Tel: 425.881.0888 or 1.844.313.7672 Email: info@fsorb.com
 - 1. Design: FSorb

2. Or approved equal.
 - a. Assembled Size: All custom baffle shapes cut from 48"x96" (4'x8') panels
 - b. Noise Reduction Coefficient (NRC)
 - 1) 2" product – 1.05 (testing per A mount).
- B. Material: Thermally bonded (heat pressed), high density, recycled polyester (100%) acoustic panel containing not less than 60 percent post-consumer recycled material.
 1. Composition: Unfaced monolithic panel.
 2. Thickness: 2"
 3. Finish: Unfaced panel color options: As selected from all standard and premium colors
 4. VOC Concentration: < 0.01 mg/m³.
 5. Fire Rating: ASTM E-84 Class A,
 - a. 2" product – Flame Spread 20 Smoke Development 350
- C. Fasteners
 1. Fasteners with color matched domes and washers at walls
 2. Fasteners as recommended by manufacturer for top fastening through grid at ceiling.

2.5 ACOUSTIC BAFFLES

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. Silentline baffles by FSorb Acoustic Wall and Ceiling Panels - Tel: 425.881.0888 or 1.844.313.7672 Email: info@fsorb.com
 2. Or approved equal.
- B. Material: Thermally bonded (heat pressed), high density, recycled polyester (100%) acoustic panel containing not less than 60 percent post-consumer recycled material.
 1. Composition: Unfaced monolithic panel.
 2. Size: As indicated on drawings.
 3. Noise Reduction Coefficient (NRC): 120.
 4. Thickness: 2".
 5. Shape: As selected from manufactures full range.
 6. End Shape: As selected from manufactures full range.
 7. Finish: Unfaced panel color options.
 8. Color: As selected from all standard and premium colors.
 9. VOC Concentration: < 0.01 mg/m³.
 10. Fire Rating: ASTM E-84 Class A,
 - a. Flame Spread 20 Smoke Development 350
- C. Hardware and Attachments: Provide for a full installation of baffles.

2.6 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
- E. Hanger Rods and Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- F. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate lateral forces.
- H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in-place.
- I. Seismic Beam End Retaining Clips (BERC2): 2-inch seismic clips designed to join main beam or cross tee to wall molding and web of grid with no visible pop rivets.
- J. Seismic Separation Joints: Manufacturer's system designed to provide seismic separation for ceiling areas in excess of 2,500 sq. ft..

2.7 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING & PANELIZED WOOD PANELS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. USG Interiors, Inc.; 15/16" Heavy Duty Donn DX Tee Bar
 - 2. Armstrong World Industries, Inc.; 15/16" Heavy duty, Prelude XL Exposed Tee
 - 3. Or Approved Equal.
- B. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, G30 (Z90) coating designation.
 - 1. Structural Classification: Heavy-duty system.
 - 2. Access: Upward and end or side pivoted, with initial access openings located throughout ceiling within each module formed by main and cross runners, with additional access available by progressively removing remaining acoustical panels.
- C. Color:
 - 1. Provide for (1) color option at acoustical panels from manufacturers full range of colors.
 - 2. Provide "Black" and painted 360 degrees for acoustical wood panels and acoustic clouds

2.8 METAL EDGE MOLDING

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. USG Interiors, Inc.; angle wall Molding MS-7 with 7/8" horizontal leg and 7/8" vertical leg. Splicing all butt and corner joints.
 - 2. Or Approved Equal
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
 - 1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 - 2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
 - 1. Exceptions to the above may be required to allow an even layout of the suspension system due to locations of other building elements like but not limited to lighting, mechanical louvers or the buildings structural components or other obstructions. If such discrepancies exist, review and obtain approval of modifications of the layout with Architect prior to proceeding with installation.

3.3 INSTALLATION, SUSPENDED ACOUSTICAL PANEL CEILINGS

- A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook." See also Acoustical Panel Ceiling details and seismic notes on drawings.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interferes with location of hangers at spacing required to support standard suspension system members install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical panel ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Splices shall be kept to a minimum. Trim sections shall be no less than 4-feet in length and there shall not be more than two (2) splice joints within 20-feet.
 4. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 5. Trim out all equipment supports and penetrations for new work throughout building including apparatus room.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
1. Splices shall be kept to a minimum. Main runners sections shall be no less than 4-feet in length and there shall not be more than two (2) splice joints within 20-feet.
- E. Arrange acoustical panels as indicated on reflected ceiling plans unless prior approval is granted.
- F. Install acoustical panels in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so panel-to-panel joints are closed by double lap of material.
1. Fit adjoining panel to form flush, tight joints. Scribe and cut panel for accurate fit at borders and around penetrations through panel.
 2. Hold panel field in compression by inserting leaf-type, spring-steel spacers between panel and moldings, spaced 12 inches (305 mm) o.c.
 3. Fabricate access units for special suspension system access members and panel units modified as required to allow for removal of access units.

4. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 INSTALLATION, ACOUSTIC CLOUD CEILINGS

- A. General: Install Acoustic Cloud ceiling and wall panels, per manufacturer's written instructions. See also Acoustic Cloud details on drawings.
- B. Locate system according to reflected ceiling plan and/or elevations.
- C. Cutting Acoustical Units: Make field cut edges of same profile as factory edges, using sharp knives or saws designed to cut plastic.
- D. Fit units in place, free from damaged edges or other defects detrimental to appearance and function.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Install units using mechanical fasteners directly to blocking, studs, or through suspended track.

3.5 INSTALLATION, SUSPENDED ACOUSTIC WOOD PANEL CEILINGS

- A. General: See Section 06 40 23 "Architectural Woodwork" for installation requirements. See Acoustical Wood Panel Ceiling details and seismic notes on drawings.
- B. Install acoustic wood panel ceilings per manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:
 1. Suspended ceiling system.
 2. Hangers, anchors and fasteners.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and post installed anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every 2 post installed anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.

- b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

3.7 PROTECTION

- A. Protect installed products until completion of project.

3.8 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace panels and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Resilient base.
- 2. Resilient molding accessories.

- B. Related Sections:

- 1. Division 01 Section "Submittal Procedures", for submittal requirements.
- 2. Division 01 Section "Sustainable Design Requirements", for applicable Sustainability requirements.
- 3. Division 09 Section "Resilient Athletic Flooring".

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00

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

- C. Sustainable Design Submittals:

- 1. Comply with requirements of Section 01 81 13
- 2. Product Data: For adhesives, indicating VOC content.
- 3. Product Data: For chemical-bonding compounds, indicating VOC content.
- 4. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
- 5. Material Ingredient Reporting:

- a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
6. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
- D. Samples for Initial Selection: For each type of product indicated.
- E. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.
- F. Maintenance Data: To include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.7 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Johnsonite.
 - c. Roppe Corporation, USA.
 - d. Or Approved Equal
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Rubber Wall Base: Products complying with ASTM F-1861, Type TS, Group 1 and with requirements specified in Resilient Wall Base, Flooring and Accessory Schedule.
 - 2. Style: Cove (base with toe).
- C. Minimum Thickness: 0.125 inch (3.2 mm)
- D. Height:
 - 1. 4 inches where required per interior elevations and finish schedule
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Finish: As selected by Architect from manufacturer's full range.
- I. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johnsonite.
 - b. R.C.A. Rubber Company (The).
 - c. Roppe Corporation, USA.
 - d. Philadelphia Commercial.
 - e. Or Approved Equal.

B. Description: Rubber reducer: Athletic flooring to concrete floor

1. Material: Rubber.
2. Profile and Dimensions: Roppe #74.
3. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in continuous lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
 - 1. Avoid seams on prominent walls where possible
 - 2. No more than one (1) seam per wall is allowed.
 - 3. No section less than 6-feet is allowed per wall.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Follow manufacturer's recommendations for job-formed corners.
 - 2. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 - 3. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 RESILIENT ACCESSORY INSTALLATION

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

- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion. Clean resilient products not more than 4 days before schedules for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

END OF SECTION

GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes: Rubber sheet floor covering, without backing.
- B. Related Requirements:
 - 1. Section 01 81 13, Sustainable Design Requirements.
 - 2. Section 09 65 20, Resilient Athletic Flooring, resilient floor coverings at exercise room.

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 REFERENCES

- A. Architectural Barriers Act Accessibility Standard (ABAAS): Specifications for making Buildings usable by physically handicapped people.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 3. Product Data: For chemical-bonding compounds, indicating VOC content.
 - 4. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
 - 5. Laboratory Test Reports: For flooring products, indicating compliance with requirements for low-emitting materials.
 - 6. Environmental Product Declaration (EPD):

- a. Include a Type III Product-Specific EPD created from a Product Category Rule.
 7. Material Ingredient Reporting:
 - a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
 - C. Samples for Initial Selection: For each type of floor covering indicated.
 - D. Samples for Verification: In manufacturer's standard size, but not less than 6-inch by 9-inch sections of each different color and pattern of floor covering required.
 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
 - E. Maintenance Data: For each type of floor covering to include in maintenance manuals.
 - F. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.
 1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
- 1.6 Delivery, Storage, and Handling:
- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 degrees F (10 degrees C) or more than 90 degrees F (32 degrees C). Store rolls upright.
- 1.7 PROJECT CONDITIONS
- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 degrees F (21 degrees C) or more than 85 degrees F (29 degrees C), in spaces to receive floor coverings during the following time periods:
 1. 48 hours before installation.
 2. During installation.
 3. 48 hours after installation.
 - B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).
 - C. Close spaces to traffic during floor covering installation.
 - D. Close spaces to traffic for 48 hours after floor covering installation.

- E. Install floor coverings after other finishing operations, including painting, have been completed.

1.8 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Floor Covering: Furnish quantity not less than 10 linear feet for every 500 linear feet or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.

PART 2 - PRODUCTS

2.1 RUBBER SHEET FLOOR COVERING

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Nora Rubber Flooring, Freudenberg Building Systems, Inc.; "NoraPlan Degree – 2 mm", <http://www.nora.com>.
 - 2. Or approved equal.
- B. Unbacked Rubber Sheet Floor Covering: ASTM F1859.
 - 1. Type: Type I (homogeneous rubber sheet).
 - 2. Thickness: 2 mm.
- C. Hardness: Manufacturer's standard hardness, measured using Shore, Type A durometer per ASTM D2240.
- D. Wearing Surface: Smooth.
- E. Sheet Width: As standard with manufacturer.
- F. Seaming Method: Heat welded.
- G. Colors and Patterns: As selected by Architect from full range of manufacturer's colors.

2.2 INSTALLATION MATERIALS

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

- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
- C. Seamless-Installation Accessories:
 - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
 - a. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 FLOOR COVERING INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor coverings.
- B. Unroll floor coverings and allow them to stabilize before cutting and fitting.

- C. Lay out floor coverings as follows:
 - 1. Maintain uniformity of floor covering direction.
 - 2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
 - 3. Match edges of floor coverings for color shading at seams.
 - 4. Avoid cross seams.

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

- E. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

- F. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

- G. Seamless Installation:
 - 1. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

- B. Perform the following operations immediately after completing floor covering installation:
 - 1. Remove adhesive and other blemishes from floor covering surfaces.
 - 2. Sweep and vacuum floor coverings thoroughly.
 - 3. Damp-mop floor coverings to remove marks and soil.

- C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

- D. Cover floor coverings until Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Rubber Flooring (Rubber Mat) at Exercise Room.
- B. Related Sections include the following:
 - 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
 - 2. Division 03 "Concrete" for floor substrate.
 - 3. Division 08 "Finish Hardware" for thresholds.
 - 4. Division 09 "Resilient Wall Base and Accessories" for transition strips.

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00
- B. Product Data: For each type of product specified .
- C. Sustainable Design Submittals:
 - 1. Product Data:
 - a. For adhesives, indicating VOC content.
 - b. For chemical-bonding compounds, indicating VOC content.
 - c. For sealants, indicating VOC content.
 - 2. Laboratory Test Reports:

- a. For flooring products, indicating compliance with requirements for low-emitting materials.
- 3. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
- 4. Material Ingredient Reporting:
 - a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
- D. Shop Drawings: Show location of seams and edges.
- E. Samples for Initial Selection: Manufacturer's color charts consisting of sections of units showing the full range of colors and patterns available for product indicated.
- F. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections of each different color and pattern of rubber floor covering specified, showing the full range of variations expected in these characteristics..
- G. Maintenance Data: For rubber floor coverings to include in the maintenance manuals specified in Division 01.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an installer who is competent in the technique required by manufacturer for installation.
- B. Source Limitations: Obtain each type, color, and pattern of rubber floor covering specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E 648.
 - 2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E 662.
- D. Toxicity Test: New York Fire Gas Toxicity Test #09300-900216-1006

1.6 PERFORMANCE REQUIREMENTS

- A. ASTM D2047, Coefficient of Friction: > 0.8

- B. ASTM E648, (NFPA 253), Critical Radiant Flux: Class I, $>0.45 \text{ W/cm}^2$
- C. ASTM E662 (NFPA 258) - Smoke Density: < 450
- D. ASTM F2772 - Specification for Athletic Performance Properties of Indoor Sports Floor Systems:
 - 1. ASTM F2569 – Shock Absorption: Class 1
 - 2. ASTM F2117 – Vertical Ball Rebound:
 - 3. ASTM F2157 – Vertical Deformation:
 - 4. ASTM E303 – Surface Friction, Dry:
- E. ASTM D2240, Hardness: Shore A; 70 ± 5
- F. ASTM F970, Static Load Limit: 250 PSI
- G. ASTM F970 (Modified), Max Weight: 1000 PSI
- H. ASTM F1515, Light Stability: $\Delta E < 8$
- I. ASTM E90, Sound Transmission Loss: 52 STC*
- J. ASTM E492, Impact Sound Transmission: 52 IIC*
- K. ASTM E2179, Delta Impact Insulation: 22 Δ IIC*

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver rubber floor coverings and installation accessories to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 deg F (10 and 32 deg C).
- C. Move rubber floor coverings and installation accessories into spaces where they will be installed at least 48 hours before installation, unless longer conditioning periods are recommended in writing by manufacturer.

1.8 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C) in spaces to receive rubber floor coverings for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After postinstallation period, maintain a temperature of not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- B. Do not install rubber floor coverings until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during rubber floor covering installation and for time period after installation recommended in writing by manufacturer.
- D. Install rubber floor coverings and accessories after other finishing operations, including painting, have been completed.
- E. Do not install rubber floor coverings over concrete slabs until slabs have cured for a minimum 30 days and have a maximum moisture content not to exceed 3 lbs.

1.9 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturers's Warranty: Submit, for Owners acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not a limitation of, other rights Owner may have under the contract documents.
 - 1. Warranty Period: 5 years commencing from Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, rubber floor coverings that may be incorporated into the Work include, but are not limited to:
 - 1. Basis of Design Product: Tuflex Spartus, by Roppe Corporation
 - 2. Or Approved Equal

2.2 RUBBER FLOOR COVERINGS

- A. Multipurpose Sports flooring tiles

- B. Vulcanized Rubber, Non-porous surface, 3/8-inch Thick, Interlocking edges, 27"x27" tiles .
- C. Color: As selected by Architect from manufacturer's full range.

2.3 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by floor covering manufacturer for applications indicated.
- B. Manufacturer's Sealant

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of rubber floor coverings will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for floor covering installation and comply with requirements specified.
- B. Subfloors: Verify that substrate complies with the following:
 - 1. Substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by floor covering manufacturer.
 - 2. Subfloor finishes comply with requirements specified in Division 03.
 - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
 - 4. High spots shall be ground level, low spots shall be filled with an approved leveling compound.
 - 5. Tolerance: 1/8" under a 10 ft straight edge in any direction.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with rubber floor covering manufacturer's written installation instructions for preparing substrates indicated to receive rubber floor coverings.
- B. Use trowelable leveling and patching compounds and crack bridging mesh, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before installing rubber floor coverings. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. General: Comply with rubber floor covering manufacturer's written installation instructions.
- B. Lay out rubber floor coverings and allow them to stabilize before cutting and fitting, if recommended in writing by manufacturer.
- C. Lay out rubber floor coverings to comply with the following requirements:
 - 1. Lay out rubber flooring and cut perimeter tiles as required to fit space.
 - 2. Roll with a 100 lb. Carpet-roller periodically.
 - 3. Provide rubber reducer strip at transition point at room entries.
- D. Install 2 coats of manufacturer's sealant per application instructions

3.4 CLEANING AND PROTECTING

- A. Do not wash floor for at least 5 days after installation:
 - 1. Thoroughly sweep floor.
 - 2. If necessary, scrub floor with neutral detergent and nylon brush.
 - 3. Pick up with auto scrubber or wet vac.
 - 4. Allow floor to dry.
- B. Protect flooring against mars, marks, indentations and other damage from construction operations and other trades and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by floor covering manufacturer and appropriate for time of installation.
- C. Replace any floor section that has been damaged or stained by no fault of the owner that can not be properly cleaned to the satisfaction of the architect at no additional cost to the owner.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fabric-reinforced resinous wall coating system as shown on the drawings and in schedules.
 - 2. Epoxy coating at ceiling (where "Epoxy Paint" is shown on the Drawings).
- B. Related Sections include the following
 - 1. Division 9 section "Gypsum Board"
 - 2. Division 9 section "Painting"

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **Project site**.
 - 1. A pre-installation conference shall be held between Applicator, General Contractor, Architect and the Owner to review requirements, application procedures, quality control, and acceptance criteria.
 - 2. The Contractor shall install with the Owner's approval, a mutually agreed upon mock-up to show final color, texture, detailing, and over all general appearance of finished system.
 - 3. The mock-up shall include the butt fabric seam joint condition and demonstrate the final appearance of the wall coating at seamless joints.
 - 4. This mock-up shall serve as a job standard for the final installation.
- B. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 00.

- B. Product Data: For each type of product specified.
- C. Sustainable Design Submittal:
 - 1. VOC content and emissions certification for epoxy coating.
 - 2. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
 - 3. Material Ingredient Reporting:
 - a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
- D. Samples for Initial Selection: Manufacturer's color charts consisting of sections of units showing the full range of colors.
- E. Samples for Verification: In manufacturer's standard size, but not less than 6-by-6-inch (150-by-150-mm) section of color specified, showing the full range of variations expected in these characteristics.
- F. Manufacturer and Installer Qualification data: Provide certificates of qualifications and references of completed work of similar size and complexity.
- G. Maintenance Data: For fabric-reinforced resinous wall coating system to include installation instructions. Include procedures for stain removal, repairing surfaces and cleaning.

1.5 QUALITY ASSURANCE

- A. The Manufacturer shall have a minimum of 10 years experience in the production, sales, and technical support of resinous industrial wall coating, urethanes and related materials.
- B. Installer Qualifications: Engage installers who are certified by manufacturer in all phases of surface preparation and application of the product specified.
 - 1. Application: Company specializing in resinous matrix wall coating application with five years experience with at least five completed projects of similar size and complexity
- C. Source Limitations: Obtain each product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. System shall be in compliance with requirements of United States Department of Agriculture (USDA), and local Health Department
- E. Fire-Test-Response Characteristics: Conform to applicable codes for wall coating flame/fuel/smoke ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver product to site under provisions of the General Conditions.
- B. Have materials checked by installing contractor for completeness and shipping damage prior to start of this work.
- C. Store and protect products under provision of the General Conditions.
- D. Store resin materials in a dry, secure area.
- E. Materials shall be stored indoors, protected from damage, moisture, direct sunlight and temperatures below 70 degrees F or above 90 degrees F
- F. Keep product away from open flame.
- G. Waste Disposal
 - 1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.7 PROJECT CONDITIONS

- A. Refer to manufacturer's instructions for environmental conditions.
- B. Surface and surrounding air temperatures must exceed 55 degrees F, but must be less than 90 degrees F, with materials at no less than 70 degrees F during application. The relative humidity in the specific location of the application shall be less than 85 % and the surface temperature shall be at least 5 F above the dew point.
- C. Maintain this temperature range 24 hours before, during and 72 hours after installation of fabric- reinforced resinous wall coating. Record material and environmental conditions for the period described above. Record shall include material, ambient and substrate temperatures; and relative humidity. Provide record to Architect upon request.
- D. Ventilate area where fabric-reinforced resinous wall coating is being installed. Post and enforce NO SMOKING or OPEN FLAME signs until wall coating has cured.
- E. Provide uniform lighting of 25 fc measured at area of installation.
- F. Restrict traffic from area where wall coating is being installed or is curing.
- G. Backerboard shall be completely clean and free of any oils, soap residue, and gypsum dust and prepared to a level 3 finish at walls and a level 4 finish at ceilings.

1.8 WARRANTY

- A. Provide three year warranty.
- B. Warranty: Include coverage against delamination from substrate, degradation of surface finish.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide complete resinous based wall coating system, with fiberglass fabric reinforcing and epoxy based topcoat.

2.2 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, fabric-reinforced resinous based wall coating system to be incorporated into the Work includes, but is not limited to:
 - 1. Basis of Design: Stranlok Mat lay-up, fiberglass fabric-reinforced resinous wall system by Tnemec Company, Inc.
 - 2. Basis of Design for Epoxy product at ceiling: Tneme-Glaze 12 mil min. dry film thickness by Tnemec Company, Inc.
 - 3. Or approved equal.
- B. Colors and Patterns: As scheduled on drawings or as selected by Owner from full range of manufacturer's colors.
- C. Fiberglass Fabric Mat: Manufacturer's specially designed reinforcing mat.
- D. Joint Sealant: Manufacturer's flexible epoxy or urethane sealant intended for use in expansion and control joint.

PART 3 - EXECUTION

3.1 GENERAL

- A. The work shall consist of preparation of the substrate, and the furnishing and application of a fiber-reinforced resinous based wall coating system. It shall be applied to the prepared areas as defined in the plans strictly in accordance with the Manufacturer's recommendations.

3.2 EXAMINATION

- A. Examine substrates, areas and conditions where installation of fiber-reinforced resinous based wall coating system will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for fiber-reinforced resinous based wall coating system installation and comply with requirements specified.
- B. Remove laitance, contaminants and provide clean and dry substrate. Voids, bug holes and other defects should be filled with as recommended by manufacturer.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. Install fabric-reinforced resinous based wall coating system per manufacturer's installation instructions
- B. Install 2 epoxy coats at ceiling per manufacturer's installation instructions –no fabric required.
- C. Primer: Components shall be squeegee-applied, then back-rolled with a short nap roller per manufacturer's recommendations.
- D. Install saturant coat according to manufacturer's system installation requirements.
- E. Install manufacturer's reinforced fabric mat per installation requirements into saturant coat. Provide butt fabric seams for a seamless application with no overlapping of fabric material at seams.
- F. Fill coat: The fill coat shall be applied to fill fabric by brush or roller. Sand out or otherwise remove imperfections: swirls, snail tracks, runs drips and sags and the like after cure. Apply fill coat at 16 to 20 dry film thickness.
- G. Topcoat and sealer application: 1-coat topcoat application minimum
 - 1. Apply final coat at 6 to 8 dry film thickness.
- H. Sealant: Install bead of manufacturer's recommended sealant prior to finish installation around outlets eschetchons and similar penetrations. Allow sealant to cure as indicated on mfg instructions. Prepare glaze coating to receive sealant. Abrade 100% of surface in contact with sealant or follow sealant mfg instruction for over coating glaze coatings.

3.4 DETAILS

- A. Integral Cove Base: A cove base shall be installed with an integral Cant with the wall system installation. Coordinate installation to provide watertight system.
 - 1. Mask off transitions to finish floor for a clean, straight line.

3.5 CLEANING AND PROTECTING

- A. Protect fabric-reinforced resinous based wall coating system against mars, marks, indentations and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint or stain exposed surfaces per this section, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural.
 - 1. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar materials or adjacent surfaces.
 - 2. If a color of finish is not indicated, Architect will select from all colors and finishes available.
- C. Painting includes field painting of exposed underside of exposed surfaces, bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
- D. Do not paint prefinished items (unless otherwise noted to be painted), concealed surfaces, finished metal surfaces, operating parts, and labels.
 - 1. Prefinished items include factory-finished components of:
 - a. Architectural woodwork.
 - b. Plastic laminate cabinetry.
 - c. Switchgear
 - d. Finished mechanical and electrical equipment.
 - e. Light fixtures.
 - f. Wood doors
 - g. Prefinished metal doors and frames
 - h. Pre-finished metal gutters and downspouts
 - i. Prefinished Metal Roof panels
 - j. Sectional Overhead Doors (Field paint exterior side of Steel Overhead Doors)
 - 2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces (unless otherwise specified):
 - a. Furred areas.

- b. Ceiling plenums.
 - c. Utility tunnels.
 - d. Pipe spaces.
 - e. Or as specifically specified in the drawings
 3. Finished metal surfaces include the following:
 - a. Anodized and milled aluminum.
 - b. Stainless steel.
 - c. Bronze and brass.
 - d. Copper piping
 4. Operating parts include moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
 5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
- E. Related Sections include the following:
- F. Related Sections include the following:
 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
 2. Division 5 Section "Metal Stairs".
 3. Division 5 Section "Metal Fabrications"
 4. Division 7 Section "Metal Roof Panels"
 5. Division 7 Section "Exterior Siding and Trim"
 6. Division 7 Section "Sheet Metal Flashing and Trim"
 7. Division 8 Section "Hollow Metal Doors and Frames".
 8. Division 8 Section "Access doors and Panels".
 9. Division 8 Section "Louvers and Vents" for prefinished louvers and blank-off panels
 10. Division 9 Section "Gypsum Board".
 11. Division 9 Section "Fabric-Reinforced Resinous Wall Coating".
 12. Division 27 Section for fire retardant painting required for telephone termination boards.
 13. Division 20-23 and 25-28: For painting of mechanical and electrical work that is not specified in other sections.
 14. Division 32 Section "Pavement markings" for parking and traffic-marking paint.

1.3 DEFINITIONS

- A. General: Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI values.
1. Gloss Level 1 (Matte or Flat finish) refers to a lusterless or matte finish with a gloss range below 5 when measured at a 60-degree meter and less than 10 when measured at a 85-degree meter. (G1)
 2. Gloss Level 2 refers to low-sheen finish with a gloss range between below 10 when measured at a 60-degree meter and between 10 and 35 when measured at a 85-degree meter. (G2)
 3. Gloss Level 3 (Eggshell) refers to low-sheen finish with a gloss range between 10 and 25 when measured at a 60-degree meter and between 10 and 35 when measured at a 85-degree meter. (G3)
 4. Gloss Level 4 (Satin) refers to medium sheen finish with a gloss range between 20 and 35 units at 60 degrees and not less than 35 units at 85 degrees. (G4)
 5. Gloss Level 5 (Semi-gloss) refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter. (G5)

1.4 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 3300
- B. Product Data: For each paint system indicated. Include block fillers and primers.
1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- C. Sustainable Design Submittals:
1. Product Data: For paints and coatings, indicating VOC content.
 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
 3. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
 4. Material Ingredient Reporting:

- a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
- D. Samples for Initial Selection: For each type of finish-coat material indicated.
- E. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
 2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
 3. Submit 3 Samples on the following substrates for Architect's review of gloss, color and texture:
 - a. Painted Wood: square Samples for each color and material on hardboard.
 - b. Painted fiber-cement board: square Samples for each color and material on hardboard.
 - c. Ferrous Metal: 4-inch- (100-mm-) square Samples of flat metal and long Samples of solid metal for each color and finish.
- F. Qualification Data: For Applicator.

1.6 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. MPI Standards:
1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
 2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting and Specification Manual".
- C. Source Limitations: Obtain fillers and primers for each coating system from the same manufacturer as the finish coats.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).

3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
 8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.8 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).
- B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.9 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
1. Quantity: Furnish Owner with an additional **5** percent, but not less than 1 gal. (3.8 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the work include, but are not limited to, products listed in other Part 2 articles.
- B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Rodda Paint Company (Rodda)
 - 2. Parker Paint / Comex Group (Parker Paint/Comex)
 - 3. Sherwin-Williams Co. (Sherwin-Williams).
 - 4. Or approved equal.

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions. Substituted products will be reviewed only if submittal of appropriate comparisons as required under section 01 6000 are provided.
- C. Chemical Components of Interior Paints and Coatings: Provide products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions:
 - 1. Flat Paints and Coatings: VOC content of not more than 50 g/L.
 - 2. Non-Flat Paints and Coatings: VOC content of not more than 150 g/L.
 - 3. Anticorrosive Coatings: VOC content of not more than 250 g/L.
 - 4. Varnishes and Sanding Sealers: VOC content of not more than 350 g/L.
 - 5. Stains: VOC content of not more than 250 g/L.
 - 6. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 - 7. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.

- b. Acrylonitrile.
- c. Antimony.
- d. Benzene.
- e. Butyl benzyl phthalate.
- f. Cadmium.
- g. Di (2-ethylhexyl) phthalate.
- h. Di-n-butyl phthalate.
- i. Di-n-octyl phthalate.
- j. 1,2-dichlorobenzene.
- k. Diethyl phthalate.
- l. Dimethyl phthalate.
- m. Ethylbenzene.
- n. Formaldehyde.
- o. Hexavalent chromium.
- p. Isophorone.
- q. Lead.
- r. Mercury.
- s. Methyl ethyl ketone.
- t. Methyl isobutyl ketone.
- u. Methylene chloride.
- v. Naphthalene.
- w. Toluene (methylbenzene).
- x. 1,1,1-trichloroethane.
- y. Vinyl chloride.

D. Colors:

1. As selected by Architect from manufacturer's full range in each type of paint indicated.
 - a. For bidding purposes: Allow for up to (4) exterior colors. Assume deep tones will be used on exterior surfaces and that colors will be custom to match other material's factory finished colors.
 - b. For bidding purposes: Allow for up to (9) interior colors from the complete range of the paint manufacturer's standard color selection. Assume 20 percent of wall areas will be painted with contrasting "accent" tones
 - c. Provide "Traffic Yellow" for interior and exterior bollards.

2.3 EXTERIOR PRIMERS

- A. Exterior Wood Primer for Acrylic Enamels (MPI #6): Factory-formulated alkyd or latex wood primer for exterior application.
 1. Parker Paints/Comex: UltraTech C312, Interior/Exterior 100% Acrylic Wood Primer. Applied at a dry film thickness of not less than 1.8 mils.
 2. Sherwin-Williams; Exterior Latex Wood Primer B42W8041: Applied at a dry film thickness of not less than 1.4 mils.
 3. Rodda Paint; 501601 First Coat Acrylic Primer: Applied at a dry film thickness of not less than 1.4 mils.
- B. Exterior Ferrous-Metal Primer (MPI #79): Solvent based anti-corrosive metal primer for exterior application.

1. Parker Paints/Comex: UltraTech C305, Alkyd Rust inhibitive Metal Primer. Applied at a dry film thickness of not less than 1.8 mils.
 2. Sherwin-Williams; Kem-Bond HS Metal Primer B50WZ4: Applied at a dry film thickness of not less than 3.0 mils.
 3. Rodda Paint:
- C. Exterior Galvanized Metal Primer (MPI #134): Factory-formulated galvanized metal primer for exterior application.
1. Parker Paints/Comex: UltraTech C309, Universal Water-Based Metal Primer. Applied at a dry film thickness of not less than 1.8 mils.
 2. Sherwin-Williams; Pro-Cryl Universal Metal Primer B66w310: Applied at a dry film thickness of not less than 3.0 mils.
 3. Rodda Paint; 508901 Metal Master Acrylic Primer: Applied at a dry film thickness of not less than 2.3 mils
- D. Exterior Aluminum Primer under Acrylic Finishes (MPI #134): Factory-formulated acrylic-based metal primer for exterior application.
1. Parker Paints/Comex: UltraTech C309, Universal Water-Based Metal Primer. Applied at a dry film thickness of not less than 1.8 mils.
 2. Sherwin-Williams; Pro-Cryl Universal Metal Primer B66w310: Applied at a dry film thickness of not less than 3.0 mils.
 3. Rodda Paint; 508901 Metal Master Acrylic Primer: Applied at a dry film thickness of not less than 2.3 mils

2.4 INTERIOR PRIMERS

- A. Interior Gypsum Board Primer (MPI #50): Factory-formulated latex-based primer for interior application.
1. Parker Paints/Comex: Pro Seal PVA Primer Acrylic Primer. Applied at a dry film thickness of not less than 1.4 mils.
 2. Sherwin-Williams; ProGreen 200 Interior Latex Primer B28W002600 Series: Applied at a dry film thickness of not less than 3.0 mils.
 3. Rodda Paint; 507801 Scotseal Heavy Bodied Latx Primer Sealer: Applied at a dry film thickness of not less than 1.4 mils
- B. Interior Wood Primer for Acrylic-Enamel and Semi-gloss Alkyd-Enamel Finishes (MPI #39): Factory-formulated acrylic-latex-based interior wood primer.
1. Parker Paint/Comex; UltraTech C312, Interior/Exterior 100% Acrylic Wood primer: Applied at a dry film thickness of not less than 3 mils.
 2. Sherwin-Williams; Multi-Purpose Latex B51W8020: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
- C. Interior Ferrous-Metal Primer (MPI #107): Factory-formulated quick-drying rust-inhibitive Acrylic-based metal primer.
1. Parker Paints/Comex; UltraTech C309, Universal Water-Based Metal Primer: Applied at a dry film thickness of not less than 1.8 mils

2. Sherwin-Williams; Pro-Cryl Universal Metal Primer B66w310: Applied at a dry film thickness of not less than 3.0 mils.
 3. Rodda Paint; 508901 Metal Master Acrylic Primer: Applied at a dry film thickness of not less than 2.3 mils.
- D. Interior Zinc-Coated Metal Primer (MPI #134): Factory-formulated galvanized metal primer.
1. Parker Paints/Comex: UltraTech C309, Universal Water-Based Metal Primer. Applied at a dry film thickness of not less than 1.8 mils
 2. Sherwin-Williams; Pro-Cryl Universal Metal Primer B66w310: Applied at a dry film thickness of not less than 3.0 mils.
 3. Rodda Paint; 508901 Metal Master Acrylic Primer: Applied at a dry film thickness of not less than 2.3 mils.

2.5 EXTERIOR FINISH COATS

- A. Exterior Semi-gloss Acrylic Enamel (MPI # 11): Factory-formulated semi-gloss (G5) waterborne acrylic-latex enamel for exterior application.
1. Parker Paints/Comex: UltraTech C241, Exterior 100% Acrylic Semi-Gloss Enamel. Applied at a dry film thickness of not less than 1.8 mils
 2. Sherwin-Williams; SuperPaint Exterior Gloss Latex A84 Series: Applied at a dry film thickness of not less than 1.4 mils.
 3. Rodda Paint; 542001 Unique II Acrylic Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.4 mils.
- B. Exterior Semi-gloss Acrylic Enamel for Ferrous and Other Metals (MPI #163 or 164): Factory formulated, light Industrial, semi-gloss (G5-G6) waterborne acrylic enamel for exterior application.
1. Parker Paints/Comex: UltraTech C413, DTM Semi-Gloss Acrylic. Applied at a dry film thickness of not less than 1.8 mils.
 2. Sherwin-Williams; Sher-Cryl HPA - High Performance Acrylic Coating Semi-Gloss (Waterborne) B66W350 Series: Applied at a dry film thickness of not less than 2.4 mils.
 3. Rodda Paint; 548901 Multi Master DTM Self-Crosslinking Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.4 mils.

2.6 INTERIOR FINISH COATS

- A. Interior Low-Luster Acrylic Enamel (MPI #138 or #139): Factory-formulated, High Performance, eggshell (G2 or G3) acrylic-latex interior enamel.
1. Parker Paints/Comex: Pro Shell 4550, Acrylic Eggshell Enamel. Applied at a dry film thickness of not less than 1.5 mils.
 2. Sherwin-Williams; SuperPaint Interior Latex Satin Wall Paint A87 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
 3. Rodda Paint; 521101 AC-909 100% Acrylic Latex Satin Enamel: Applied at a dry film thickness of not less than 1.5 mils.

- B. Interior Semi-gloss Acrylic Enamel (MPI #141): Factory-formulated, High Performance, semi-gloss (G5) acrylic-latex enamel for interior application.
 - 1. Parker Paints/Comex: Wall Glow 3850 Acrylic Semi-Gloss. Applied at a dry film thickness of not less than 1.5 mils.
 - 2. Sherwin-Williams; SuperPaint Interior Latex Semi-Gloss Enamel A88 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).
 - 3. Rodda Paint; 542001 Unique II 100% Acrylic Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.5 mils.

- C. Interior Semi-Gloss Acrylic Enamel for Ferrous and other Metals (MPI #153): Factory formulated, light Industrial, semi-gloss (G5) for interior application.
 - 1. Parker Paints/Comex: DTM Acrylic 9225 Semi-Gloss. Applied at a dry film thickness of not less than 2.0 mils.
 - 2. Sherwin-Williams; Sher-Cryl HPA - High Performance Acrylic Coating Semi-Gloss (Waterborne) B66W350 Series: Applied at a dry film thickness of not less than 2.5 mils.
 - 3. Rodda Paint; 548901 Multi Master DTM Self-Crosslinking Semi-Gloss Enamel: Applied at a dry film thickness of not less than 2.4 mils.

- D. Epoxy Finish Coating: Fabric-reinforced Resinous Wall Coating system Top coat and Sealer application: 2-coat topcoat application minimum.
 - 1. Refer to Section 09 85 10 "Fabric-reinforced Resinous Wall Coating". Color as scheduled on drawings or as selected by Architect.

- E. Fire Retardant Paint Top Coat: 2-coat topcoat application minimum.
 - 1. FLAME CONTROL NO. 40-40A. A Water Base Low-Gloss Fire Retardant Paint (Overcoat) Fire Hazard Classification, CLASS "A". Applied at a dry film thickness of not less than 1.5 mils.

- F. Interior Waterborne Clear Satin Varnish: Factory-formulated clear satin acrylic-based polyurethane varnish applied at spreading rate recommended by manufacturer.
 - 1. Sherwin-Williams; Minwax, Polycrylic Protective Finish, Satin, 3333.
 - 2. Or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.
 - 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.
1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturers written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
 - a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
 - b. Verify moisture content of 15% or less of all wood to be painted.
 - c. Exterior grade plywood, cedar or pretreated wood shall be installed for a minimum of 45 days prior to applying primer coats.
 - d. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.
 - e. If transparent finish is required, backprime with spar varnish.

- f. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on backside.
 - g. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.
4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
- a. Blast steel surfaces clean as recommended by paint system manufacturer and according to the following:
 - 1) Power tool cleaning: SSPC-SP 6/NACE No. 3
 - 2) Hand tool cleaning: SSPC-SP 10/NACE No. 2.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.
5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
6. Overhead Door Exterior Surfaces: (includes Prefinished/primed roofing where noted on drawings)
- a. Clean Surface with phosphate soap and water.
 - b. Lightly Scuff Surface with 100 grit sandpaper, careful not to expose bare metal.
 - c. Wipe and rinse with clean water only to remove any loose dust or soap film.
 - d. Spot prime any areas of exposed metal and prime with high quality bonding primer.
- D. Material Preparation: Mix and prepare paint materials according to manufacturers written instructions.
- 1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 - 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
 - 3. Use only thinners approved by paint manufacturer and only within recommended limits.
- E. Tinting: Tint each undercoat, a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors to be determined after submittal of color samples by contractor and Architects color board (using color samples provided by contractor) approval by Owner.
 2. Paint surface treatments, and finishes are indicated in these specifications.
 3. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 4. Provide finish coats that are compatible with primers used.
 5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 6. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 7. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
 8. Paint backsides of access panels and removable or hinged covers to match exposed surfaces.
 9. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
 3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions and as required in these specifications.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted. **(not allowed for overhead and metal doors)**
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required. **(not allowed for overhead and metal doors)**
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required. **(not allowed in electrical, mechanical and server rooms)**

- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. **Provide total dry film thickness of the entire system as recommended by manufacturer.**
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping. (Do not paint copper piping)
 2. Uninsulated plastic piping.
 3. Pipe hangers and supports.
 4. Tanks that do not have factory-applied final finishes.
 5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
 6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
 7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
 8. **Do Not** paint ducting specified as stainless steel
- G. Electrical items to be painted include, but are not limited to, the following:
1. Switchgear boxes that are located outside of an electrical room. (to be verified by architect)
 2. Panel backboards. (Fire Retardant Paint)
 3. Electrical equipment that is indicated to have a factory-primed finish for field painting.
- H. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- I. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- K. Overhead door and metal door paint to be spray applied only, to provide a smooth finish with no drips or surface irregularities. Field paint exterior side of overhead door prior to installation.
- L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

- A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:
 - 1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.
 - 2. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal.
 - 1. Semi-gloss Acrylic-Enamel Finish: Two finish coats over two coats rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior Semi-gloss Acrylic Enamel for Ferrous and Other Metals.

- B. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces: (Includes Zinc based shop primed materials)
 - 1. Semi-gloss Acrylic-Enamel Finish: Two finish coats over one coat galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior Semi-gloss Acrylic Enamel for Ferrous and Other Metals.
- C. Aluminum: Provide the following finish systems over exterior aluminum surfaces:
 - 1. Semi-gloss Acrylic-Enamel Finish: **Two finish coats over one coat primer.**
 - a. Primer: Exterior aluminum primer under acrylic finishes.
 - b. Finish Coats: Exterior Semi-gloss Acrylic Enamel for Ferrous and Other Metals.
- D. Overhead Doors: Provide the following finish systems over properly prepared exterior surfaces of steel overhead doors: (includes Prefinished/primed roofing where noted on drawings)
 - 1. Semi-gloss Acrylic-Enamel Finish: **Two finish coats over one coat bonding primer.**
 - a. Primer: High quality manufacturer recommended bonding primer.
 - b. Finish Coats: Exterior Semi-gloss Acrylic Enamel for Ferrous and Other Metals.

3.8 INTERIOR PAINT SCHEDULE

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Low-Luster Acrylic-Enamel Finish (eggshell): **Two finish coats over one coat primer.** (all rooms and areas required to be painted unless noted otherwise)
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - 2. Semi-gloss Acrylic-Enamel Finish: **Two finish coats over one coat primer.** (Restrooms, Shower rooms, and Laundry room, Wash Alcove, Decon room, Bunker storage, Sprinkler Riser Alcove.)
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- B. Wood and Hardboard: Provide the following paint finish systems over new interior wood and MDF surfaces indicated to be painted:
 - 1. Semi-gloss Acrylic-Enamel Finish: **Two finish coats** over a wood undercoater.
 - a. Primer: Interior wood primer for acrylic-enamel and semi-gloss alkyd-enamel finishes.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.

- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
1. Semi-gloss Acrylic-Enamel Finish: **Two finish coats** over a primer coat.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior Semi-Gloss Acrylic enamel for Ferrous and Other Metals.
- D. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces: (Includes Zinc based shop primed materials)
1. Semi-gloss Acrylic-Enamel Finish: **Two finish coats** over a primer coat.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior Semi-Gloss Acrylic enamel for Ferrous and Other Metals.
- E. Plastic Pipe: Provide the following finish systems over exposed interior plastic piping surfaces:
1. Semi-gloss Acrylic-Enamel Finish: **Two finish coats** over a primer coat.
 - a. Primer: manufacturer's recommended high quality bonding primer.
 - b. Finish Coats: Interior Semi-Gloss Acrylic enamel for Ferrous and Other Metals.
- F. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
1. Low-Luster Acrylic Finish: **Two** finish coats. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coats: Interior Low-Luster Acrylic Enamel.
- G. Electrical/Communications Fire Retardant Backerboard: Provide the following finish system:
1. Fire Retardant Paint Top Coat: Two finish coats.
- H. Interior Varnished Wood:
1. Interior Water Borne Varnish:
 - a. Topcoat: Sherwin-Williams, Minwax, Polycrylic Protective Finish, Satin, 3333.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All construction shall be in accordance with Appendix A – Pavement Markings, Signing, Traffic Signal, and Illumination System Specifications.
- B. This Section specifies traffic signage, including but not limited to, construction requirements and materials, for but not limited to, the following:
 - 1. Sign posts and foundations
 - 2. Sign panels
- C. Related Sections include the following:
 - 1. Appendix A – Pavement Markings, Signing, Traffic Signal, and Illumination System Specifications.
 - 2. Division 1 Section "Submittal Procedures" for submittal requirements.
 - 3. 26 57 00 – Roadway Lighting.
 - 4. 32 17 23 – Pavement Markings.
 - 5. 34 41 00 – Roadway Signaling and Control Equipment.

1.2 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project.

1.3 SUBMITTALS

- A. Comply with requirements of Part 1.1.C above.
- B. Submit complete manufacturer's product literature, cut sheets, shop drawings, installation instructions, etc. for each of the materials used if available.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of Part 1.1.C above.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Part 1.1.C above.

1.6 WARRANTY

- A. Comply with requirements of Part 1.1.C above.

PART 2 - PRODUCTS

- A. Comply with requirements of Part 1.1.C above.

PART 3 - EXECUTION

- A. Comply with requirements of Part 1.1.C above.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Toilet, shower and janitorial accessories.
- B. Related Sections include the following:
 - 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
- C. Division 6 Section "Rough Carpentry" for solid backing.
 - 1. Division 8 Section "Mirrors".
 - 2. Division 22 Section "Plumbing Fixtures"

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3300
- B. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.
- A. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Manufacturer data to demonstrate responsible sourcing of raw materials for Credit MRc3: Sourcing of Raw Materials.

- B. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions and directions for preparing cutouts and installing anchoring devices.
- C. Operation and Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.5 QUALITY ASSURANCE

- A. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.
 - 1. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.6 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories. If a conflict is identified, notify architect prior to installation.
- B. Contractor to review drawing interior elevations to insure coordination of restroom accessories as called out in these specifications.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - 1. Minimum Warranty Period: 15 years from date of Substantial Completion.
- B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide accessories by the following:
 - 1. Toilet and Bath Accessories:

- a. Bobrick Washroom Equipment, Inc.
- b. Bradley Corporation.
- c. Or Approved Equal.

2.2 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch (0.8-mm) minimum nominal thickness, unless otherwise indicated.
- B. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch (0.9-mm) minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.
- C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60 (Z180).

2.3 GRAB BARS

- A. Horizontal and Vertical Grab Bars: 18 ga. Stainless steel, Satin finish, concealed mounting, 1-1/2" diameter, configuration as indicated on drawings Basis of design; Bobrick #B-6806 series.
 - 1. Provide at water closet locations: B-6897; 1 continuous "L" horizontal and 1 vertical at each location (Provide 5 total; 1 each at location (room 102, 108, 111, 216 and 218)
 - 2. Provide at shower locations: B-5806 x48 and B-5806x24; (Provide 2 pair; 1 at each at rooms 216 and 218)

2.4 TOILET PAPER DISPENSERS

- A. Surface Mounted, Double Roll Toilet Paper Dispenser: Bobrick B-6867 (Provide 7; 1 each at rooms 102, 108, 111, 214, 215, 216 and 218)

2.5 SOAP DISPENSER (OFCI)

- A. Manufacturer: TBD
- B. Coordinate location and provide blocking for 14 locations (*1 at 102, 108, 110, 111, 113, 121, 200, 202, 214, 215, 216, 218 and 2 at 217*)

2.6 PAPER TOWEL DISPENSER (OFCI)

- A. Manufacturer: TBD
- B. Coordinate location and provide blocking for 14 locations (*1 at 102, 108, 110, 111, 113, 115, 121, 200, 202, 214, 215, 216, 217 and 218*)

2.7 TOILET SEAT COVER DISPENSER

- A. Recessed Seat Cover Dispenser: Bobrick B-301. (Provide 3 total; 1 each at rooms 102, 108 and 111)

2.8 WASTE RECEPTACLES (OFOI)

- A. Manufacturer: TBD
- B. Free Standing

2.9 SHOWER ACCESSORIES

- A. Shower Curtain: Opaque white vinyl 0.2 mm thick, hemmed at top and bottom, with corrosion-resistant nickel plated grommets at top for hooks. 72" height x width to suit 60" wide shower stall opening sizes. Bobrick #B 204-2.
 - 1. Provide 1 at each shower, (6) locations. (rooms 111, 113, 214, 215, 216 and 218)
- B. Shower Curtain Hooks: Provide stainless steel shower curtain hooks with rollers to suit grommet spacing and shower stall opening size.
 - 1. Provide 1 set at each shower, (6) locations. (rooms 111, 113, 214, 215, 216 and 218)
- C. Shower Curtain Rod: B-6107x36, Provide 1 at each shower, (6) locations. (rooms 111, 113, 214, 215, 216 and 218)

2.10 MISCELLANEOUS ACCESSORIES

- A. Rob Hooks: Bobrick B-6727 (Provide 26 total; 5 at shelf, 1 at rooms 102, 108, 113 and 2 at rooms 111, 214, 215, 216 and 218)
- B. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, re-supply, etc. Provide minimum of (3) keys to Owner's representative.

2.11 HAND SANITIZER DISPENSERS: (OFCI)

- A. Manufacturer: TBD
- B. Quantity: 4
- C. Coordinate location and provide blocking

2.12 MOP/ BROOM HOLDER: (OFCl)

- A. Manufacturer: TBD
- B. Coordinate location and provide blocking

2.13 TOWEL RACKS

- A. Towel Racks: Bobrick B-683x24; Provide 2 at room 111.

2.14 MIRRORS

- A. Welded-Frame Mirror: One-piece, roll-formed 3/4" x 3/4" (19 x 19mm) angle-frame. Type 304 stainless steel angle with satin finish. Corners heliarc welded, ground and polished smooth. Beveled frame edge at mirror for improved appearance. No. 1 quality, 1/4" (6mm) glass mirror; warranted against silver spoilage for 15 years. Galvanized steel back. Secured to concealed wall hanger with theft-resistant mounting. Bobrick # B-290 2436
 - 1. Provide 8 total; 1 at rooms 102, 108, 111, 214, 215, 216, 217 and 218

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide and coordinate all blocking necessary for grab bars, mirrors, and all other accessories including owner provided and contractor installed items and owner provided and owner installed items.
- B. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
 - 1. Not all manufactures provide fasteners for their products. Contractor is responsible for providing all needed mounting hardware for units.
- C. Install grab bars to withstand a downward load of at least 250 lbf (1112 N), when tested according to method in ASTM F 446.
- D. Shower Enclosure: Apply Furring to framing above the shower enclosure, the depth of shower enclosure nailing flange to provide even finish. Apply sealant between wall board and shower enclosure.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fire-protection cabinets for the following:
 - a. Cabinets by contractor. Portable fire extinguishers to be furnished by owner installed by contractor.
- B. Owner-Furnished Material: Fire extinguishers.
- C. Related Sections include the following:
 - 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 3300
- B. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
 - 1. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- C. Sustainable Design Submittals:

1. Comply with requirements of Section 01 81 13

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 1. Sheet: ASTM B 209 (ASTM B 209M).
 2. Extruded Shapes: ASTM B 221 (ASTM B 221M).
- B. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 clear.

2.3 FIRE-PROTECTION CABINET

- A. Available Manufacturers:
 1. JL Industries, Inc.
 2. Larsen's Manufacturing Company.
 3. Or Approved Equal.
- B. Cabinet Type: Suitable to accommodate one 2A10BC fire extinguisher, with a clear cabinet size of 10 1/2" wide x 24" high x 6" deep.

- C. Cabinet Construction: Non-rated or 1-hour fire rated based on rating of designated wall assembly.
- D. Cabinet Material: Aluminum sheet.
 - 1. Shelf: Same metal and finish as cabinet.
- E. Semi-recessed Cabinet: Cabinet box partially recessed in walls of shallow depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
 - 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth at 2x6 walls.
- F. Cabinet Trim Material: Extruded-aluminum shapes.
- G. Door Material: Aluminum sheet.
- H. Door Style: Fully Glazed.
- I. Door Glazing: Tempered float glass (clear).
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- K. Accessories:
 - 1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
 - 2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
 - 3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER"
 - 1) Location: Applied to cabinet glazing.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: Black.
 - 4) Orientation: Vertical Ascending
- L. Finishes:
 - 1. Aluminum: Clear anodic.

2.4 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 - 1. Weld joints and grind smooth.
 - 2. Provide factory-drilled mounting holes.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed.
- B. Verify that sound insulation and/or fire rated construction is in place as required where applies.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
 - 1. Fire-Protection Cabinets: Top of cabinet at 54 inches (1372 mm) above finished floor to top of cabinet.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Fixed, extruded aluminum exterior sun control assemblies.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submittal requirements.
 - 2. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
 - 3. Division 05 Section "Structural Steel Framing."

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Prior to commencing the installation, review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, and any trade that requires coordination with the work.

1.5 REFERENCES

- A. General: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

- B. ASTM (ASTM):
 - 1. ASTM B 26/B 26M, "Standard Specification for Aluminum-Alloy Sand Castings."
 - 2. ASTM B 209/B 209M, "Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate."
 - 3. ASTM B 221/B 221M, "Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes."
 - 4. ASTM D 1187, "Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal."

- C. National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. NAAMM MFM, "Metal Finishes Manual."

- D. SSPC: The Society for Protective Coatings (SSPC):
 - 1. SSPC Paint 12, "Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)."

- E. South Coast Air Quality Management District (SCAQMD):
 - 1. SCAQMD Rule #1168, "Adhesive and Sealant Applications," including most recent amendments.

1.6 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide exterior sun control assemblies capable of withstanding the effects of loads and stresses from dead loads, live loads, snow loads, wind loads, and normal thermal movement without evidencing permanent deformation of assembly or components including blades, frames, and supports; noise or metal fatigue caused by blade rattle or flutter; or permanent damage to fasteners and anchors.
 - 1. Dead Load: Per structural drawings.
 - 2. Live Load: Per structural drawings.
 - 3. Snow Load: Per structural drawings.
 - 4. Wind Load: Per structural drawings.
 - 5. Thermal Movements: Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures in engineering, fabricating, and installing exterior metal fabrications to prevent buckling, opening of joints, overstressing of components and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - a. Temperature Change (Range): 120 °F or 67 °C ambient, 180 °F or 100 °C material surfaces.

1.7 SUBMITTALS

- A. General: See Section 01 33 00 - Submittal Procedures.

- B. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Product data shall include, but shall not be limited to, manufacturer's technical and descriptive data on exterior sun control components and assemblies.

- C. Shop Drawings: Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data, including, but not limited to, plans; elevations; and sections and details showing profiles, angles, and spacing of blades, frames and supports. Show unit dimensions related to supporting and adjoining structures and construction. Indicate anchorage details and locations.
 - 1. Submit shop drawings which have been signed and sealed by a professional engineer licensed to practice in the State in which the Project is located.

- D. Samples:
 - 1. Submit samples for initial color selection. Submit samples of each specified finish. Submit samples in form of manufacturer's color charts showing full range of colors and finishes available. Where finishes involve normal color variations, include samples showing the full, range of variations expected.
 - 2. Submit samples for verification purposes. Submit 2 inch (51 mm) by 3 inch (76 mm) minimum size sample of selected color coating. Additional samples may be required to show design, fabrication techniques, and workmanship.

- E. Quality Control Submittals:
 - 1. Design Data: For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by a Washington State professional engineer who was responsible for their preparation. Only the loading on the structure at the connections will be reviewed.
 - 2. Qualification Data: Submit qualification data for firms and persons specified in Quality Assurance Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.

- F. Sustainable Design Submittals:
 - 1. Low-Emitting Materials: Submit certification by the manufacturer confirming that products (i.e., adhesives, sealants, paints, coatings, etc.) meet or exceed the volatile organic compound (VOC) limits set by specific agencies or other requirements as outlined in the LEED Green Building Rating System. VOC limits shall be clearly stated in the submittal.
 - 2. Daylighting 75 Percent of Spaces: Submit certification by the manufacturer confirming that products provide the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.
 - 3. Optimize Energy Performance: Submit certification by the manufacturer confirming that products contribute to increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

- G. Maintenance Data: Submit maintenance data for exterior sun control devices to include in operation and maintenance manuals specified in Division 01 - General Requirements.

1.8 QUALITY ASSURANCE

A. Qualifications:

1. **Manufacturer Qualifications:** Manufacturer shall be a firm engaged in the manufacture of exterior sun control devices of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 10 years.
2. **Installer Qualifications:** Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing exterior sun control devices similar in type and scope to that required for this Project.
3. **Engineer Qualifications:** The engineer shall be a professional engineer legally authorized to practice in the jurisdiction where the Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of products similar to this Project in material, design, and extent, and that have a record of successful in-service performance.
4. **Welder Qualifications:** Qualify welding processes and welding operators in accordance with AWS standard qualification procedures. Operators shall carry proof of qualification on their persons.

B. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.

C. Welding Standards: Comply with applicable provisions of AWS D1.2.

D. Coordination: Coordinate installation of exterior sun control devices with provision of exterior wall system, window framing system, curtain wall system, etc., to ensure proper structural support is provided, attachment of exterior sun control devices is compatible with substrate, and weathertightness of exterior envelope is maintained.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.10 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to fabrication of the work and preparation of shop drawings, to ensure proper fitting of the work. Show recorded measurements on final shop drawings. Notify the Owner and the Architect, in writing, of any dimensions found which are not within specified dimensions and tolerances in the Contract Documents, prior to proceeding with the fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1. Established Dimensions: Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabricating of exterior sun control assemblies without field measurements. Coordinate construction to ensure that exterior sun control assemblies correspond to established dimensions.

1.11 WARRANTY

- A. General: See Section 01 77 00 - Closeout Procedures.
- B. Special Warranty: The Contractor shall warrant the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for a period of five years. This special warranty shall extend the one year period of limitations contained in the General Conditions. The special warranty shall be countersigned by the manufacturer and the Installer.
- C. Special PVDF Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish within the specified warranty period and agreeing to repair finish or replace work that shows evidence of finish deterioration. Deterioration of finish includes, but shall not be limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
 1. Warranty Period: Warranty period shall be 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Vertical Sunshades, VS Series as manufactured by DAMS Incorporated. D. Architectural Metal Solutions Incorporated; 5919 W. 118th Street, Alsip, IL 60803; Phone: 708-224-4300; Website: www.damsinc.com or approved equal.

2.2 MATERIALS

- A. Aluminum:
 1. Aluminum Extrusions: ASTM B 221/B 221M, Alloy 6063-TB or T2.
 2. Aluminum Sheet: ASTM B 209/B 209M, Alloy 3003 or Alloy 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
 3. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- B. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 1. Use types and sizes to suit unit installation conditions.
 2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

- C. Anchors and Inserts: Type, size, and material required for loading and installation indicated. Use non-ferrous metal or hot dip galvanized anchors and inserts for exterior installations and elsewhere as needed for corrosion resistance. Use toothed steel or expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 EXTRUDED ALUMINUM EXTERIOR SUN CONTROLS

- A. General: Provide vertical, fixed, extruded aluminum exterior sun control assemblies complying with the following:
 - 1. Vertical blade style and size: 2" x 18" extruded aluminum rectangle tube with end caps
 - 2. Attachment bracket: Machine aluminum u-bracket to t-bracket connection. As detailed on the architectural drawings.

2.4 FABRICATION

- A. Assemble exterior sun control assemblies in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitation. Clearly mark units for reassembly and coordinated installation.
- B. Exterior sun control assemblies shall be assembled in accordance with manufacturer recommendations.
- C. Maintain equal blade spacing, including, but not limited to, separation between blades and frames to produce a uniform appearance.
- D. Include supports, anchorage, and accessories required for complete assembly.

2.5 FINISHES

- A. Comply with NAAMM MFM for architectural metal products for recommendations for applying and designating finishes. Finish exterior sun control devices after assembly if welded.
 - 1. Aluminum Finishes: Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.
 - a. High Performance Organic Coating: AA-C12-C42-R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
 - 1) Standard Two-Coat Polyvinylidene Fluoride (PVDF) Finish Coating: Manufacturer's standard thermocured system, complying with AAMA 2605, composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight, as produced by Arkema, Inc. ("Kynar 500") or by Solvay Solexis, Inc. ("Hylar 5000"). Provide minimum 1.2 mil (0.030 mm) total dry film thickness.

- b. Color: As selected by the Architect from manufacturer's standard choices for color and gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - 1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the Project Site.

3.3 INSTALLATION

- A. Install exterior sun control devices in accordance with reviewed product data, final shop drawings, and engineering calculations.
- B. Locate and place exterior sun control assemblies level, plumb, and at indicated alignment with adjacent work.
- C. Use concealed anchorage.
- D. Form closely fitted joints with exposed connections accurately located and secured.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be finished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by applying a heavy coating or bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

3.4 CLEANING

- A. Periodically clean exposed surfaces of exterior sun control devices that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- B. Before final inspection, clean exposed surfaces with water and a mild soap not harmful to finishes.
- C. Clean-up and touch-up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

3.5 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the exterior sun control devices shall be without damage at time of Substantial Completion.
 - 1. Use temporary protective coverings where needed and approved by the manufacturer. Remove protective covering at the time of Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Aluminum ground-set fixed cone-tapered flagpole with top-mounted down lighting.
- B. Related Sections include the following:
 - 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
 - 2. Division 03 Section "Cast-in-Place Concrete" for concrete requirements in flagpole footing.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide flagpoles capable of withstanding the effects of wind loads as determined according to the building code in effect for this Project or NAAMM FP 1001, "Guide Specifications for Design Loads of Metal Flagpoles," whichever is more stringent. Use heavy pipe size if required for flagpole type and height specified.

1.4 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 8113 for Low-emitting Materials submittal requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For flagpole required.
 - 1. Include installation instructions, construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Sustainable Design Submittals:

1. Comply with requirements of Section 01 81 13

A. Delegated Design Structural Calculations: For flagpoles, comply with design loadings, and provide structural analysis data for pole and footing signed and sealed by the qualified professional engineer responsible for their preparation.

B. Shop drawings: For each flagpole.

1. Include the following

- a. Plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.

C. Sample Warranty: sample of manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain each flagpole as a complete unit from a single manufacturer, including fittings, accessories, bases, lighting fixtures, lamps, wiring and anchorage devices.

- B. Electrical Connections: Electrical installation must be performed by a qualified Certified Electrician.

1.8 DELIVERY, STORAGE AND HANDLING

- A. General: Spiral wrap flagpoles with heavy kraft paper or other weathertight wrapping and enclose in a hard fiber tube or other protective container.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's form in which manufacturer agrees to repair or replace components of flagpole that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Basis of design: Illuminator series IL35 (12v); The Flagpole Warehouse; 3600 Cantrell Industrial Ct., Acworth, GA 30101; (800) 962-0956 tel. (770) 974-4560 fax; Email: flagpoles@flagco.com

2.2 FLAGPOLES

- A. Pole Construction, General: Construct poles and ship to Project site in one piece, if possible. If more than one piece is necessary, provide snug-fitting precision joints with self-aligning, internal splicing sleeve arrangement for weathertight, hairline field joints.
- B. Aluminum Flagpoles: Tapered flagpole, fabricate from seamless, extruded tubing complying with ASTM B 241 (ASTM B 241M), alloy 6063, Heat treat after fabrication to comply with ASTM B 597, temper T6.
1. Minimum wall thickness of 0.188 inch (4.8 mm).
 2. Provide cone-tapered aluminum flagpoles with 7-inch butt.
 3. Exposed Height: (1) at 30 feet and (1) at 35 feet.
 4. Directional sanded, spun aluminum, satin finish.
- C. Foundation Tube: Provide foundation tube meeting requirements of engineer's design. Galvanized corrugated-steel foundation tube, 0.0635-inch (1.6-mm) minimum wall thickness, sized to suit flagpole and installation. Provide with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges all welded together. Galvanize steel parts, including foundation tube, after assembly. Provide loose hardwood wedges at top of foundation tube for plumbing pole.
- D. Baseplate: Furnish flagpole assembly complete with anchorages and mounting plates, as recommended by manufacturer, to suit size of flagpole and type of installation.
1. Provide heavy duty (0.188") aluminum flashing collar with the same finish to match flagpole.
- E. Quantity: 2.

2.3 FITTINGS

- A. Beacon to match material and finish of pole, to house Integral flagpole light fixture and external halyard fittings.
1. Quantity: 2; 1 at each flagpole.

- B. External Halyard System: Furnish pole with external halyard system consisting of a manually operated geared "M" winch with control stop device and removable handle. Provide stainless braided aircraft-type cable and concealed revolving truck assembly with plastic coated counterbalance sling.
 - 1. Provide 2 halyards and 2 cleats at flagpole.
- C. Halyard Flag Snaps: Provide swivel snap hooks for three flags, as follows:
 - 1. Aluminum or stainless steel.
 - 2. Provide with neoprene or vinyl covers.
- D. Cleats
 - 1. 9", Sating finish
 - 2. Quantity: 2; 1 at each flagpole.

2.4 FLAGPOLE LIGHT

- A. Down-light fixture and beacon combination.
 - 1. 2; 6 watt LED lamps
 - a. Volt: 12
 - 2. 25,000 hour rated.
 - 3. White color light.
 - 4. Revolve 359 degrees.
 - 5. Transformer inside fixture. Dual Primary 115/230 VAC transformer with direct buried waterproof enclosure.
 - 6. 50 feet, 18/3 electrical wire.
- B. Quantity: 2; 1 at each flagpole.

2.5 MISCELLANEOUS MATERIALS

- A. Concrete: Comply with requirements of Division 3 Section "Cast-in-Place Concrete."

2.6 FINISHES

- A. Aluminum: Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 MM or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, including foundation; accurate placement, pattern, orientation of anchor bolts, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.
- B. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.
- C. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.
- D. Coordinate installation of on grade junction box and power supply for integral beacon down light.

3.3 FLAGPOLE INSTALLATION

- A. General: Prepare and install flagpole where shown and in compliance with accepted shop drawings and manufacturer's instructions.
 - 1. Provide positive lightning ground for each flagpole installation.
 - 2. Anchoring details to be reviewed and approved by structural engineer prior to installation.
- B. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.
- C. Mounting Brackets and Bases: Anchor brackets and bases securely through to structural support with fasteners as indicated on Shop Drawings.
- D. Seal flashing collar with clear silicone sealant per section 07 92 00 to secure in place

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Custom-manufactured stainless steel shelf
2. Bunker Storage Lockers
3. Wash Center
4. Wall Mount Wire Shelving – Adjustable.
5. Metal Shelving
6. Work Bench
7. Under Counter Cable Management
8. Whiteboard (OFCI)
9. Metal Storage Shelving
10. Bike Hooks
11. Bike Rack
12. Drying Rack
13. Know Box
14. Signage (Not included in Section 01 2100 Allowances)

- B. Related Requirements:

1. Division 01 Section “Sustainable Design Requirements” for applicable Sustainability requirements.
2. Division 01 “Allowances” for Exterior and Interior Signage Allowances”
3. Division 06 Section “Rough Framing” for additional continuous backing and blocking requirements

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor’s responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product data and installation instructions and required construction and installation details for each product indicated.
- C. Sustainable Design Submittals:
 1. Comply with requirements of Section 01 81 13

- D. Provide color and finish options for initial selection
- E. Provide 3"x4" color samples on actual substrate for each color selected for verification
- F. Warranty and Maintenance Data: For each product indicated to be included final maintenance manuals required in Division 1.

1.5 QUALITY ASSURANCE

- A. Manufacturing Standards: Provide complete units produced by a single manufacturer, including fittings, accessories, bases and anchorage devices.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's form in which manufacturer agrees to repair or replace components of products failing in material or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 CUSTOM STAINLESS STEEL SHELF

- A. Shelf: Provide fixed custom stainless steel shelf, satin finish, 18-8 type 304 – 16 gauge, 12" deep x length shown on the drawings, with 1" return edges all sides with hemmed edge.
- B. Shelf brackets: Provide triangular bracket of same material as for shelf. Weld to shelf with return leg for screw anchorage to wall.
- C. Welds: All spot welds to be ground smooth, cleaned and polished with no visible markings or color distortion.

2.2 BUNKER GEAR STORAGE LOCKERS

- A. Manufacturer - Basis of Design: "Gear Grid" product line, as manufactured by Mid-Minnesota Wire, Forest Lake, MN; phone 888/643-6694; web site www.geargrid.com, or approved equal.
- B. Model: "Gear Grid" Wall Mounted Storage System and Free-standing Tube Wall structure.
 - 1. Locker Sizes: Jumbo 24"W x 20"D x 74 1/2"H
 - 2. Quantity Required: 34 units. See drawings for configurations.
 - 3. Construction: Units shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knock-down shipping, securing units to mounting surface and on applicable accessories.
 - 4. Vertical Dividers:
 - a. Outer Frames: 1.25" O.D. x 16 gauge wall thickness ASTM A513 steel tubing.
 - b. Inner Grid: .25" diameter ASTM 510 cold drawn steel wire resistance welded to a 3" square pattern.
 - 5. Back Panel:
 - c. Grid: .25" diameter ASTM 510 cold drawn steel wire resistance welded to a 3" square pattern.

- C. Accessories (provide one (1) set of accessories per unit)
 - 1. Shelves: (1) top, (1) bottom per unit.
 - 2. Apparel Hooks: (3) per unit.
 - 3. Horizontal Hang Bar: 1.25" stainless steel tubing with powder coated brackets attached to mesh side panel. (1) per unit.
 - 4. Coat Drying Hanger: .25" diameter, 304 stainless steel wire with black vinyl coating on hook end. (2) per unit.
 - 5. Glove Drying Hanger: .25" diameter, 304 stainless steel wire with black vinyl coating on hook end. (1) per unit.
 - 6. Continuous topside storage shelving above all units.

- D. Free-standing Tube Wall structures: Provide Free-standing Tube Wall structure engineered and constructed specifically for installation. Unit shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knock-down shipping, securing units to mounting surface and on applicable accessories
 - 1. Vertical Posts: 4" x 4", .250" wall thickness ASTM A513 steel tube.
 - 2. Floor Mounting Plates: 1/2" steel plate welded to Vertical Posts. 3/8" mounting holes as needed.
 - 3. Horizontal Frames: 4" x 4", .1875" wall thickness ASTM A513 steel tube. Frames mechanically fastened to Vertical Posts with supplied or identified hardware.

- E. Finish: Powder Coated
 - 1. Color: As selected from manufacturer's full range.
 - a. (1) Can of touch-up paint

2.3 WASH CENTER

- A. Manufacturer - Basis of Design: "GearGrid" product line, as manufactured by Mid-Minnesota Wire, Forest Lake, MN; phone 888/643-6694; web site www.geargrid.com, or approved equal.

- B. Model: "Gear Grid" Wash Center
 - 1. Size: (1) 4'-0" unit at rooms Wash Alcove 115.
 - 2. Construction: Units shall be welded at all applicable joints. Forming of metal shall be completed by standard cold-forming operations. Use of fasteners will only be required to allow for knock-down shipping, securing units to mounting surface and on applicable accessories.
 - 3. Back Panel:
 - a. Outer Frames: 1.25" sq. x 16 gauge minimum wall thickness ASTM A513 steel tubing.
 - b. Grid: .25" diameter ASTM 510 cold drawn steel wire resistance welded to a 3" square pattern.

- C. Finish: Powder Coated
 - 1. Color: As selected from manufacturer's full range.
 - a. (1) Can of touch-up paint

2.4 WALL MOUNT WIRE SHELVING UNITS

- A. Manufacturer - Basis of Design: InterMetro Industries Corporation; North Washington Street, Wilkes-Barre, PA. 18705; web site www.metro.com, or approved equal.
1. Erecta Adjustable Metal Wall Shelving; (2) 60" wide shelves – (2) rows high, (3) 54" mounting posts with intermediate post support, 12 inches deep, Chrome Finish. (1) complete adjustable system at Decon 113 – see int. elev.
 2. Erecta Adjustable Metal Wall Shelving; (6) 72" wide shelves – (3) rows high, (2) 54" mounting posts with intermediate post support, 12 inches deep, Chrome Finish. (1) complete adjustable system at Shop 116 – see int. elev.
 3. Erecta Adjustable Metal Wall Shelving; (9) 72" wide shelves – (3) rows high, (2) 54" mounting posts with intermediate post support, 12 inches deep, Chrome Finish. (1) complete adjustable system at PPE Repair 118 – see int. elev.
 4. Provide mounting fasteners into solid wood wall blocking and framing.

2.5 METAL STORAGE SHELVING

- A. At Rooms 118
1. Basis of Design: Global Industrial Extra Heavy-Duty Shelving
 2. Heavy Duty, steel, open shelving with (6) steel shelves or (3) steel shelves (including bottom and top shelves)
 3. Welded box shape with lapped and welded corners for rigidity
 4. Size: As shown in drawings.
 - a. 48"W x 18"D x 39"H
 5. Finish: Powder coated, as selected from manufacturer's standard colors.
 6. Delegated Design to provide code required seismic attachments.
 - a. Provide (Washington State Licensed) Engineering and permitting
 7. Quantity: 6 total; (5 at room 118 and 1 at room 116.)
- B. At Room PPE Storage 117
1. Basis of Design: Husky 4-Tier Extra Heavy-Duty Welded Steel Shelving
 2. Heavy Duty, steel, open shelving with (4) steel shelves.
 3. Welded box shape with lapped and welded corners for rigidity
 4. Size: 77"W x 24"D x 78"H.;
 5. Finish: Powder coated, as selected from manufacturer's standard colors.
 6. Delegated Design to provide code required seismic attachments.
 - a. Provide (Washington State Licensed) Engineering and permitting
 7. Quantity: 2.

2.6 WORK BENCH

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Burroughs
 2. Or approved equal.
- B. Long lasting, high quality industrial workbench comes standard with rugged 2" square, 14 gauge tubular steel height adjustable legs. Legs adjust from 28" to 42"H at 2" increments, legs come with mounting hardware to attach to the bench top. 1-3/4"thick kiln-dried birch top with mineral oil protectant and standard square edge. Includes adjustable leveling floor glides and leveling foot plates that allow floor anchoring. Dimensions are 72"W x 30"D. Powder coat finish.

1. Model #WB318898TN
2. Capacity: 5000 lbs.
3. Legs Style: Square tube.
4. Quantity: 5 total; 2 at shop 116 and 3 at PPE Repair 118.

2.7 FLAMMABLE LIQUIDS STORAGE CABINET

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Global Industrial
 2. Or approved equal.
- B. NFPA Flammable Liquid Code #30 and the OSHA standard 1910.106 for storage of class I, II and III liquids. FM approved. All-welded construction, 18 gauge cabinet with 14 gauge doors. The double-walled design with 1-1/2" insulating air space and dual 2" air vents that connect to exhaust system to maintain safe temperatures. Built-in grounding connector and leveling feet. 350 lb. capacity shelves adjust easily on 2-1/2" centers. Double self-closing doors equipped with 4" hinges with sturdy brass pins with-proof sill, a flush paddle handle with 3 point latching and a highly visible trilingual warning. Latching engages when doors are closed without handle rotation. Automatic closing when fusible link melts at 165° F with self-indexing doors that close in sequence to ensure tight closure and a recessed self-close mechanism that allows access to top shelf. Flush door handle prevents passersby from catching or banging.
1. Capacity: 45 Gallon
 2. Size: 43"Wx18"Dx65"H
 3. Quantity: 1 at shop 116

2.8 BIKE RACK

- A. Basis of Design: Huntco; "Tilikum Bike Rack" or Approved Equal
- B. Materials: Mild Steel, 2"x 2" .120 inch wall Square Steel Tubing
- C. Finishes: Thermoplastic Powder Coating, 12 mils
1. Color as selected from Manufacturers full range
- D. Capacity: 2
- E. Quantity: 2

2.9 UNDER COUNTER CABLE MANAGEMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Cable Organizer.com
 2. Or approved equal.
- B. Continuous entire length of desk, Metal wire under desk cable tray. Break at desk supports.
- C. Color: Powder Coated Black.
- D. Location: FF Work Area 105.

2.10 WHITEBOARD (OFCI)

- A. Manufacturer:
 - 1. Clairidge
 - 2. Or approved equal.
- B. Whiteboard: Magnetic Dry-erase.
 - 1. Frame: Aluminum
 - 2. Construction: Steel-backed and square miter corners.
 - 3. Surface Material: Porcelain surface; dry-erase surface.
 - 4. Location: per plan.
- C. Tackboard: Magnetic Dry-erase.
 - 1. Frame: Aluminum
 - 2. Construction: Steel-backed and square miter corners.
 - 3. Surface Material: Porcelain surface; dry-erase surface.
 - 4. Location: per plan.

2.11 DRYING RACK

- A. Manufacturer: Air One Equipment, Inc. 847.289.9000
 - 1. SKU & Type: TG-6, Ram Air 6 Unit Turnout Gear Dryer
 - 2. Quantity: 1 at room 117.

2.12 KNOX BOX

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Knoxbox, Electronic Knoxvault 4400 Single Lock Model
 - 2. Or approved equal.
- B. Recessed mount with vertical hinge for new construction with tamper alert. Provide a steel backing plate for mounting the KNOX-BOX to building metal framing. Use 4 - 3/8" Grade 5 or Grade 8 fasteners and large, thick steel washers to mount. Mount approximately 50 inches above grade. Provide weather tight installation.
- C. Color: Selected by Architect from manufacturers full range.
- D. Quantity: Provide 3. Location to be approved by owner.

2.13 SIGNAGE

- A. Definitions:
 - 1. ADA-ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines."
- B. Fabricator Qualifications:

1. Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
 2. Source Limitations for Signs: Obtain each sign type indicated from one source from a single manufacturer.
- C. Regulatory Requirements:
1. Signage required to be accessible to people with disabilities must comply with requirements in ADA-ABA Accessibility Guidelines and with requirements of authorities having jurisdiction, whichever are more stringent.
 2. Comply with applicable provisions in ICC/ANSI A117.1 2003.
- D. Coordination: Coordinate placement of anchorage devices with templates for installing signs.
1. Coordinate blocking requirements prior to framing.
- E. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
- G. Exterior Signage
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Gemini
 - b. Or Approved Equal.
 2. Exterior Building Pin Mounted with Spacers Flat Cut Metal Signage:
 - a. Pin mounted, 1/2" thick aluminum, plate letters.
 - b. Font: Arial bold (or as selected by Architect)
 - c. Color: As Selected by Architect - powder coated.
 - d. Location: As shown on drawings and below.
 - 1) "13118" Building Address signage north elevation – 8" tall
 - 2) "KIRKLAND" north elevation – 12" tall.
 - 3) "FIRE DEPARTMENT" north elevation – 6.25" tall.
 3. Exterior Building LED Back Lit (Halo Lighted) Pin Mounted with Spacers Metal Signage:
 - e. Pin mounted, 2" thick stainless steel, dimensional letters.
 - f. Font: Arial bold (To be verified)
 - g. Back: Removeable clear Lexan
 - h. Color: Vert. brushed stainless steel.
 - i. Location: As shown on drawings and below.
 - 1) "27" north elevation – 72.5" tall.
 - 2) "KIRKLAND FIRE DEPARTMENT" west elevation – 30" tall.
 - j. Lighting: Sloan RGB color changing LEDs and G2G WIFI 300 controller with remote-control capability or approved equal. Power and data per the electrical drawings. Provide components for a complete system.
 4. Existing Monument Sign: See Specification Section; 01 21 00 ALLOWANCE NO. 4
- F. Interior Signage

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Vista Signs
 - b. Vertical Signage Solutions
 - c. Fast Signs
 - d. Or Approved Equal.
2. Interior Raised letter signs with Braille and optional graphics on acrylic plastic (including ADA signs)
 - a. Base Acrylic Material: 1/8-inch Acrylic with non-glare (matte) surface.
 - 1) Laminated second surface graphic or solid embedded color material.
 - a) Sign Color: Color as selected from full range available.
 - b. Height and width: as required to meet specifications. 6" x 8" minimum unless noted otherwise
 - c. Edges: Square to conform to sign frame interior space.
 - d. Raised Characters:
 - 1) Character Font: San Serif
 - 2) Character Height: 3/4-inch or as indicated
 - 3) Character Color: TBD.
 - 4) Character Thickness: 1/32-inch
 - 5) Character Adhesive: 3M Scotch 467HP adhesive or approved manufacturer's standard.
 - e. Raised Graphics or Icons:
 - 1) Graphic Color: TBD.
 - 2) Graphic Thickness: 1/32-inch
 - 3) Graphic Adhesive: 3M Scotch 467HP adhesive or approved manufacturer's standard.
 - f. Braille: Clear Grade II Raster Braille with domed surface
 - g. Interior signs shall be mounted with double-faced tape or screws (tamperproof) as furnished by the manufacture.
 - h. Signage attachment to be approved by manufacture
 - i. Provide architect with attachment method in shop drawings. Interior Signage.
 - j. Refer to drawings for additional signage requirements.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Examine substrates, areas and conditions under which accessories will be installed with installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Coordinate with other trades for required anchoring requirements including but not limited to blocking, preset anchors and anchor bolts.

3.2 INSTALLATION

- A. Install according to manufacturer's instructions.

- B. Install units plumb and level.
- C. Anchor wall mounted equipment to wall blocking or other structural element.
 - 1. Install solid blocking as required for attachment.

3.3 ADJUSTING AND CLEANING

- A. Adjust and clean all surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coverings.
- B. Provide final protection and maintain conditions that insure work during construction is without damage or deterioration other than natural weathering at time of substantial completion.
- C. Replace damaged items that cannot be repaired to like new condition as determined solely by the owner.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Microwave
2. Refrigerators
3. Refrigerators / Freezer
4. Dishwashers
5. Range
6. Range Hood (see Mechanical specifications)
7. Washers
8. Dryers
9. Stacked Dryers
10. Stacked Washer
11. Washer Extractor

- B. Related Sections include the following:

1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
2. Division 10 Section "Miscellaneous Specialties" for drying rack
3. Division 22 Section "Plumbing Fixtures". For plumbing fixtures
4. Division 22 for plumbing connections for appliances.
5. Division 23 for Range Hood and ducting connections for appliances.
6. Division 26 for electrical services and connections for appliances.

- C. Owner Supplied Items:

1. The Contractor shall install all necessary mechanical and electrical connections for the complete operation of each Owner supplied item. The Contractor shall notify Owner of lead time for each piece of equipment so as not to delay the construction schedule.

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 8113 for Low-emitting Materials submittal requirements.

1.4 DELIVERY

- A. Deliver appliances only after utility rough in is complete and construction in the spaces to receive appliances is substantially complete and ready for installation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all materials and installation kits required for each appliance as necessary for complete installation and operation of each appliance.

2.2 MICROWAVE

- A. Manufacturer: GE MONOGRAM
 - 1. Model # & Type: GE MONOGRAM ZES1227SLSS
 - 2. Color: Stainless Steel trim
 - 3. Quantity: 1

2.3 REFRIGERATORS

- A. Manufacturer: ELECTROLUX
 - 1. Model # & Type: ELECTROLUX E133AR80WS
 - 2. Color: Stainless Steel trim
 - 3. Quantity: 2

2.4 REFRIGERATOR / FREEZERS

- A. Manufacturer: ELECTROLUX
 - 1. Model # & Type: ELECTROLUX EW23BC87SS
 - 2. Color: Stainless Steel trim
 - 3. Quantity: 1

2.5 DISHWASHER

- A. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
- B. Manufacturer: GE MONOGRAM
 - 1. Model # & Type: GE MONOGRAM ZDT925SPNSS
 - 2. Color: Stainless Steel trim

3. Quantity: 1

2.6 RANGE

A. Manufacturer: GE MONOGRAM

1. Model # & Type: GE MONOGRAM ZGP366NTSS
2. Color: Stainless Steel trim
3. Quantity: 1

B. Manufacturer: GE MONOGRAM

1. Model # & Type: GE MONOGRAM ZGP364NDTSS
2. Color: Stainless Steel trim
3. Quantity: 1

2.7 WASHERS

A. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.

B. At 202 Laundry

1. Manufacturer: Whirlpool
 - a. Model # & Type: WFW562OH
 - b. Color:
 - c. Quantity: 2

C. At 113 Decon

1. Manufacturer: Speed Queen
 - a. Model # & Type: AFNE9BSP116T, with one stacking kit.
 - b. Color:
 - c. Quantity: 1

2.8 DRYERS

A. At 202 Laundry

1. Manufacturer: Whirlpool
 - a. Model # & Type: WED562OH
 - b. Color:
 - c. Quantity: 2

B. At 113 Decon

1. Manufacturer: Speed Queen

- a. Model # & Type: ADE3RGS175T, stacked.
- b. Color:
- c. Quantity: 1

2.9 WASHER EXTRACTOR

A. Manufacturer: Continental

1. Model # & Type: EH03011102222000 (32"X32") w/ Auto Detergent
2. Color:
3. Quantity: 1 at 113 Decon.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for plumbing, mechanical, and electrical services, with Installer present, to verify actual locations of services before appliance installation.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- D. Utilities: Refer to Divisions 22, 23 and 26 for plumbing, venting and electrical requirements.
- E. Install manufacturer's installation kits per manufacturer's instructions as required for each appliance as necessary for complete installation and operation.
- F. Roof mounted equipment and vents to include curb and flashing for a weather tight installation.

3.3 ADJUSTING AND CLEANING

- A. Test each item of appliances to verify proper operation. Make necessary adjustments.
- B. Verify that accessories required have been furnished and installed.

- C. Replace all light bulbs not working at substantial completion
- D. Clean and replace all filters at final completion
- E. Remove packing material from appliances and leave units in clean condition, ready for operation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Resilient-tile entrance mats.

- B. Related Requirements:

- 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.

1.3 COORDINATION

- A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.4 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.5 ACTION SUBMITTALS

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

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

- B. Shop Drawings:

- 1. Items penetrating floor mats and frames, including door control devices.
- 2. Divisions between mat sections.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.

D. Sustainable Design Submittals:

1. Comply with requirements of Section 01 81 13

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient-Tile Entrance Mats: Full-size tile units equal to **2** percent of amount installed, but no fewer than **10** units.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Accessibility Standard: Comply with applicable provisions in **the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.**

2.2 RESILIENT-TILE ENTRANCE MATS

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

1. Philadelphia Commercial; Succession II Tile
2. Or approved equal.

B. Carpet-Type Tiles: **Polypropylene** carpet bonded to 1/8- to 1/4-inch- (3.2- to 6.4-mm-) thick, flexible vinyl backing to form mats 3/8 (9.5 mm) thick with nonraveling edges.

1. Colors, Textures, and Patterns: **As selected by Architect from full range of industry colors.**
2. Tile Size: 24"x24".

2.3 FABRICATION

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.
 - 1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Hydraulic passenger elevators.

B. Related Requirements:

1. Section 01 10 00 "Summary" for purchase contract for elevators negotiated by Owner and assigned to Contractor.
2. Section 01 50 00 "Temporary Facilities and Controls" for temporary use of elevators for construction purposes.
3. Section 03 30 00 "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
4. Section 04 20 00 "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
5. Section 05 12 00 "Structural Steel Framing" for the following:
 - a. Attachment plates, angle brackets, and other structural-steel preparations for fastening guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills that are part of steel frame.
6. Section 05 50 00 "Metal Fabrications" for the following:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Divider beams.
 - c. Hoist beams.
 - d. Structural-steel shapes for subsills.
 - e. Pit ladders.
 - f. Cants made from steel sheet in hoistways.
7. Section 09 90 00 "Painting" for field painting of hoistway entrance doors and frames.
8. Division 27 for twisted pair conductors used for telephone service for elevators **and for Internet connection to elevator controllers for remote monitoring of elevator performance if required.**
9. Division **28** for smoke detectors in elevator lobbies to initiate emergency recall operation **and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation** and for connection to elevator controllers.

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

1.5 ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures; hoistway entrances; and operation, control, and signal systems.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- C. Shop Drawings:
 - 1. Include plans, elevations, sections, and large-scale details indicating service at each landing; machine room layout; coordination with building structure; relationships with other construction; and locations of equipment.
 - 2. Include large-scale layout of car-control station **including operation control panel**.
 - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support as well as maximum and average power demands.
- D. Samples for Initial Selection: For finishes involving color selection.
- E. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes, **3-inch- (75-mm-)** square Samples of sheet materials and **4-inch (100-mm)** lengths of running trim members.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Manufacturer Certificates: Signed by elevator manufacturer, certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service **including standby-power generator**, as shown and specified, are adequate for elevator system being provided.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
1. Submit manufacturer's/installer's standard operation and maintenance manual, in accordance with ASME A17.1/CSA B44 **including diagnostic and repair information available to manufacturer's and installer's maintenance personnel**.
- B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard **five-year** maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.10 COORDINATION

- A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
- B. Furnish well casing and coordinate delivery with related excavation work.
- C. Coordinate locations and dimensions of other work specified in other Sections that relates to hydraulic elevators, including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.11 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
 - 2. Warranty Period: 1 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the following:
 - 1. Otis; HydroFit 2100.
 - 2. Or approved equal.
- B. Source Limitations: Obtain elevators from single manufacturer.
 - 1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, are manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

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

- B. Accessibility Standard: Comply with applicable provisions in **the United States Access Board's ADA-ABA Accessibility Guidelines and ICC A117.1.**
- C. Seismic Performance: Elevator system withstands the effects of earthquake motions determined according to **ASCE/SEI 7** and complies with elevator seismic requirements in ASME A17.1/CSA B44.
 - 1. Project Seismic Design Category: **D.**
 - 2. Elevator Component Importance Factor: **1.5.**
 - 3. Design earthquake spectral response acceleration short period (Sds) for Project is **0.843.**
 - 4. Provide earthquake equipment required by ASME A17.1/CSA B44.
 - 5. Provide seismic switch required by ASCE/SEI 7.

2.3 ELEVATORS

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components are used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
 - 1. Type:
 - a. Holeless, beside-the-car, telescoping, **dual** cylinder.
 - 2. Rated Load: 2100 lb (953 kg).
 - 3. Rated Speed: 100 fpm (0.51 m/s).
 - 4. Operation System: Single automatic operation.
 - 5. Auxiliary Operations:
 - a. Standby-power operation.
 - b. Standby-powered lowering.
 - c. Automatic dispatching of loaded car.
 - d. Nuisance call cancel.
 - e. Loaded-car bypass.
 - f. Off-peak operation
 - g. Automatic operation of lights and ventilation fans.
 - 6. Security Features: **Car-to-lobby feature.**
 - 7. Car Enclosures:
 - a. Inside Width: Not less than **68 inches (1727 mm)** from side wall to side wall.
 - b. Inside Depth: Not less than **52 inches (1324 mm)** from back wall to front wall (return panels).
 - c. Inside Height: Not less than **93 inches (2362 mm)** to underside of ceiling.
 - d. Front Walls (Return Panels): **Satin stainless steel, ASTM A480/A480M, No. 4 finish with integral car door frames.**
 - e. Car Fixtures: **Satin stainless steel, ASTM A480/A480M, No. 4 finish.**
 - f. Side and Rear Wall Panels: **Satin stainless steel, ASTM A480/A480M, No. 4 finish**
 - g. Reveals: **Satin stainless steel, ASTM A480/A480M, No. 4 finish.**
 - h. Door Faces (Interior): **Satin stainless steel, ASTM A480/A480M, No. 4 finish.**
 - i. Door Sills: **Aluminum**
 - j. Ceiling: **Satin stainless steel, ASTM A480/A480M, No. 4 finish**

- k. Handrails: **1/2 by 2 inches (13 by 50 mm) rectangular satin stainless steel**, at **sides and rear** of car.
- l. Floor: Manufacturer's standard carpet.
- m. Floor prepared to receive resilient flooring specified in Section 09 65 00 "Resilient Flooring".
- 8. Hoistway Entrances:
 - a. Width: **36 inches (914 mm)**.
 - b. Height: **84 inches (2134 mm)**.
 - c. Type: **Single-speed side sliding**
 - d. Frames : **Satin stainless steel, ASTM A480/A480M, No. 4 finish**
 - e. Doors and Transoms: **Satin stainless steel, ASTM A480/A480M, No. 4 finish**
 - f. Sills : **Aluminum**
- 9. Hall Fixtures: [**Satin stainless steel, ASTM A480/A480M, No. 4 finish**
- 10. Additional Requirements:
 - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from **satin stainless steel, ASTM A480/A480M, No. 4 finish**
 - b. Provide hooks for protective pads complete set(s) of full-height protective pads.

2.4 SYSTEMS AND COMPONENTS

- A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.
 - 1. Pump is **submersible type with submersible squirrel-cage induction motor, and shall be suspended inside oil tank from vibration isolation mounts or is tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and is mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.**
 - 2. Motor has **wye-delta**] starting.
 - 3. Motor has variable-voltage, variable-frequency control.
- B. Hydraulic Silencers: System has hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.
- C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.
 - 1. Cylinder units are connected with dielectric couplings.
 - 2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D1785, joined with PVC fittings complying with ASTM D2466 and solvent cement complying with ASTM D2564.
- D. Hydraulic Fluid: Elevator manufacturer's standard **fire-resistant** fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.
- E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

- F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than **1-inch (25-mm)** clearance from cylinder and extending above pit floor. Casing has means of monitoring effectiveness to comply with ASME A17.1/CSA B44.
- G. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler is electrically nonconductive, displaces or absorbs water, and gels or solidifies at temperatures below **60 deg F (16 deg C)**.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hydro Safe Oil Division, Inc., <http://www.hydrosafe.com>, No-Ox-Id Liquid Elevator Casing Filler E-800.
 - b. Or approved equal.
- H. Car Frame and Platform: Welded steel units.
- I. Guides: **Polymer-coated, nonlubricated sliding guides or sliding guides with guide-rail lubricators**. Provide guides at top and bottom of car frame.

2.5 OPERATION SYSTEMS

- A. Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.
- B. Auxiliary Operations:
 - 1. Single-Car Standby-Power Operation: On activation of standby power, car is returned to a designated floor and parked with doors open. Car can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at hallway. Manual operation causes automatic operation to cease.
 - 2. Single-Car Standby-Powered Lowering:
 - a. On activation of standby power, if car is at a floor, it remains at that floor, opens its doors, and shuts down. If car is between floors, it is lowered to a preselected floor, opens its doors, and shuts down. If car is below the preselected floor, it is lowered to the next lower floor, opens its doors, and shuts down.
 - b. On activation of standby power, car is lowered to the lowest floor, opens its doors, and shuts down.
 - 3. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
 - 4. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls[**and predetermined weight**] can be adjusted.
 - 5. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.
 - 6. Off-Peak Operation: During periods of low traffic, half of the elevators in a group are taken out of service and switched to low-power mode.
 - 7. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after 5 minutes and are re-energized before car doors open.

- C. Security Features: Security features do not affect emergency firefighters' service.
 - 1. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby, that causes [car] to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.6 DOOR-REOPENING DEVICES

- A. Infrared Array: Provide door-reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams causes doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door-reopening device, a loud buzzer sounds and doors begin to close at reduced kinetic energy.

2.7 SIGNAL EQUIPMENT

- A. Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Provide buttons and lighted elements illuminated with LEDs.
- B. Car-Control Stations: Provide manufacturer's standard **recessed** car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
 - 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Swing-Return Car-Control Stations: Provide car-control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.
 - 1. Mark buttons and switches for function. Use both tactile symbols and Braille.
 - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- D. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
 - 1. Visual Alarm Monitoring (VAM):
 - a. Visual, text and video based 24/7 live interactive system.
 - b. Fully accessible by the deaf, hard of hearing and speech impaired and shall include voice-only options.

- c. Has the ability to communicate with emergency personnel using existing video conferencing technology, chat/text software or other approved technology.
- E. Firefighters' Two-Way Telephone Communication Service: Provide **telephone jack** in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in **Section 28 31 11 "Fire Alarm System."**
- F. Car Position Indicator: Provide **illuminated**, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- G. Hall Push-Button Stations: **Provide one hall push-button station at each landing**
 1. Provide [manufacturer's standard wall-mounted units] [units with flat faceplate for mounting with body of unit recessed in wall] [jamb-mounted units].
 2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.
 3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in **Section 28 31 11 "Fire-Alarm Systems"**.
- H. Hall Lanterns: Units with illuminated arrows; however, provide single arrow at terminal landings. Provide **[one of]** the following:
 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
 2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
 3. Units mounted in both jambs of entrance frame **[for each elevator]**.
 4. Units mounted in both car door jambs; **may be used only for single elevators**.
- I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
 1. At manufacturer's option, audible signals may be placed on cars.
- J. Hall Position Indicators: Provide **illuminated**, digital-display-type position indicators, located above hoistway entrance at ground floor.
 1. Provide units **with flat faceplate for mounting and with body of unit recessed in wall**.
 2. Integrate ground-floor hall lanterns with hall position indicators.
- K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby-power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
- L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.8 FINISH MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, commercial steel, Type B, exposed, matte finish.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, commercial steel, Type B, pickled.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304.
- D. Stainless Steel Bars: ASTM A276, Type 304.
- E. Stainless Steel Tubing: ASTM A554, Grade MT 304.
- F. Aluminum Extrusions: **ASTM B221 (ASTM B221M)**, Alloy 6063.
- G. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500 or No. C77600.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

- D. Install piping above the floor, where possible. Install underground piping in casing.
 - 1. Excavate for piping and backfill encased piping according to applicable requirements in Division 31 Section "Earthwork."
- E. Lubricate operating parts of systems as recommended by manufacturers.
- F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
- G. Leveling Tolerance: **1/4 inch (6 mm)**, up or down, regardless of load and travel direction.
- H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
- I. Locate hall signal equipment for elevators as follows unless otherwise indicated:
 - 1. Place hall lanterns either above or beside each hoistway entrance.
 - 2. Mount hall lanterns at a minimum of **72 inches (1829 mm)** above finished floor.

3.3 FIELD QUALITY CONTROL

- A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.
- B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

- A. Temporary Use: Do not use elevator for construction purposes:
 - 1. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.
 - 2. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

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

- B. Check operation of elevator with Owner's personnel present before date of Substantial Completion **and again not more than one month before end of warranty period**. Determine that operation systems and devices are functioning properly.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Conform to General Conditions, Supplementary Conditions, the modifications thereto and Division 1 - General Requirements for all work.

1.2 SUMMARY

- A. Design Intent:
1. System to provide coverage for entire building.
 2. Provide hydraulically designed (or pipe schedule only if acceptable by authorities having jurisdiction) system to NFPA 13 occupancy requirements.
 3. Determine volume and pressure of incoming water supply from water flow test data.
 4. Interface system with building fire and smoke alarm systems.
 5. Piping from the site connection to the flange at the base of the sprinkler riser is specifically included in Division 21 00 00.
- B. **This is a design/build specification.** Provide all required design, permits, labor, materials and installation of fire protection work, complete and operable in accordance with these specifications and drawings. Work of Division 21 includes, but is not limited to, that as delineated in conceptual information shown on the drawings and the following specification sections:
- | | |
|----------|--|
| 21 00 00 | Fire Suppression General Conditions |
| 21 05 00 | Common Work Results for Fire Suppression |
| 21 13 13 | Wet-Pipe Sprinkler Systems |
- C. Related Sections:
- | | |
|--------|--|
| 018100 | Jobsite Indoor Air Quality Construction Plan |
| 018113 | Sustainable Design Requirements |

1.3 CODES AND STANDARDS

- A. Conform to following code and agency requirements having jurisdictional authority over fire protection installation.
1. International Building Code (IBC) with local amendments.
 2. National Electrical Code (NEC) NFPA 70.
 3. Requirements of OSHA.
 4. National Fire Protection Association (NFPA) Codes and Standards.
 5. ASTM, ASME, ANSI and NEMA standards, as referenced in subsequent sections.
 6. Local Water District Requirements.
 7. Local Health Department Requirements.

1.4 SUSTAINABLE DESIGN REQUIREMENTS

- A. Comply with project requirements to achieve LEED Certification.
- B. Comply with Construction Waste Management plan. Refer to Division 01.

- C. LEED-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC, per referenced standards and no added urea-formaldehyde. Cleaning products used during construction and close-out procedures shall meet Green Seal standards GS-34, GS-37, and SG-40, or the California Code of Regulations, Title 17 Section 94509, VOC standards for cleaning products.
- D. Commissioning activities and submittals: Refer to Divisions 1, 22, and 23.
- E. Refer to Division 1 for more information on related LEED Credits.

1.5 SUBMITTALS

- A. See Division 01 - Submittal Procedures.
- B. Field Test Reports: Include results of hydrostatic and flow tests with hydraulic calculations.
- C. Design Data: Submit design calculations signed and sealed by NICET Level III Certified Designer.
- D. Provide one electronic copy of product data submittals for all products listed under "Part 2 Products" of Division 21 and all additional products noted on drawings or required for completion of project.
- E. Electronic: **All sections of Division 21 shall be submitted together in one complete PDF file with bookmarks for each section. Multi-part submittals will be returned without review.**
 - 1. First Page: Name of Project, Owner, Location & Contracting Company.
 - 2. Index Page: List of specification sections with contents by Tag or item.
 - 3. Bookmarks: Electronic bookmark of each specification section corresponding to listing in index.
- F. Clearly indicate on each page the equipment schedule designation (Tag) and/or specification section, as applicable. Indicate model and all accessories intended for use.
- G. Equipment vendor cover page with contact information shall precede submittal by that vendor.
- H. Submitted product information shall include (as applicable) but not be limited to the following information:
 - 1. Product description
 - 2. Manufacturer and model
 - 3. Dimensions
 - 4. Performance Ratings (i.e. capacity, rpm, HP, temperature)
 - 5. Construction Materials
 - 6. Ratings (i.e. UL, FM, NEMA, etc)
 - 7. Electrical data
 - 8. Vibration Isolation
 - 9. Controls and wiring diagrams
 - 10. Accessories
 - 11. Engineering technical data (i.e. pressure drops, leakage rates, pump curves)
- I. LEED Specific Submittals:
 - 1. LEED Submittals: Submit the LEED VOC Form, for any VOC-containing material to be used inside the building envelope, including materials for patching, touch-up and cleaning.

2. Submit data or signed letter from manufacturer or engineer that indicates ozone depleting substances such as halons, CFC's and HCFC's are not in the fire-suppression system.

1.6 SHOP DRAWINGS

- A. Prepare Shop Drawings stamped and signed by a NICET Class III Certified designer. Develop in accordance with NFPA 13 and the State and Local Fire Marshals. Submit PDF copies of these drawings for approval prior to beginning work.
- B. Submit shop drawings to Architect, Local Fire Marshal, and all other approving authorities. Drawings shall be approved by all agencies prior to fabrication or installation. **Drawings submitted for Architect's approval shall have been stamped approved by the Fire Department.**
- C. The Contractor shall draw the design team's attention to any areas in which they contemplate deviations from the conceptual information shown on the contract documents (e.g., due to site conditions).
- D. These drawings and diagrams shall show all pipe sizes as well as the manufacturer's name and catalog number of each piece of equipment used.
- E. The Architect's review of such drawings shall not relieve the Contractor of responsibility for deviations from the Contract drawings or specifications, nor shall it relieve him from responsibility for errors or omission in such drawings.
- F. Fire Sprinkler shop drawings shall indicate all relevant pipe, ceiling, and structural elevations and clearances. All elbows, offsets, and turns shall be clearly identified. All required access doors shall be shown. By submission of sheet fire sprinkler shop drawings, the Contractor acknowledges that coordination has been done to ensure that all ductwork and piping fits and no conflicts exist.
- G. Indicate layout of piping and sprinkler locations coordinated with ceiling type, lighting, structural and mechanical. Conform to symmetrical spacing of heads and integrate into locations of lights and other ceiling devices. Center heads on ceiling tiles (+/- 1") and align in straight rows.
- H. Indicate detailed pipe layout, hangers and supports, sprinklers, components and accessories. Include building sections and a plot plan showing location of underground supply connections, outside control valves, fire department connections and other equipment to be used.
- I. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation layout, mounting and support details, and piping connections.
- J. Indicate layout of flexible connectors, expansion joints, expansion compensators, loops, offsets and swing joints.
- K. Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation.
- L. Indicate system controls.

1.7 FIRE SPRINKLER PERMIT

- A. Fire Sprinkler contractor shall prepare all documents for permit application, submit and obtain the permit from reviewing authority. All costs and fees to obtain the permit shall be paid by the Fire Sprinkler Contractor.

1.8 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 13 and Local and/ or State Fire Marshal.
- B. Perform work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of continuous representation, a stocking distributor and service representative in the State of Washington.
- B. Contractor: Licensed and regularly engaged in the specialized design and installation of automatic sprinkler equipment as listed by UL or other nationally recognized testing laboratories. Minimum three years' experience and have installed at least five systems of comparable size.
- C. Bids by wholesalers, suppliers or any firm whose principal business is not that of manufacturing and/or installing fire protection systems are not acceptable.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Furnish cast iron and steel valves with temporary protective coating with end caps and closures on piping and fittings. Maintain in place until installation.
- C. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.

1.11 FIELD MEASUREMENTS

- A. Where the word 'verify' is used on the documents, the contractor shall field verify the existing conditions and modify the scope of the installation as required to meet the verified conditions without additional cost to the Owner.
- B. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.

1.12 COORDINATION

- A. Visit the site and become familiar with existing conditions affecting work.
- B. Verify locations of any overhead or buried utilities on or near site. Determine such locations in conjunction with all public and private utility companies and with all authorities having jurisdiction.

- C. Mechanical drawings are diagrammatic and do not indicate all possible site conditions. The contractor shall verify all measurements, dimensions and connections on site and coordinate between trades to preclude interferences. The contractor shall provide adjustments to piping as necessary to fit conditions including but is not limited to relocation, offsets, and transitions.
- D. In the event of a conflict with other trades of work, the following priority from highest to lowest shall be followed: Structural, lighting, HVAC, plumbing/piping and sprinklers. Starting with the lowest priority, the HVAC, plumbing, and sprinkler contractors shall provide whatever materials, offsets, labor etc. is required to resolve the conflict.
- E. When discrepancies occur between plans and specifications, the Architect will determine which takes precedence and the Contractor shall perform the selected requirement at no additional cost.
- F. Prior to ordering equipment cross-check mechanical and electrical drawings and specifications to assure proper location and electrical characteristics of connections serving mechanical and electrical equipment.
- G. Advise the Architect of any modifications required to suit equipment furnished. Costs for modifications due to equipment substitution will be borne by the contractor.
- H. Wherever conflicts occur between different parts of the Contract Documents the greater quantity, the better quality, or larger size shall prevail unless the Architect informs the Contractor otherwise in writing.
- I. The scale of each drawing is relatively accurate, but the Contractor is warned to obtain the necessary dimensions for any exact takeoffs from the Architect. No additional cost to the Owner will be considered for failure to obtain exact dimensions where not clear or in error on the drawings. Any device of fixture roughed in improperly and not positioned on implied centerlines or as required by good practice must be repositioned at no cost to the Owner.

1.13 CUTTING, FITTING, REPAIRING AND PATCHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where necessary for installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting, where possible, by setting sleeves, frames, etc., and by coordinating for openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for ducts and piping.
- C. Cut all holes neatly and as small as possible to admit work. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

1.14 SALVAGE

- A. Remove excess piping and plug or cap any unused branch connections. Remove scrap pipe and all other excess materials from the site.
- B. Comply with contractor's Construction Waste Management Plan. Retain and submit all trip and tip tickets for all construction debris and waste hauling, indicating material content, tonnage, date hauled and facility to where materials were hauled.

1.15 EXTRA MATERIALS

- A. Provide extra sprinklers under provisions of NFPA 13.
- B. Furnish suitable wrenches for each sprinkler type.
- C. Furnish metal storage cabinet adjacent to alarm valve. Lettered "Automatic Sprinklers - Reserve Supplies."

1.16 FINAL APPROVAL

- A. Completion and approval of the following is required for final approval of systems.
 - 1. Execution of Architect's and Engineer's final observation reports
 - 2. Operation and maintenance instruction
 - 3. Operation and maintenance manuals submitted
 - 4. Equipment cleaning
 - 5. Record drawings submitted
- B. See Division 01.

1.17 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. General: In addition to requirements of Division 01, following initial operation of mechanical systems and prior to acceptance by the Architect, perform the following services.
- B. At least two weeks prior to each instruction period, give written notification of readiness to proceed to the Architect and Owner, and obtain mutually acceptable dates.
- C. Conduct demonstrations and instructions for the Owner's representatives, pointing out requirements for operating, servicing and maintaining equipment and systems. Describe general system operation and specific equipment functions. Cover all equipment calibration, setpoint adjustment, safeties and alarms.
- D. Furnish qualifications of Contractor's personnel in charge of the instruction; foreman position is minimum acceptable. Where equipment startup is performed by supplier's or manufacturer's personnel, those personnel should also provide training on that equipment.
- E. During demonstrations and instructions include and reference information from maintenance manuals and contract drawings.
 - 1. Provide documentation of all instruction which includes:
 - a. Date and time of instruction
 - b. Name, affiliation and qualifications of the instructor
 - c. Name and affiliation of the attendees
 - d. Topics, systems, and equipment covered
 - e. Length of instruction
- F. Minimum duration of instruction period is 2 hours.

1.18 OPERATING AND MAINTENANCE MANUALS

- A. Contents: Furnish, in accord with Division 1, one PDF and one bound copy of operating and maintenance manuals to include the following:
 - 1. Manufacturers, suppliers, contractor names, addresses and phone numbers.

2. Warranty service contractors' names, address and phone numbers (if different from above).
 3. Schedule and description of routine maintenance for each component to include oiling, lubrication and greasing data.
 4. Test data log.
 5. Manufacturer's cuts and rating tables, including brochures for all submittal items.
 6. Part numbers of all replaceable items.
 7. Control diagrams and operation sequence.
 8. Written guarantees.
 9. Record drawings corrected and completed.
 10. Completed equipment start-up forms and checklists.
- B. Binders:
1. Furnish typewritten or printed index and tabbed dividers between principal categories.
 2. Bind each manual in a hard-backed loose-leaf binder.
- C. Imprint on cover:
1. Name of project.
 2. Owner.
 3. Location of project.
 4. Architect.
 5. Contractor.
 6. Year of completion.
- D. Imprint on backing:
1. Name of project.
 2. Year of completion.
- E. Submittals:
1. Preliminary Copies: Prior to scheduled completion of the project, provide one PDF copy for review by the Architect.
 2. Final Copies: After approval of the preliminary copy, submit one PDF and one bound copy to the Owner.
- 1.19 EQUIPMENT AND PIPE CLEANING
- A. Clean interior and exterior of all equipment. Equipment shall be free of dirt, construction debris, corrosion, etc.
 - B. Adequate provisions shall be made during construction to eliminate dirt, debris or other material from entering and collecting inside of pipe. Any collection of material shall be thoroughly cleaned before equipment startup and if necessary before owner occupancy.
 - C. Clean exterior of all exposed pipe.
 - D. Flush entire piping system of foreign matter.
 - E. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.
- 1.20 RECORD DRAWINGS
- A. See Division 1.

- B. Submit two digital files with all drawings in PDF and AutoCAD format.
- C. Show location of equipment and size of piping. Where appropriate provide tag or label identification for all valves and similar equipment. Indicate locations and elevations of exterior pipe and utility connections. Maintain continuously updated drawings during progress of project.

1.21 TESTING

- A. Provide completed start-up forms and checklists.

1.22 WARRANTIES AND CONTRACTOR'S GUARANTEE

- A. Furnish one year warranty from date of substantial completion for all systems unless specifically noted otherwise.
- B. All work, material and equipment shall be free of defect, complete and in perfect operating order at time of delivery to Owner.
- C. Without cost to Owner, **correct all defects and failures discovered within one year from date of final acceptance**, except when in the opinion of the Architect such condition is due to neglect or carelessness of the Owner.
- D. The guarantee of the Contractor is independent of shorter time limits by any manufacturer of equipment he has furnished. Submit with Operation and Maintenance Manual all guarantees which exceed one year.
- E. Make all necessary adjustments during first year of operation.
- F. The presence of any inspector or observer during any construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.

PART 2 NOT USED

PART 3 EXECUTION

3.1 DOCUMENTATION

- A. Additional plan submittals to Local Fire Marshal: If additional drawing submittals are required at any time during construction contractor shall prepare and submit drawings, review with Fire Marshal, and pick up subsequent approved drawings.

3.2 INSPECTION

- A. Do not allow any work to be covered up or enclosed until inspected, tested and approved by the Architect and all authorities having jurisdiction over the work.
- B. Should any work be enclosed or covered up before such inspection and test, Contractor shall at his own expense uncover work, and after it has been inspected, tested and approved, make all repairs as necessary to restore all work disturbed by him to its original condition.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Verify devices are installed and connected to fire alarm system.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Pipe
 2. Valves
 3. Hangers and Support
 4. Expansion Fittings and Loops
 5. Seismic Controls
 6. Identification

1.2 EXPANSION AND SEISMIC DESIGN REQUIREMENTS

- A. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- B. Expansion Compensation Design Criteria:
1. Installation Temperature: 50 degrees F.
 2. Fire Protection System Temperature: 90 degrees F.
 3. Safety Factor: 30 percent.
- C. Seismic performance: Provide seismic restraint in compliance with local jurisdiction and IBC 1613 requirements.

1.3 QUALITY ASSURANCE

- A. Through penetration firestopping of fire rated assemblies: ASTM E814 with 0.10" w.g. minimum positive pressure differential. Minimum 1-hour protection.
- B. Installed products shall have surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
- C. Perform work in accordance with local jurisdiction's requirements and AWS D1.1 for welding hanger and support attachments to building structure.
- D. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.1 BURIED PIPING

- A. Note that piping from the combination meter to the RPBP must be in piping suitable for domestic water (i.e., stainless steel).
- B. Steel Pipe: ASTM A53 Grade B, ASTM A135, ASTM A795 Schedule 40 black.
1. Steel Fittings: ASME B16.9, wrought steel, butt welded; ASTM A234, wrought carbon steel and alloy steel; with half-lapped 10 mil polyethylene tape.
 2. Cast Iron Fittings: ASME B16.1 flanges and flanged fittings.
 3. Joints: AWS D1.1, welded.
 4. Protection: ASME C105 polyethylene jacket with heat shrink sleeves or double layer, half-lapped 10 mil polyethylene tape to 6" above grade.

- C. Copper Tubing: Type K annealed. ASTM B75, ASTM B88, ASTM B251.
 - 1. Fittings: Cast copper alloy ASME B16.18; wrought copper and bronze, ASME B16.22. Pressure type solder joint.
 - 2. Joints: Silver braze, AWS A5.8 Classification BCuP-3 or BCuP-4; Solder, ASTM B32 Grade 95TA.
 - 3. Protection: ASME C105 polyethylene jacket with heat shrink sleeves or double layer, half-lapped 10 mil polyethylene tape to 6" above grade.

2.2 ABOVE GROUND PIPING

- A. Note that piping from the combination meter to the RPBP must be in piping suitable for domestic water (i.e., stainless steel).
- B. Steel Pipe: ASTM A53 Grade B, ASTM A135, ASTM A795 Schedule 40 black; Schedule 10 UL listed light wall; ASTM A-795 Type E, Grade A Eddy-Flow or Dyna-Flow UL listed thin wall flow pipe.
 - 1. Steel Fittings: ASME 16.9, wrought steel, butt welded; ASME B16.25, butt weld; ASTM A234, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
 - 2. Cast Iron Fittings: ASME B16.1 flanges and flanged fittings; ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded.
 - 4. Ductile Iron Fittings: ASTM A536, Grade 65-45-12. In applicable sizes, fittings shall be short pattern, with flow equal to standard pattern fittings. Basis of Design: Victaulic FireLock.
 - 5. Mechanical Grooved Couplings: Ductile iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers. ASTM A449. Victaulic, Gruvlok or approved equal.
 - a. Rigid Type: Housings cast with offsetting, angle-pattern, bolt pads to provide system rigidity and support and hanging in accordance with NFPA-13, fully installed at visual pad-to-pad offset contact. (Couplings that require exact gapping at specific torque ratings are not permitted.). Basis of Design: Victaulic Style 009N and 107N.
 - b. Flexible Type: For use in locations where vibration attenuation and stress relief are required: Basis of Design: Victaulic Style 177 or Style 77.
 - 6. Installation-Ready™ fittings for Schedule 40/10 grooved end steel piping in fire protection applications sizes 1-¼ thru 2½ inches. Ductile iron housing conforming to ASTM A-536, Grade 65-45-12, with Installation-Ready™ ends, pre-lubricated Grade "E" EPDM Type 'A' gasket, and ASTM A449 electroplated steel bolts and nuts. UL listed for a working pressure of 300 psi and FM approved for working pressure 365 psi.
- C. Steel Pipe: ASTM A135 Grade A, UL threadable thin wall, black.
 - 1. Cast Iron Fittings: ASME B16.4, threaded fittings.
 - 2. Malleable Iron Fittings: ASME B16.3 threaded type.

2.3 VALVES

- A. Manufacturers: UL & FM approved by Nibco, Stockham, Milwaukee or approved equal.
- B. Gate Valves:
 - 1. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid bronze or cast iron wedge, flanged or grooved ends. Basis of Design: Victaulic Series 771.

2. Over 2 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged or grooved ends. Basis of Design: Victaulic Series 772, for use with Series 773 (wall) or 774 (upright) post.
- C. Ball Valves:
1. Up to and including 2 inches: Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded or sweat fitting ends.
 2. Supervised valves provided with weatherproof actuator housing, handwheel, and supervisory switches. Basis of Design: Victaulic Series 728.
- D. Butterfly Valves:
1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch where required.
 2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable pressure-responsive EPDM seat, stainless steel stem (offset from the disc centerline to provide complete 360-degree circumferential seating), wafer, lug, or grooved ends. With extended neck, weatherproof actuator housing with hand wheel and gear drive and integral indicating device where required. Basis of Design: Victaulic Series 705.
- E. Check Valves:
1. Up to 2 inches: Bronze body and swing disc, rubber seat, threaded ends.
 2. 2 to 4 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, grooved or flanged ends.
 3. 2 inches and over: Ductile iron body, stainless steel or bronze disc with resilient seal, or elastomer coated ductile iron disc with welded-in nickel seat. Stainless steel spring. Wafer, grooved or flanged ends. Basis of Design: Victaulic Series 717.
- F. Drain Valves:
1. Compression Stop: Bronze with hose thread nipple and cap.
 2. Ball Valve: Brass with cap and chain, 3/4 inch hose thread.
- 2.4 BACKFLOW ASSEMBLY
- A. Provide by civil.
- 2.5 PIPE HANGERS AND SUPPORTS
- A. Conform to NFPA 13.
 - B. Hangers for Pipe Sizes 1 to 6 inch: Carbon steel, adjustable swivel, band hanger. Tolco Fig 200 or equal.
 - C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - D. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
 - E. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
 - F. Vertical Support: Steel riser clamp.

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

2.6 FLEXIBLE PIPE CONNECTORS

- A. Manufacturers: Metraflex, Mason or approved equal.
- B. Steel Piping:
 - 1. UL Listed
 - 2. Inner Hose: Stainless Steel.
 - 3. Exterior Sleeve: Braided stainless steel.
 - 4. Joint: Flanged, threaded with union or welded, as specified for pipe joints.
 - 5. Maximum offset: 3/4 inch.

2.7 FLEXIBLE SPRINKLER HOSE CONNECTIONS

- A. Manufacturers: Vic-Flex, FlexHead or approved equal.
- B. The drop system shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel Male threaded nipple or Victaulic FireLock IGS Groove Style 108 coupling for connection to branch-line piping, and a zinc plated steel reducer with a female thread for connection to the sprinkler head.
- C. Performance:
 - 1. FM Approved for its intended use pursuant to FM 1637 Approval Standard for Flexible Sprinkler Hose with Threaded End Fittings.
 - 2. UL Listed for its intended use pursuant to UL 2443 Standard for Flexible Sprinkler Hose with Fittings for Fire Protection Service.
 - 3. Seismically qualified for use pursuant to ICC-ES AC-156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.
- D. Flexible Hose Assemblies and End Fittings:
 - 1. 100% Type 304 Stainless Steel.
 - 2. Straight Hose Assembly or Elbow Hose Assembly.
 - 3. 1/2 inch or 3/4 inch outlet.
 - 4. 175 psi / 300 psi maximum rated pressure.
 - 5. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1 inch true-bore internal corrugated hose diameter.
 - 6. Union joints shall be provided for ease of installation.
- E. Ceiling Bracket:
 - 1. Type G90 Galvanized Steel.
 - 2. The bracket shall allow installation before the ceiling tile is in place.
 - 3. Direct attachment type, having integrated snap-on clip ends positively attached to the ceiling using tamper-resistant screws.
 - 4. Flexible Hose Attachment: Removable hub type with set screw.

2.8 FIRESTOPPING-APPLIED

- A. Manufacturers: RectorSeal, Dow Corning, 3M Fire Protection or approved equal.
- B. General:
 - 1. Fire stopping materials shall conform to Flame (F) and Temperature (T) ratings as required by applicable building codes and tested by nationally accepted test agencies per ASTM E 814 or UL 1479 fire tests for through penetrations, and

2. ASTM E 1966 or UL 2079 for construction joints, and UL 2307 for perimeter edge joints.
 3. Fire stopping material shall be free of asbestos, PCBs, ethylene glycol, and lead.
 4. Do not use any product containing solvents or that requires hazardous waste disposal.
 5. Fire stopping shall be performed by a contractor trained or approved by firestop manufacturer.
 6. Select products with rating not less than rating of wall or floor being penetrated.
- C. Single Source Responsibility: Provide firestop systems for all conditions from a single supplier.
- D. Product Description: Provide Latex caulk/sealant, Silicone caulk/sealant, Intumescent Wrap Strip, Firestop Putty, Firestop Collar or Intumescent Sleeve to meet each specific application and performance requirement.
- E. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- F. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
1. Forming/Damming Materials: Mineral fiberboard, backer rod or other type recommended by Manufacturer's tested system.
- 2.9 FIRE STOPPING-CAST IN PLACE
- A. Manufacturers: Presealed Systems "Hydro Flame" or approved equal.
 - B. Product Description: Factory assembled for use in concrete floors, outer sleeve lined with intumescent strip, radial extended flange, waterstop gasket/mid-body seal.
 - C. General: UL listed system with 3 hour fire rating. Watertight, Class 1 with 3 feet head pressure for 72 hours.
 - D. Installation: Provide device based upon pipe type, size and concrete thickness. Align with penetration layout and nail in place. Secure cap prior to pouring concrete. Deburr and clean debris from pipe prior to installation. Coat pipe end with compatible lubricant as necessary.
- 2.10 MECHANICAL SLEEVE SEALS
- A. Manufacturers: Metraflex Metraseal, Thunderline Link-Seal or approved equal.
 - B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- 2.11 PIPING ACCESSORIES
- A. Manufacturers: Grinnell, EMCO Wheaton, OPW or approved equal.
 - B. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.

- C. Swivel Joints: Fabricated steel, bronze, ductile Iron or cast steel body, double ball bearing race, field lubricated, with rubber or Buna-N o-ring seals.

2.12 PIPE MARKERS

- A. Color and Lettering shall conform to ASME A13.1.
- B. Fire service piping labels shall be red background with white lettering. Legend shall indicate service of pipe.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 EXECUTION

3.1 PREPARATION - PIPING

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges, unions or grooved couplings.

3.2 INSTALLATION - PIPING

- A. Install piping in accordance with NFPA 13 for sprinkler systems.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, to not interfere with use of space and other work.
- D. Group piping whenever practical at common elevations.
- E. Install pipe sleeve at piping penetrations through footings, partitions, walls, and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with NFPA 13.
 - 2. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.
 7. Install copper plated hangers and supports for copper piping.
 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- H. Slope piping and arrange systems to drain at low points.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Do not penetrate building structural members unless indicated.
- K. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.
- L. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- M. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- N. Install gate, ball, or butterfly valves for shut-off or isolating service.
- O. Install drain valves at main shut-off valves, low points of piping and apparatus.
- 3.3 INSTALLATION – EXPANSION FITTINGS AND LOOPS
- A. Install Work in accordance with ASME B31.9.
 - B. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
 - C. Provide support and anchors for controlling expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
 - D. Provide grooved piping systems with minimum one joint per inch pipe diameter instead of flexible connector supported by vibration isolation. Grooved piping systems need not be anchored.
- 3.4 INSTALLATION – SEISMIC CONTROLS
- A. Provide seismic restraints and hangers in compliance with NFPA 13.
 - B. Seismic Bracing: Follow NFPA 13 and the following.
 1. Bracing shall be bidder designed to resist seismic loading.
 2. Provide seismic calculations as required for $I_p = 1.5$.
- 3.5 INSTALLATION – FIRESTOPPING AND SEALS AT PARTITIONS
- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items requiring firestopping.

- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings. Primers must comply with VOC limits per Green Seal standards GS-03 (1997), GS-11 (1993), or SCAQMD Rule #1113 (2004).
- C. Place intumescent coating in sufficient coats to achieve rating required.
- D. Clean adjacent surfaces of firestopping materials.
- E. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and/or roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- F. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and/or roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - 2. Install escutcheons where piping penetrates non-fire rated surfaces in occupied spaces.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations air tight. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.6 INSTALLATION - IDENTIFICATION

- A. Identification is not required on sprinkler branch lines and run-outs to heads.
- B. Identification is required on:
 - 1. Bulk mains
 - 2. Incoming fire service
 - 3. FDC piping
 - 4. Standpipe (not in stairwell)
- C. Identify service and flow direction (and pressure where more than one pressure is used). Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Install a minimum of one label for each story traversed by piping.
- D. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- E. Install labels with sufficient adhesive for permanent adhesion.

3.7 INTERFACE WITH OTHER PRODUCTS

- A. Inserts:
1. Install inserts for placement in concrete forms.
 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.8 MANUFACTURER'S FIELD SERVICES

- A. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes wet-pipe sprinkler system design, installation, and certification.

1.2 SYSTEM DESCRIPTION

- A. This section requires design and installation of wet pipe sprinkler systems for building fire protection. For areas subject to freezing, see Section 21 13 16 for design and installation of dry pipe sprinkler systems.
- B. Perform work in accordance with NFPA 13, state and local municipality having jurisdiction.
- C. Determine volume and pressure of incoming water supply from water flow test data. Revise design when test data become available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections. Note if location(s) are indicated on Drawings.
- F. Fire suppression system shall not contain ozone depleting substances such as halons, CFC's and HCFC's.

PART 2 PRODUCTS

2.1 SPRINKLERS

- A. Manufacturers: Tyco, Reliable, Viking or approved equal.
- B. Provide "quick response" heads in all residential occupancies.
- C. Provide "quick response" heads in all light hazard occupancies.
- D. Suspended T-bar Ceiling Type:
 - 1. Type: Semi-recessed pendant type with matching escutcheon plate.
 - 2. Sprinkler and escutcheon plate finish: White enamel factory finish.
 - 3. Fusible link: Glass bulb type temperature rated for specific area hazard.
- E. GWB Ceiling Type:
 - 1. Type: Semi-recessed pendant type with matching escutcheon plate.
 - 2. Sprinkler and escutcheon plate finish: White enamel factory finish.
 - 3. Fusible link: Glass bulb type temperature rated for specific area hazard.
- F. Exposed Area Type:
 - 1. Type: Standard upright type.
 - 2. Finish: Brass
 - 3. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- G. Side wall Type:
 - 1. Type: Standard horizontal side wall type.

2. Sprinkler and escutcheon plate finish: Brass, Chrome plated or White enamel factory finish as selected by architect.
3. Fusible Link: Glass bulb type temperature rated for specific area hazard.

H. Guards: Finish matching sprinkler finish.

2.2 PIPING SPECIALTIES

- A. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.
- B. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts.

2.3 FIRE DEPARTMENT CONNECTION

- A. Manufacturer: Potter-Roemer or approved equal.
- B. Post Type: Free standing type with ductile iron pedestal brass finish.
- C. Threaded Inlets: Two-way 2-1/2" connections with fire department threads. Threaded cast brass plug and chain of matching material and finish.
- D. Drain: 3/4 inch automatic drip, outside or connect to drain.
- E. Label: "Sprinkler - Fire Department Connection".

2.4 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Controls: Supervisory switches. Coordinate with fire alarm section of work.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13.
- B. Install pressure gauges on each side of sprinkler alarm valve.
- C. Install approved backflow assembly at sprinkler system water source connection.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.
- E. Locate outside alarm on building exterior wall.
- F. Place pipe runs to minimize obstruction to other work.
- G. It shall be a specific requirement that insofar as possible, all sprinkler system mains and branches shall be installed as close as possible to the structural members, not the ceiling.
- H. Install main piping in concealed spaces above finished ceilings or soffits; branch piping in joist space or other concealed space to sprinkler heads.
- I. Center sprinklers in two directions in ceiling tile and install piping offsets.

- J. Install guards on sprinklers exposed to potential damage.
- K. Provide drains at system low points.
- L. Hydrostatically test entire system.
- M. Testing must be witnessed by Authorities having jurisdiction.

3.2 CLEANING

- A. Flush entire piping system of foreign matter.

3.3 PROTECTION OF INSTALLED CONSTRUCTION

- A. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons not receiving field paint finish. Remove after painting. Replace painted sprinklers with new.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Conform to General Conditions, Supplementary Conditions, the modifications thereto and Division 01 - General Requirements for all work in Division 22.

1.2 SUMMARY

- A. Provide labor, materials and appliances necessary for satisfactory installation of mechanical work ready to operate in strict accordance with these specifications and drawings. Work of Division 22 includes, but is not limited to, that as delineated in the following specification sections:

22 00 00	Plumbing General Conditions
22 05 00	Common Work Results for Plumbing
22 07 00	Plumbing Insulation
22 08 00	Commissioning (<i>Welsh</i>)
22 11 00	Facility Water Distribution
22 13 00	Facility Sanitary Sewerage
22 14 00	Facility Storm Drainage
22 15 00	General Service Compressed Air Systems
22 23 00	Natural-Gas Systems
22 30 00	Plumbing Equipment
22 40 00	Plumbing Fixtures

- B. TEST AND BALANCE: Provided by 23 05 93. Provide all necessary coordination, assistance and documentation.

- C. Related Sections:
018100 Jobsite Indoor Air Quality Construction Plan
018113 Sustainable Design Requirements

1.3 CODES AND STANDARDS

- A. Conform to following code and agency requirements having jurisdictional authority over mechanical installations.
1. Uniform Plumbing Code (UPC) with local amendments.
 2. International Mechanical Code (IMC) with local amendments.
 3. International Building Code (IBC) with local amendments.
 4. International Fuel Gas Code (IFGC) with local amendments.
 5. National Electrical Code (NEC) NFPA 70.

6. Requirements of OSHA and EPA.
7. National Fire Protection Association (NFPA) Codes and Standards.
8. ASME code for construction of pressure vessels.
9. American Gas Association (AGA) Standards.
10. ASTM, ANSI and NEMA standards, as referenced in subsequent sections.
11. Local Sewer District Requirements.
12. Local Water District Requirements.
13. Local Health Department Requirements.
14. Washington State Energy Code.
15. LEED Requirements.

1.4 SUSTAINABLE DESIGN REQUIREMENTS:

- A. Comply with project requirements to achieve LEED Certification.
- B. Comply with Construction Waste Management plan. Refer to Division 01.
- C. LEED-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC, per referenced standards and no added urea-formaldehyde. Cleaning products used during construction and close-out procedures shall meet Green Seal standards GS-34, GS-37, and SG-40, or the California Code of Regulations, Title 17 Section 94509, VOC standards for cleaning products.
- D. Commissioning activities and submittals: Refer to Divisions 1, 22, and 23.
- E. Refer to Division 1 for more information on related LEED Credits.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to International Building Code with local amendments, FM and UL for fire resistance ratings and surface burning characteristics.
- B. Provide vibration isolation on motor driven equipment 0.5 hp or more, plus connected piping.
- C. Provide minimum static deflection of isolators for equipment as follows:
 1. 5 hp and less: 1 inch

1.6 PRODUCT SUBSTITUTIONS:

- A. Manufacturers and models of equipment and material indicated herein and on drawings are those upon which mechanical design is based. Other manufacturers with products considered equal in general quality may be listed without specific model designation. Manufacturers not listed must be submitted for approval.
- B. Substitutions will be evaluated based on product manufacturer only. Specific product model, specifications, options and accessories will be evaluated during submittals. Approval of a manufacturer substitution does not constitute approval of the submitted product.
- C. Any equipment other than the basis of design is considered a substitution.
- D. In selecting substitute equipment, the Contractor is responsible for and must guarantee equal performance and fit. Cost of redesign and all additional costs incurred to accommodate the substituted equipment shall be borne by the Contractor.

- E. Unless indicated otherwise, "or approved" may be assumed for all products in Division 22.

1.7 SUBMITTALS

- A. Provide one electronic copy of product data submittals for all products listed under "Part 2 Products" of Division 22 and all additional products noted on drawings or required for completion of sequence of operations.
- B. **Electronic: All sections of Division 22 shall be submitted together in one complete PDF file with bookmarks for each section. Multi-part submittals will be returned without review.**
 - 1. First Page: Name of Project, Owner, Location & Contracting Company.
 - 2. Index Page: List of specification sections with contents by Tag or item.
 - 3. Bookmarks: Electronic bookmark of each specification section corresponding to listing in index.
- C. Clearly indicate on each page the equipment schedule designation (Tag) and/or specification section, as applicable. Indicate selected model and all accessories intended for use.
- D. Equipment vendor cover page with contact information shall precede submittal by that vendor.
- E. Submitted product information shall include (as applicable) but not be limited to the following information:
 - 1. Product description
 - 2. Manufacturer and model
 - 3. Dimensions
 - 4. Performance Ratings (i.e. capacity, rpm, HP, temperature)
 - 5. Construction Materials
 - 6. Ratings (i.e. UL, ASTM, NEMA, etc)
 - 7. Electrical data
 - 8. Sound level data (corresponding to scheduled values)
 - 9. Vibration Isolation
 - 10. Controls and wiring diagrams
 - 11. Accessories
 - 12. Engineering technical data (i.e. pressure drops, leakage rates, pump curves)
- F. LEED Specific Submittals:
 - 1. LEED Submittals: Submit the LEED VOC Form, for any VOC-containing material to be used inside the building envelope, including materials for patching, touch-up and cleaning.
 - 2. Construction Waste Management: Retain and submit all trip and tip tickets for all construction debris and waste removed from site, indicating material content, tonnage, date hauled and facility to where materials were hauled. This submittal is to the general contractor only.
- G. If requested by Architect or Engineer, submit Manufacturer's Installation Instructions on any equipment, procedures, or certifications so requested.
- H. Do no ordering, fabrication or manufacturing of products until return of approved submittals.

1.8 SHOP DRAWINGS

- A. The Contractor shall also submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by the Engineer for purposes of clarification of the Contractor's intent. Also submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under the section shall include (but not be limited to) the following, where applicable to this project:
 - 1. Electrical interlock wiring diagrams.
 - 2. Piping layout plans and interference details.
 - 3. Custom sink layout.
- B. By submission of plumbing shop drawings, the Contractor acknowledges that coordination has been done to ensure that all piping fits and no conflicts exist.
- C. The Architect's review of shop drawings shall not relieve the Contractor of responsibility for deviations from the Contract drawings or specifications, unless he has, in writing, called the attention of the Architect to such deviations at the time of the submission, nor shall it relieve him from responsibility for errors or omission in such shop drawings.

1.9 COMMISSIONING

- A. See Division 01 and Section 22 08 00 for roles and responsibilities of commissioning.
- B. Provide all necessary commissioning assistance, equipment and documentation as required by the Commissioning Plan.
- C. The duty and responsibility for all Division 22 commissioning work shall be assigned to a specific individual. Inform the General Contractor, Commissioning Professional (CCXP) of the contact information for the person so assigned.
- D. Perform corrective actions needed to resolve deficiencies identified during commissioning. Record action taken on commissioning deficiency log.

1.10 PLUMBING PERMIT

- A. Plumbing contractor shall prepare all documents for plumbing permit application, submit for and obtain the permit. All costs and fees to obtain the permit shall be paid by the Plumbing Contractor.
- B. Contractor shall not commence work until permit is obtained. Contractor is solely responsible to insure that the permit application and any revisions are submitted in a timely manner so as not to impact project schedule.

1.11 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 – Building Services Piping for installation of piping systems and ASME Section IX – Welding and Brazing Qualifications for welding materials and procedures.
- B. Perform Work in accordance with the Uniform Plumbing Code including State and local amendments.
- C. Provide products requiring electrical connections listed and classified by UL as suitable for purpose specified and indicated.

- D. Perform Work in accordance with Washington State Energy Code.

1.12 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.13 SEQUENCING

- A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect all equipment, materials, and insulation from weather, construction traffic, dirt, water, chemicals, and damage by storing in original packaging and under cover. Where original packaging is insufficient, provide additional protection. Maintain protection in place until installation.
- C. Inspect all products and materials for damage prior to installation.
- D. Protect piping from all entry of foreign materials by providing temporary end caps or closures on piping and fittings. Furnish temporary protective coating on cast iron and steel valves.
- E. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.
- F. Protect materials and finishes during handling and installation to prevent damage.
- G. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- H. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.15 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply fire stopping materials when temperature of substrate material and ambient air is below 60 degrees F. Maintain this minimum temperature before, during, and for minimum 3 days after installation of fire stopping materials.
- B. Provide ventilation in areas to receive solvent cured materials.
- C. Do not install underground piping or valves when bedding is wet or frozen.
- D. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer. Maintain temperature during and after installation for minimum period of 24 hours.

- E. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.
- F. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

1.16 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
- B. Verify by field measurements, sizes and configurations are compatible with wall construction and layout.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.

1.17 COORDINATION

- A. Visit the site and become familiar with existing conditions affecting work.
- B. Verify locations of any overhead or buried utilities on or near site. Determine such locations in conjunction with all public and private utility companies and with all authorities having jurisdiction.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.
- D. Plumbing drawings are diagrammatic and do not indicate all possible site conditions. The contractor shall verify all measurements, dimensions and connections on site and coordinate between trades to preclude interferences. The contractor shall provide adjustments to piping as necessary to fit conditions including but is not limited to relocation, offsets, and transitions.
- E. In the event of a conflict with other trades of work, the following priority from highest to lowest shall be followed: Structural, lighting, HVAC, plumbing/piping and sprinklers. Starting with the lowest priority, the HVAC, plumbing, and sprinkler contractors shall provide whatever materials, offsets, labor etc. is required to resolve the conflict.
- F. When discrepancies occur between plans and specifications, the Architect will determine which takes precedence and the Contractor shall perform the selected requirement at no additional cost.
- G. Prior to ordering equipment cross-check plumbing and electrical drawings and specifications to assure proper location and electrical characteristics of connections serving mechanical and electrical equipment.
- H. Advise the Architect of any modifications required to suit equipment furnished. Costs for modifications due to equipment substitution will be borne by the contractor.
- I. Wherever conflicts occur between different parts of the Contract Documents the greater quantity, the better quality, or larger size shall prevail unless the Architect informs the Contractor otherwise in writing.

- J. The scale of each drawing is relatively accurate, but the Contractor is warned to obtain the necessary dimensions for any exact takeoffs from the Architect. No additional cost to the Owner will be considered for failure to obtain exact dimensions where not clear or in error on the drawings. Any device or fixture roughed in improperly and not positioned on implied centerlines or as required by good practice must be repositioned at no cost to the Owner.
- K. Where the word 'verify' is used on the documents, the contractor shall field verify the existing conditions and modify the scope of the installation as required to meet the verified conditions without additional cost to the Owner.
- L. Coordinate trenching, excavating, bedding, backfilling of buried systems with requirements of this specification.
- M. Coordinate wall openings, piping rough-in locations, concrete housekeeping pads, and electrical rough-in locations to accommodate Work of this Section.

1.18 CUTTING, FITTING, REPAIRING AND PATCHING

- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where necessary for installation of plumbing work. Perform work only with craftsmen skilled in their respective trades.
- B. Avoid cutting, where possible, by setting sleeves, frames, etc., and by coordinating for openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for piping.
- C. Cut all holes neatly and as small as possible to admit work. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.

1.19 SALVAGE

- A. Remove excess piping and plug or cap any unused branch connections. Remove scrap pipe and all other excess materials from the site.
- B. Comply with contractor's Construction Waste Management Plan. Retain and submit all trip and tip tickets for all construction debris and waste hauling, indicating material content, tonnage, date hauled and facility to where materials were hauled.

1.20 ELECTRICAL

- A. Motors:
 - 1. Temperature Rating: Rated for 40 degree C environment with maximum 50 degree C temperature rise for continuous duty at full load.
 - 2. Starting Capability: Not less than 12 starts per hour.
 - 3. Phase Characteristics: Squirrel-cage induction poly-phase motors for 3/4 HP and larger, and capacitor-start single-phase motors for 1/2 HP and smaller. At equipment manufacturer's option, 1/6 HP and smaller may be split-phase type.
 - 4. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
 - 5. Enclosure Type: Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and guarded drip-proof motors where exposed to contact by employees or building occupants. Weather-protected Type I for outdoor use, Type II, where not housed.
 - 6. Overload Protection: Built-in thermal overload protection.

7. Name Plate: Indicate full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
 8. All motor efficiencies shall conform to Washington State Energy Code and NEMA MG-1.
- B. Motor Starters: By plumbing equipment manufacturer where factory mounted controls are provided. Variable frequency drives by Division 22, all other starters provided by Electrical Contractor.
- C. Power Wiring: By Electrical Contractor.
- D. Control Wiring: Responsibility of Division 22, including all line and low voltage control wiring. Owner will not entertain additional cost due to lack of coordination between Plumbing Contractor and Electrical Contractor.

1.21 PROJECT CLOSEOUT

- A. Completion, submission and approval of the following is required for final project closeout.
1. Execution of Architect's and Engineer's final observation reports (punchlist)
 2. Operating and Maintenance Instructions
 3. Operating and Maintenance Manual
 4. Equipment and Pipe Cleaning
 5. Record Drawings
 6. Testing
 7. Commissioning
 8. Warranty
- B. See Division 01 for additional requirements.

1.22 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. General: In addition to requirements of Division 01, following initial operation of plumbing systems and prior to acceptance by the Architect, perform the following services.
- B. At least two weeks prior to each instruction period, give written notification of readiness to proceed to the Architect and Owner, and obtain mutually acceptable dates.
- C. Conduct demonstrations and instructions for the Owner's representatives, pointing out requirements for operating, servicing and maintaining equipment and systems. Describe general system operation and specific equipment functions. Cover all equipment calibration, setpoint adjustment, safeties and alarms.
- D. Furnish qualifications of Contractor's personnel in charge of the instruction; foreman position is minimum acceptable. Where equipment startup is performed by supplier's or manufacturer's personnel, those personnel should also provide training on that equipment.
- E. During demonstrations and instructions include and reference information from maintenance manuals and contract drawings.
1. Provide documentation of all instruction which includes:
 - a. Date and time of instruction
 - b. Name, affiliation and qualifications of the instructor
 - c. Name and affiliation of the attendees
 - d. Topics, systems, and equipment covered
 - e. Length of instruction

- F. Minimum duration of instruction periods:
1. Plumbing Systems 4 hours

1.23 OPERATING AND MAINTENANCE MANUALS

- A. Contents: Furnish, in accord with Division 1, one PDF and one bound copy of operating and maintenance manuals to include the following:
1. Manufacturers, suppliers, contractor names, addresses and phone numbers.
 2. Warranty service contractors' names, address and phone numbers (if different from above).
 3. Schedule and description of routine maintenance for each component to include oiling, lubrication and greasing data.
 4. Test data log.
 5. Manufacturer's cuts and rating tables, including brochures for all submittal items.
 6. Part numbers of all replaceable items.
 7. Control diagrams and operation sequence.
 8. Written guarantees.
 9. Record drawings corrected and completed.
 10. Completed equipment start-up forms and checklists.
- B. Operation and Maintenance Data:
1. Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.
 2. Submit fixture, trim, exploded view and replacement parts lists.
 3. Submit replacement part numbers and availability, and nearest service depot location and telephone number.
- C. Binders:
1. Furnish typewritten or printed index and tabbed dividers between principal categories.
 2. Bind each manual in a hard-backed loose-leaf binder.
- D. Imprint on cover:
1. Name of project.
 2. Owner.
 3. Location of project.
 4. Architect.
 5. Contractor.
 6. Year of completion.
- E. Imprint on backing:
1. Name of project.
 2. Year of completion.
- F. Submittals:
1. Preliminary Copies: Prior to scheduled completion of the project, submit one PDF copy for review by the Architect.
 2. Final Copies: After approval of the preliminary copy, submit one PDF and one bound copy to the Owner.

1.24 EQUIPMENT AND PIPE CLEANING

- A. Clean interior and exterior of all equipment. Equipment shall be free of dirt, construction debris, corrosion, etc.

- B. Adequate provisions shall be made during construction to eliminate dirt, debris or other material from entering and collecting inside of pipe and equipment. Any collection of material shall be thoroughly cleaned before equipment startup and if necessary again before owner occupancy.
- C. Clean exterior of all exposed pipe and equipment.
- D. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

1.25 RECORD DRAWINGS

- A. Submit one digital file with all drawings in PDF format.
- B. Show location of equipment, location and size of piping. Locate all valves and similar equipment with tag or label identification. Indicate locations and elevations of exterior pipe and utility connections. Maintain continuously updated drawings during progress of project.
- C. Record actual locations of equipment, clean-outs, controlling devices, and all above grade, under-floor, and buried piping.

1.26 TESTING

- A. Provide completed start-up forms and checklists.
- B. Coordinate Test and Balance with Division 23 05 93. Provide all necessary assistance and documentation.

1.27 WARRANTIES AND CONTRACTOR'S GUARANTEE

- A. All work, material and equipment shall be free of defect, complete and in perfect operating order at time of delivery to Owner.
- B. Furnish one year warranty from date of substantial completion for all systems unless specifically noted otherwise.
- C. Without cost to Owner, **correct all defects and failures discovered within one year from date of final acceptance**, except when in the opinion of the Architect a failure is due to neglect or carelessness of the Owner.
- D. The guarantee of the Contractor is independent of shorter time limits by any manufacturer of equipment furnished. Submit with Operation and Maintenance Manual all guarantees that exceed one year (e.g.: water heaters).
- E. Make all necessary balancing and control adjustments during first year of operation.
- F. The presence of any inspector or observer during any construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.

PART 2 NOT USED

PART 3 EXECUTION

3.1 DOCUMENTATION

- A. Additional plan submittals to reviewing authority: If additional drawing submittals are required at any time during construction contractor shall submit drawings, review with authority, and pick up subsequent approved drawings. Engineer will revise and/or prepare drawings for submittal.

3.2 INSPECTION

- A. Do not allow any work to be covered up or enclosed until inspected, tested and approved by the Architect and all authorities having jurisdiction over the work.
- B. Should any work be enclosed or covered up before such inspection and test, Contractor shall at his own expense uncover work, and after it has been inspected, tested and approved, make all repairs as necessary to restore all work disturbed by him to its original condition.

3.3 FIELD QUALITY CONTROL

- A. Inspect installed fire stopping for compliance with specifications and submitted schedule.
- B. Inspect isolated equipment after installation for proper movement clearance.
- C. Test domestic water piping system in accordance with applicable code and local authority having jurisdiction.
- D. Test sanitary waste and vent piping system in accordance with applicable code and local authority having jurisdiction.
- E. Test storm drainage piping system in accordance with applicable code and local authority having jurisdiction.

3.4 CLEANING

- A. Clean adjacent surfaces of fire stopping materials.
- B. Clean plumbing fixtures and equipment.
- C. Use acceptable cleaning products per IAQ Management Plan.
- D. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

3.5 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.
- B. Do not permit use of plumbing fixtures before final acceptance.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General Plumbing Valves.
 - 2. Hangers and Supports.
 - 3. Expansion Fittings and Loops.
 - 4. Vibration and Seismic Controls.
 - 5. Firestopping.
 - 6. Access Panels
 - 7. Tags and Identification.
 - 8. Execution

1.2 GENERAL REQUIREMENTS

- A. Comply with requirements and recommendations of Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58 and SP-69.
- B. Comply with Federal "Reduction of Lead in Drinking Water Act" – 2011. Pipes, pipe fittings, plumbing fittings and fixtures shall be "Lead Free" meaning not more than a weighted average of 0.25% lead in wetted surfaces.

1.3 SCOPE

- A. This section includes products, assemblies and methods applicable to more than one of the systems specified in the following sections of Division 22.

1.4 MATERIALS AND EQUIPMENT

- A. Where two or more units of same class of equipment are required, use products of a single manufacturer. All equipment shall be new and free from damage.
- B. Provide major equipment components with manufacturer's name, address, catalog number and capacity indicated on a nameplate, securely affixed in a conspicuous place.
- C. Furnish standard and fabricated hangers and supports complete with necessary inserts, bolts, nuts, rods, washers and other accessories.

1.5 QUALITY ASSURANCE

- A. Installed products shall have surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
- B. Perform work in accordance with local jurisdiction's requirements and AWS D1.1 for welding hanger and support attachments to building structure.
- C. LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.
- D. Plastic welding and solvents must comply with VOC limits per SCAQMD Rule #1168, IEQ Credit 4.2. VOC limits are no more than 510 g/L for PVC; 490 g/L for CPVC; and 325g/L for ABS.

PART 2 PRODUCTS

2.1 GENERAL VALVE REQUIREMENTS

- A. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted. Brass valves are not permitted.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.

2.2 GATE VALVES

- A. Manufacturers: NIBCO or equal by Apollo, Hammond, Milwaukee, Stockham or approved equal.
- B. 4 inches and Smaller: Use ball valve or butterfly valve in lieu of gate valve.

2.3 BALL VALVES

- A. Manufacturers: NIBCO or equal by Apollo, Hammond, Milwaukee, Stockham or approved equal.
- B. 2 inches and Smaller: Lead-Free, NSF-61-8, UPC-IGC-157, MSS SP 110, 600 psi WOG, two piece silicon performance bronze body, bronze trim, bronze ball, full port, PTFE seats, blow-out proof stem, solder or threaded ends with union, lever handle. For insulated piping provide 2" extended handles of non-thermal conductive material. Nibco Model T/S-585-80-LF.

2.4 BALL VALVES – STAINLESS STEEL

- A. Manufacturers: Victaulic (for specific use with Vic-press stainless steel piping system) or approved equal.
- B. Stainless steel body, ball, and stem, PTFE seats, 304 stainless steel handle, nut, and stem washer, with Schedule 10S stainless steel type 316 Vic-Press™ and/or grooved ends. Victaulic Series P569.

2.5 CHECK VALVES

- A. Swing Check Valves:
 - 1. Manufacturers: NIBCO or equal by Apollo, Hammond, Milwaukee, Stockham or approved equal.
 - 2. 2 inches and Smaller: Lead-Free, NSF-61-8, MSS SP 80, 200 psi CWP, silicone performance bronze body and cap, bronze disc with PTFE seat, Y-pattern design, solder or threaded ends. Nibco Model T/S-413-Y-LF.
 - 3. 2-1/2 inches and Larger: Lead-Free, NSF-61-8, MSS SP 71, Class 125, 200 psi CWP, cast iron body, bronze trim, bronze disc and seat, flanged ends. Nibco Model F-910-LF.
- B. Spring Loaded Check Valves:
 - 1. Manufacturers: NIBCO or equal by Apollo, Hammond, Milwaukee, Stockham, Titan or approved equal.

2. 2 inches and Smaller: Lead-Free, NSF-61-8, MSS SP 80, 250 psi CWP, silicone performance bronze body, in-line spring lift check, silent closing, PTFE disc, integral seat, solder or threaded ends. Nibco Model T/S-480-Y-LF.
3. 2-1/2 inches and Larger: Lead-Free, NSF-61-8, MSS SP 71, Class 125, 200 psi CWP, wafer style, cast iron body, Buna-N bonded to bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends. Nibco Model F-910-LF.

2.6 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports with incompressible insulation inserts and shields for all piping to be insulated per 220700.
 1. Manufacturer: Pipe Shields, INC or approved equal.
 2. Material: Calcium Silicate or Urethane per temperature application.
 3. Thickness: Insert thickness shall match required insulation thickness per 220700.
- B. Plumbing Piping - DWV: Cast-iron or PVC
 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 4. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 5. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 6. Vertical Support: Steel riser clamp.
 7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 8. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
- C. Plumbing Piping - Water: Copper
 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring, with rigid insulation inserts.
 2. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis, with rigid insulation inserts and saddle.
 3. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis, with rigid insulation inserts and saddle.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 6. Vertical Support: Steel riser clamp.
 7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 8. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Copper-plated, Carbon-steel ring.
- D. Steel Piping: Natural Gas
 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 2. Hangers for Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 3. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 4. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
 5. Vertical Support: Steel riser clamp.

6. Floor Support for Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- E. Secondary Pipe Positioning and Supports:
1. Makeshift, field devised methods of plumbing pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96. Hubbard "HOLDRITE" support systems or approved equal.
 2. For vertical mid-span supports of piping 4" and under, use HOLDRITE Stout Brackets™ with HOLDRITE Stout Clamps or two-hole pipe clamps (MSS Type 26).
 3. For plenum applications use pipe supports that meet ASTM E-84 25/50 standards, such as the HOLDRITE Flame Fighter™ or approved equal.
- 2.7 HANGER ACCESSORIES
- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
- 2.8 INSERTS
- A. Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- 2.9 ACCESS PANELS
- A. Milcor or approved equal.
- B. Include an allowance for a minimum of 16 access panels.
- C. Architectural grade, 16 guage frame and door, painted steel or stainless steel based on application.
- 2.10 UNIONS AND FLANGES
- A. Unions for Pipe 2 inches and Smaller:
1. Ferrous Piping: Class 150, 300 psi CWP, malleable iron, threaded.
 2. Copper Piping: Class 150, 300 psi CWP, bronze unions.
 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 4. PVC Piping: PVC.
 5. CPVC Piping: CPVC.
- B. Flanges for Pipe 2-1/2 inches and Larger:
1. Ferrous Piping: Class 150, 300 psi CWP, forged steel, slip-on flanges.
 2. Copper Piping: Class 150, 300 psi CWP, slip-on bronze flanges.
 3. PVC Piping: PVC flanges.
 4. CPVC Piping: CPVC flanges.
 5. Gaskets: 1/16 inch thick preformed neoprene gaskets.
- C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or Schedule 80 threaded PVC pipe (ASTM D2464).

2.11 FLEXIBLE PIPE CONNECTORS

- A. Manufacturers: Metraflex, Mason or approved equal.
- B. Braided Stainless Steel (Pump Connection)
 - 1. 304 Stainless Steel flexible hose, close pitch, annular corrugated.
 - 2. 304 Stainless Steel double braided outer covering.
 - 3. ANSI Class 150 carbon steel flanges or carbon steel male pipe thread.
 - 4. UL listed, ANSI/NSF-61
- C. Victaulic Style flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three (3) couplings, for each connector, shall be placed in close proximity to the source of vibration.

2.12 EXPANSION JOINTS

- A. Manufacturers: Metraflex, Mason or approved equal.
- B. Flexible Expansion Loop (seismic joints): Copper Pipe
 - 1. Bronze hose & double bronze braid, copper fittings.
 - 2. Two flexible sections of hose and braid, two 90° elbows and a 180° return, assembled.
 - 3. Support nut and drain plug at bottom of 180° return.
 - 4. Provide nesting for multiple pipe runs.
 - 5. UL listed, ANSI/NSF-61
- C. Flexible Expansion Loop (seismic joints): Steel Pipe
 - 1. Stainless steel hose & double stainless steel braid, carbon steel fittings.
 - 2. Two flexible sections of hose and braid, two 90° elbows and a 180° return, assembled.
 - 3. Support nut and drain plug at bottom of 180° return.
 - 4. Provide nesting for multiple pipe runs.
 - 5. For natural gas service provide AGA certification.

2.13 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Metal Counterflashing: 22 gage galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.14 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage galvanized steel.
- C. Sealant: Acrylic

- D. Size large enough to allow for movement due to expansion and to provide for continuous insulation or installation of fire sealant at fire-rated walls. Note that insulation is discontinuous at fire walls.

2.15 MECHANICAL SLEEVE SEALS

- A. Manufacturers: Metraflex Metraseal, Thunderline Link-Seal or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.16 MECHANICAL FIRESTOPPING SLEEVE SEALS

- A. Manufacturers: Metraflex Metraseal 120 or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking intumescent synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation. UL listed for 2 hour fire protection.

2.17 FORMED STEEL CHANNEL

- A. Manufacturers: Allied Tube & Conduit, B-Line Systems, Unistrut or approved equal.
- B. Product Description: Galvanized 12 gage steel with holes 1-1/2 inches on center.

2.18 SUPPORT ACCESSORIES

- A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.
- B. Swivel Joints: Bronze body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

2.19 FIRESTOPPING-APPLIED

- A. Manufacturers: RectorSeal, Dow Corning, 3M Fire Protection or approved equal.
- B. General:
 - 1. Fire stopping materials shall conform to Flame (F) and Temperature (T) ratings as required by applicable building codes and tested by nationally accepted test agencies per ASTM E 814 or UL 1479 fire tests for through penetrations, and ASTM E 1966 or UL 2079 for construction joints, and UL 2307 for perimeter edge joints.
 - 2. Fire stopping material shall be free of asbestos, PCBs, ethylene glycol, and lead.
 - 3. Do not use any product containing solvents or that requires hazardous waste disposal.
 - 4. Fire stopping shall be performed by a contractor trained or approved by firestop manufacturer.
 - 5. Select products with rating not less than rating of wall or floor being penetrated.

- C. Single Source Responsibility: Provide firestop systems for all conditions from a single supplier.
- D. Product Description: Provide Latex caulk/sealant, Silicone caulk/sealant, Intumescent Wrap Strip, Firestop Putty, Firestop Collar or Intumescent Sleeve to meet each specific application and performance requirement.
- E. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- F. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
 - 1. Forming/Damming Materials: Mineral fiberboard, backer rod or other type recommended by Manufacturer's tested system.

2.20 FIRE STOPPING-CAST IN PLACE

- A. Manufacturers: Presealed Systems "Hydro Flame" or approved equal.
- B. Product Description: Factory assembled for use in concrete floors, outer sleeve lined with intumescent strip, radial extended flange, waterstop gasket/mid-body seal.
- C. General: UL listed system with 3 hour fire rating. Watertight, Class 1 with 3 feet head pressure for 72 hours.
- D. Installation: Provide device based upon pipe type, size and concrete thickness. Align with penetration layout and nail in place. Secure cap prior to pouring concrete. Deburr and clean debris from pipe prior to installation. Coat pipe end with compatible lubricant as necessary.

2.21 VIBRATION ISOLATORS

- A. Manufacturers: Mason, Amber Booth or approved equal.
- B. Neoprene Pad Isolators:
 - 1. Rubber or neoprene-waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs: not to exceed 0.7 times width.
 - 2. Configuration: Single layer.
- C. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

2.22 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches high.
- B. Metal Tags: Brass, Aluminum or Stainless Steel with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges. Plain English designations.
- C. Information Tags: Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.

- D. Tag Chart: Plain English designations so no chart or index is required.

2.23 PIPE MARKERS

- A. Color and Lettering shall conform to ASME A13.1 and UPC. Specific examples are noted in the table below.

Service	Background Color	Letter Color	Legend
Domestic Cold Water	Green	White	DOMESTIC COLD WATER
Domestic Hot Water	Green	White	DOMESTIC HOT WATER
Domestic Recirculation	Green	White	DHW RECIRC
Tempered Domestic Water	Green	White	TEMPERED WATER
Waste	Black	White	SANITARY SEWER
Vent	Black	White	SANITARY VENT
Condensate Drain	Black	White	CONDENSATE
Storm Drainage	Black	White	STORM
Compressed Air	Blue	White	COMPRESSED AIR {xxx} PSI
Natural Gas	Yellow	Black	NATURAL GAS

- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, imprinted with service type in large letters, manufactured for direct burial service.
- E. Underground Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with service type in large letters.

2.24 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color-coded head.
- B. Color code plumbing valves green.

2.25 LOCKOUT DEVICES

- A. Lockout Hasps: Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices: Nylon device preventing access to valve operator, accepting lock shackle.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Provide access to existing piping and equipment and other installations remaining active and requiring access.
- B. Extend existing piping installations using materials and methods compatible with existing installations.

3.2 SURFACE PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond of adhesives or firestopping.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- E. Degrease and clean surfaces to receive adhesive for identification materials.

3.3 INSTALLATION-CLEARANCE

- A. Appliances and equipment shall be accessible for inspection, service, repair and replacement.
- B. A minimum of 36" of clearance shall be provided in front of the control side of appliances and equipment. Provide additional space when required by NEC.

3.4 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.5 INSTALLATION – ACCESS PANELS

- A. Furnish access panels for installation at all concealed equipment which requires service, maintenance or adjustment to include but not limited to equipment, valves, open drains, control valves and controls.
- B. Provide location layout and required size for all access panels to general contractor. Layout shall be regular and consistent, maintain a uniform wall panel height of 24" centerline above finished floor, unless noted otherwise.

- C. Provide fire rated access panels where installed in fire rated assembly.
- D. Provide stainless steel access panels where installed in tile surfaces.
- E. Furnish access panels to general contractor for installation.
- F. Paint installed access panels to match wall or ceiling. Verify that panels are not painted shut.

3.6 INSTALLATION - VALVES

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4 inch ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access panels where valves and fittings are not accessible.
- F. Insulate valves according to application in Section 22 07 00.
- G. For installation of valves in domestic water systems refer to Section 22 11 00.

3.7 VALVE APPLICATIONS

- A. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- B. Install globe valves for throttling, bypass, or manual flow control services.
- C. Install spring loaded check valves on discharge of pumps.

3.8 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- F. Where piping is parallel and at same elevation, provide multiple pipe or trapeze hangers.
- G. Adjust hangers and supports as required to bring system to proper line and grade. Piping shall be plumb with floor and parallel/perpendicular to building structure.
- H. Support riser piping independently of connected horizontal piping.

- I. Provide copper plated hangers and supports for copper piping, or sheet lead packing between pipe and hanger.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Insulated piping shall have insulation run continuous through hangers and supports with use of rigid inserts. Insulation shall be glued to both sides of insert at hangers and supports, no insulation gaps are allowed. Refer to Section 22 07 00.
- M. Support of pipe, tubing and equipment shall be accomplished by means of engineered products, specific to each application. Makeshift, field devised methods shall not be allowed.
- N. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.

3.9 INSTALLATION – SEISMIC CONTROLS

- A. Provide seismic restraints and hangers in compliance with IBC 1613 and ASCE 7.
- B. Seismic Bracing: Follow IBC 1613, ASCE 7, SMACNA Seismic Restraint Manual and the following.
 - 1. Bracing shall be bidder designed to resist seismic loading in accord with Chapter 16 of the International Building Code, ASCE 7 or the SMACNA guideline.
 - 2. Provide seismic calculations as required for $I_p = 1.5$.

3.10 INSTALLATION-PIPING PROTECTION

- A. Provide protective shield plates in concealed locations where piping, other than cast-iron or steel, is installed in studs, joists or rafters. Plates shall be 16 gage steel and cover the pipe area plus 2". Shields may be omitted if piping is more than 1-1/2" from nearest edge of structural member.
- B. Prevent contact between dissimilar metals, such as copper tubing and steel, by use of copper-plated, plastic coated, or flexible materials. All supports which contact copper tubing shall be copper plated.

3.11 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members, formed steel channel or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.
- E. When water heaters and similar equipment are installed in a suspended application, an engineered and manufactured platform, such as the Hubbard Enterprises/HOLDRITE

Suspended Water Heater Platform shall be used. Weight loading capability shall include a minimum safety factor of 2.

3.12 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around pipes penetrating equipment rooms for sound control.
- C. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- D. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- E. Seal drains watertight to adjacent materials.
- F. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.13 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with insulation and caulk or fireproof airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

3.14 INSTALLATION – FIRESTOPPING AND SEALS AT PARTITIONS

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating and to uniform density and texture. Remove dam material after firestopping material has cured.
- D. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- E. Place intumescent coating in sufficient coats to achieve rating required.

- F. Clean adjacent surfaces of firestopping materials.
- G. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and/or roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- H. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition, floor, ceiling, and/or roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - 2. Install escutcheons where piping penetrates non-fire rated surfaces in occupied spaces.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations air tight. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.15 INSTALLATION – VIBRATION ISOLATION

- A. Install isolation for motor driven equipment.
- B. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other ends. Install in horizontal plane unless indicated otherwise.
- D. Provide grooved piping systems with minimum of three flexible couplings instead of flexible connector supported by vibration isolation.
- E. Bases:
 - 1. Set steel bases for 1 inch clearance between housekeeping pad and base.
- F. Adjust equipment level.
- G. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- H. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector or as follows:
 - 1. Up to 4 inch Diameter: First three points of support.

2. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.16 INSTALLATION – EXPANSION FITTINGS AND LOOPS

- A. Provide support and anchors for controlling contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.
- B. Install Work in accordance with ASME B31.9.
- C. Rigidly anchor pipe to building structure. Provide pipe guides to direct movement only along axis of pipe. Erect piping so strain and weight is not on cast connections or apparatus.
- D. Provide expansion loops as indicated in Drawings.

3.17 INSTALLATION - IDENTIFICATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Identify nonpotable water outlets with plastic permanent mounted sign in uppercase lettering which reads, "CAUTION: NONPOTABLE WATER, DO NOT DRINK." Signage shall be black lettering on yellow background.
- E. Nameplates: Identify plumbing equipment (water heaters, pumps, heat transfer equipment, tanks, and water treatment devices) with plastic nameplates.
 1. Identify in-line pumps and other small devices with name tags.
 2. Identify control panels and major control components outside panels with plastic nameplates.
 3. Identity description should be as numbered on drawings or plain English description. i.e. "WH-1" or "Rain Water Storage Tank".
 4. Label automatic controls, instruments, and relays. Key to control schematic.
 5. Label wall controls and switches with associated equipment designation and control function, i.e. "DCP, Timer".
- F. Valve Tags: Identify valves in main and branch piping with tags.
 1. Do not provide numbered tags.
 2. Provide tags with plain English description of service and function. i.e. "Domestic Hot Water, Kitchen"
- G. Pipe Labels: Identify piping, concealed or exposed, with plastic tape pipe markers.
 1. Identify service, flow direction, and pressure.
 2. Install in clear view and align with axis of piping.
 3. Locate identification on straight runs including risers and drops with spacing not to exceed 20 feet.
 4. Locate adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Provide ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

I. Equipment and Valve Tag Index: Plain English designations so no chart or index is required.

3.18 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by firestopping material installation.

3.19 SCHEDULES

A. Pipe Hanger Spacing

PIPE MATERIAL	MAXIMUM HANGER SPACING (Feet)	HANGER ROD DIAMETER (Inches)
ABS (All sizes)	4	3/8
Aluminum (All sizes)	10	1/2
Cast Iron (All Sizes)	5	3/8
Cast Iron (All Sizes) with 10 foot length of pipe	10	3/8
CPVC, 1 inch and smaller	3	1/2
CPVC, 1-1/4 inches and larger	4	1/2
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
PVC (All Sizes)	4	3/8
Steel, 3 inches and smaller	6	1/2
Steel, 4 inches and larger	12	3/8

B. Pipe Isolation Schedule:

Pipe Size Inch	Isolated Distance from Equipment
1	120 diameters
2	90 diameters
3	80 diameters
4	75 diameters

C. Equipment isolation schedule:

ISOLATED EQUIPMENT	BASE		ISOLATOR	
	TYPE	THICKNESS	TYPE	DEFLECTION
Inline Pumps	N/A	N/A	Braided Flex	
Air Compressor	Concrete	4"	Neoprene	
Water Heater			Copper Flex	

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Piping system insulation.
 2. Equipment insulation.
 3. Pipe insulation jackets.
 4. Equipment insulation jackets.
 5. Insulation accessories including vapor retarders and accessories.

1.2 QUALITY ASSURANCE

- A. Provide insulation tested for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. All systems components subject to heat loss or gain, such as, piping, storage tanks, vessels, valves etc. shall be insulated to conform with the Washington State Energy Code (as minimum).
- C. LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

1.3 IDENTIFICATION

- A. Insulation shall bear a manufacturer's mark indicating the product R-value or K-value and thickness. This mark shall be visible after installation and shall be repeated at an interval of no greater than 10 feet.
- B. R-values shall be based on insulation at 75 F mean temperature difference.
- C. For rigid or spray foam the aged R-value per inch shall be provided in submittals.

PART 2 PRODUCTS

2.1 GLASS FIBER, RIGID

- A. Manufacturers: Johns Manville Micro-Lok AP-T Plus or equal by Owens-Corning, Knauf, Manson or approved equal.
- B. Insulation: Rigid, noncombustible. ASTM C547.
1. 'K' factor: 0.23 at 75 degrees F.
 2. Fiberglass or Earthwool with ECOSE
 3. Maximum Service Temperature: 850 degrees F.
 4. Maximum Moisture Absorption: 0.2 percent by volume.
 5. Density: 3.0 lb/cu ft.
- C. Vapor Retarder Jacket: ASJ+ or Type I, reinforced facing, paintable. Longitudinal acrylic adhesive closure system with factory supplied butt strips. ASTM C1136.
- D. Rigid clamp/hanger insert: Preformed, incompressible (Calcium Silicate or similar), matching pipe size and insulation thickness.

2.2 GLASS FIBER, BLANKET

- A. Manufacturers: Johns Manville Micro-Flex or equal by Owens-Corning, Knauf, Manson or approved equal.
- B. Insulation: Semi-rigid, shot-free, continuous fiber, noncombustible. ASTM C1393.
 - 1. 'K' factor: 0.24 at 75 degrees F.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Maximum Moisture Absorption: 0.2 percent by volume.
 - 4. Density: 2.5 lb/cu ft.
- C. Vapor Retarder Jacket: Type I, reinforced facing, will accept paint. Seal with pressure sensitive tape. ASTM C1136.

2.3 POLYOLEFIN INSULATION

- A. Manufacturers: IMCOA or similar.
- B. Polyolefin or Polyethylene pipe insulation is **NOT ACCEPTABLE** for any application.

2.4 ELASTOMERIC CELLULAR FOAM

- A. Manufacturers: Armacell AP/Armaflex, Aeroflex Aerocel or approved equal.
- B. Preformed flexible, closed-cell, elastomeric thermal insulation: Type I, Tubular form, self-seal or continuous, 25/50-rated, CFC free, low VOC, 'K' factor: 0.27 at 75 degrees F. ASTM C534.
- C. Rigid clamp/hanger insert: Armacell Armafix, polyurethane insert and aluminum jacket, single piece with self-adhering closure.

2.5 CLOSED CELL POLYURETHANE SYSTEM (BELOW GRADE)

- A. Manufacturers: Thermacor Copper-Therm or approved equal.
- B. Factory-fabricated, pre-insulated piping system including copper pipe, insulation, jacket, fittings and field installed joint covers.
- C. Pipe: Type K copper
- D. Insulation: Rigid 2.0 lb/cu. ft. polyurethane foam, 90% closed cell, 0.15 K factor per ASTM C518, CFC-free, bonded to pipe.
- E. Jacket: Extruded white PVC, virgin NSF approved Class 12454-B conforming to ASTM D-1784 Type 1 Grade 1, minimum 60 mils thick. Jacket shall be bonded to insulation.
- F. Fittings: Same insulation and jacket as piping.
- G. Field Joints: Insulate with urethane foam to pipe insulation thickness, jacket with PVC sleeve and seal with pressure sensitive polyethylene backed rubberized bitumen adhesive tape 30 mils thick.
- H. Installation: Factory field technicians shall inspect installation, field joints and pressure testing.

2.6 PIPE INSULATION AND EQUIPMENT JACKETS

- A. PVC Plastic Pipe Jacket:
 - 1. Product Description: One piece molded type fitting covers and sheet material, off-white color. ASTM D1784.
 - 2. Thickness: 15 mil indoor, 30 mil outdoor.
 - 3. Connections: Brush on welding adhesive.
- B. Aluminum Pipe Jacket:
 - 1. Thickness: 0.016 inch thick sheet. ASTM B209.
 - 2. Finish: Embossed
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Apply insulation when building is thoroughly dry to prevent shrinkage.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulate entire piping system including fittings, valves, unions, flanges, strainers, flexible connections, pump fittings, connections to equipment and expansion joints. Use canvas jackets for valves and other irregular shapes.
- D. Insulate flanges and unions with removable sections and jackets.
- E. Piping Inserts and Shields:
 - 1. Insulation shall be continuous through supports and hangers with incompressible inserts and shields. Do not directly clamp/support pipe scheduled to be insulated.
 - 2. Shields: Galvanized steel saddle between pipe clevis hangers or pipe rollers and insulation. Minimum 6 inches long, of contour matching adjoining insulation; may be factory fabricated.
 - 3. Inserts: Between pipe clamps, hangers or rollers and piping.
 - 4. Insert material: Compression resistant insulating material suitable for insulation type and planned temperature range and service.
 - 5. Glue insulation to both sides of insert.
 - 6. Shields without inserts may be used at clevis hangers on refrigerant piping 5/8" and smaller with continuous insulation.
- F. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.

- H. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- I. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- J. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands. Any adhesives used must comply with VOC limits per LEED IEQ Credit 4.1.
- K. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- L. Finish insulation at supports, protrusions, and interruptions.
- M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

3.3 SCHEDULES

- A. Piping: Provide on piping as listed below. Exception: In residential units only, the water piping downstream of the submeters can be insulated per the minimum Washington State Energy Code requirements.

Service	Insulation Type	PIPE SIZE			
		<1"	1" to 1-1/4"	1-1/2" to 4"	4" to 8"
Domestic Cold Water	Glass Fiber RIGID	1/2"	1/2"	1/2"	1/2"
Domestic Hot Water Supply	Glass Fiber RIGID	1"	1"	1-1/2"	1-1/2"
Domestic Hot Water Recirc.	Glass Fiber RIGID	1"	1"	1-1/2"	1-1/2"
Domestic water H/C/R/T outside conditioned space	Glass Fiber RIGID	1-1/2"	1-1/2"	2"	2"
Condensate Drains	RIGID / FOAM	1/2"	1/2"	1/2"	1/2"
Roof Drain & Overflow Bowls in conditioned area	Glass Fiber RIGID	1/2"	1/2"	1/2"	1/2"
Rainleader & Overflow Piping in conditioned area	Glass Fiber RIGID	1/2"	1/2"	1/2"	1/2"

1. Do not insulate direct burial rain leader.
2. Do not insulate direct burial cold water.
3. For all exterior piping applications use only Elastomeric Cellular Foam with Aluminum jacket.
4. For all below grade piping application use only insulation specifically engineered for application. (Closed Cell Polyurethane System)

- B. Equipment: Provide on equipment as listed below.

Service	Insulation Type	Thickness	Jacket
Expansion Tank	Glass Fiber BLANKET	2"	Reinforced White- Kraft Paper

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. System specific commissioning procedures

B. Related Sections:

1. The following sections specify commissioning activities for this project:

01 91 13 – General Commissioning Requirements

2. All sections related to the following commissioned systems may contain start-up, testing and/or commissioning related activities:

Domestic Hot Water & Circulator
Gas & Utility Meters

1.2 DESCRIPTION OF WORK

- A. Work includes the completion and documentation of formal commissioning procedures by the Contractor on selected equipment and systems as listed under 1.1 B. Commissioning is defined as the process of verifying and documenting that the installation and performance of selected building systems meet the specified design criteria and therefore satisfies the design intent and the Owner's operational needs. The Contractor shall be responsible for participation in the commissioning process as outlined herein, and in subsequent sectional references and attachments throughout the project documents. Commissioning procedures shall be designed and conducted under the direction of the Commissioning Authority (CxA) and coordinated by the Contractor Commissioning Coordinator (CCC).
- B. This section contains the system specific commissioning requirements for the systems referenced herein.

PART 2 – PRODUCTS

- 2.1 Documentation requirements for the systems to be commissioned are specified in Section 01 91 13, Part 2 - Products

PART 3 – EXECUTION

- 3.1 Execution of the commissioning process for the systems to be commissioned is specified Section 01 91 13, Part 3 - Execution

SCHEDULE A – Start-up Plan , Contractor Checklists and Document Tracking

A Startup Plan shall be developed as outlined in Section 01 91 13. The Startup Plan shall include manufacturer's startup procedures and Contractor Checklists (CCL) as provided by the CxA.

Sample CCLs are included in this Schedule. The Contractor responsible for delivery of the equipment and appurtenances associated with the systems listed in Table – A shall be responsible for completion of the CCL for each individual piece of equipment in the system group. The CCLs included within this Schedule are sample versions and are representative of what will be included in the final Commissioning Plan.

The Contractor is responsible to demonstrate the proper operation of all installed systems and the final CCLs shall contain the requirements to document these demonstrations. In no case shall the checklists require performance criteria more stringent than specified by the Project Documents.

The CCC is responsible for collecting the completed CCLs and start-up documents and maintaining the Startup Plan during installation and startup activities. The CCC shall review the material for completeness, then sign off on the CCLs as an indication that documents are complete. Once all CCLs and start-up documents are received, they shall be turned over to the CxA.

The following Table - A identifies the CCLs and related documents that will be included in the final Startup Plan. Listed as subcategories below each system are the documents that shall be required to be submitted as part of the system startup activities. This documentation includes installation, startup, static tests, pressure tests, cleaning, flushing, disinfecting, certifications and other miscellaneous checklists. This table shall be used as a document tracking mechanism by the CxA, CCC and Contractor for the process of submittal, review and approval of installation and startup documents and CCLs. The table shall be included in the Startup Plan, which is a subset of the Commissioning Plan.

Table-A Key:

- A. System description for each system commissioned. A Contractor Checklist is included for each commissioned system. The subcategories include required documentation to be submitted with the CCL.
- B. Contractor responsible for installation, startup, testing and submittal of documents for commissioned system. To be filled in after contract award.
- C. Date the proposed documents are received by the CxA from the responsible Contractor. NOTE: These documents shall include, but are not limited to, procedures and forms to include such activities as: manufacturer's installation and start-up, pressure testing, TAB, cleaning, flushing and disinfection. The CCL is provided by the CxA.
- D. Indicates that CxA has received and approved proposed installation and start-up documentation.
- E. Date the completed documents are received by the CxA from the responsible Contractor.
- F. Indicates that CxA has received and approved completed documentation.
- G. Notes on status of forms, irregularities and rework needed

Table - A: System Summary and Documentation Tracking

A	B	C	D	E	F	G
System Description Documents Required	Responsible Contractor	Proposed Document Received	O K	Completed Document Received	O K	Notes
Domestic Hot Water Heater						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Domestic Hot Water Pumps						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Gas & Utility Meters						
Manufacturer Start-up Documentation						
Zero/Span calibration check		CxA Provided				
Contractor Checklist		CxA Provided				

SAMPLE
 Domestic Hot Water Heaters – Gas
 Contractor Checklist

Water Heater WH-1
 Location: Area/Room Served:
 Manufacturer: Model:

Check	RC	CxA	Note
Equipment			
Area is cleaned and clear of construction debris.			
Unit is clean and has no visible physical damage.			
Equipment labels are installed per project documents.			
Unit is accessible for service.			
Mounting is appropriate with vibration isolation as specified.			
Piping			
Piping insulated per project documents.			
Piping, valves and insulation are complete.			
Temperature and pressure indicators as specified.			
Control Devices			
Control wires and devices are complete.			
Control wire and devices are labeled.			
Electrical			
Supply power is installed and disconnect is accessible.			
Disconnect is labeled.			
Nameplate Minimum Circuit Amps.			
Nameplate Maximum Overcurrent Protection Device Amps.			
Installed overload.			
Overloads and/or fusing is appropriate.			
Operating controls and safeties are installed.			
Convenience outlet within 50' of equipment.			
Start-Up			
Manufacturer's installation and start-up procedures complete.			
Start-up documentation submitted to CxA.			
Readiness			
System is ready for functional performance testing			
Representative photograph provided			

Sign-Off:

Team Member	Name	Date
Responsible Contractor (RC):		
Commissioning Authority (CxA):		

Notes:

Sample Contractor Checklist
 Gas & Utility Meters

Unit No:		Contractor:	
Location:		Serves:	
Manufacturer:		Model:	

Check	RC	CxA	Note
Equipment			
Area is cleaned and clear of construction debris.			
Unit is clean and has no visible physical damage.			
Equipment labels are installed per project documents.			
Unit is accessible for service.			
Mounting is appropriate.			
Meter readout is visible and per project documents.			
Electrical			
Supply power is installed and disconnect is accessible.			
Disconnect is labeled.			
Supply power is sourced per project documents (e-power).			
Wires labeled per project documents.			
Piping			
Unions installed on all equipment requiring disconnects for servicing.			
Pressure gauges installed per project documents			
All valves tagged with number and function, valve index posted.			
Start-Up			
Manufacturer's installation and start-up procedures complete.			
Meter calibration complete and documented.			
Communication protocols set up and interface verified working correctly (ModBus, BacNet, LonWorks, IP address, etc.)			
Communication with Building Automation System and/or data acquisition and display system confirmed			
Start-up documentation submitted to CxA.			
Readiness			
System is ready for functional performance testing			
Representative photograph provided			

Sign-Off:

Team Member	Name	Date
Responsible Contractor (RC):		
Commissioning Authority (CxA):		

Notes:

SCHEDULE B – Functional Performance Tests

Functional Performance Tests

- 1 The preliminary versions of the Functional Performance Test and Verification Outline sheets contained in this Schedule define the individual systems to be tested and Contractor responsibilities based on the specific method of commissioning. These preliminary Functional Performance Test and Verification Outline sheets represent information available at the time of commissioning specification development. The final versions may be somewhat different and will be included within the Commissioning Plan as presented at the initial commissioning coordination meeting.
- 2 The methods of functional performance test and verification are listed in Table 1 of this Schedule. The Contractor will be responsible for supporting the testing activity as indicated. This may include developing the test plan and functional performance test forms for approval by the Commissioning Authority, performing testing to be witnessed by the CxA or providing support during functional performance testing conducted by the CxA or their sub-Authority.
- 3 Contract documents state that the Contractor is responsible to demonstrate that all systems comply with contract requirements and meet the project design intent. The scope of testing outlined in the following Functional Performance Test and Verification Outline sheets in this Schedule represent the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. If systems fail the initial tests additional testing may be required.
- 4 The following Test Summary Table identifies the functional tests that will be conducted on this project. This table will be used as a document tracking mechanism for the process of submittal and review of contractor provided testing documentation.
- 5 The contractor is responsible for submitting proposed functional test documentation to the Commissioning Authority for review and approval at least one month prior to these activities. It is the Contractor's responsibility to notify the Commissioning Authority in advance of the scheduled activity, testing or startup date. A minimum of 5 working days advance notification is required. If the CxA is not notified in advance of a scheduled start-up or testing activity, the start-up or testing shall be rescheduled and repeated to the satisfaction of the CxA.
- 6 The "Responsible Contractor" column of the table will be completed during the Initial Commissioning Coordination Meeting by assigning an individual Contractor responsible for the activities associated with each system based on what contractor provided that system.

Table – B: Functional Test Summary Table

A	B	C	D	E	F	G
	Responsible Contractor	Proposed Test Forms Received	O K	Testing Complete	O K	Notes
Hot Water Heaters/Pumps						
Gas & Utility Meters						

Summary Table Key:

- A. System description for each system commissioned.
- B. Contractor responsible for providing testing. To be filled in after contract award.
- C. Date the proposed test forms are received by the CxA from the responsible Contractor (if applicable).
- D. Indicates that CxA has received and approved the proposed test forms.
- E. Date(s) testing was performed by contractor.
- F. Indicates that Commissioning Authority has witnessed and approved the testing and received all completed test forms.
- G. Notes on status of forms, irregularities and rework needed.

Table 1 – Functional Test and Verification Methods

The following applies regardless of test method.

The contractor shall support the CxA during testing or verification, including but not limited to: scheduling and sequencing and adequate time for testing, on-site support during testing, testing instruments and equipment, setting up trend logs, providing access to equipment (including lifts), providing access to control systems both on-site and remotely.

The CxA shall do one or a combination of the following to verify contractor testing:

1. The CxA shall witness all or portions of the tests during contractor testing.
2. The CxA shall re-conduct the functional tests on all or portions of the systems using the same test plan and data sheets.
3. The contractor shall be required to duplicate some of the testing by demonstrating a percentage of the system as selected and witnessed by the CxA.

If during the verification process inconsistencies are found that demonstrate that the functional testing conducted by the contractor was not properly executed, the CxA shall suspend verification and the contractor shall be required to correct the problems and re-conduct the entire functional test and verification for the system(s) in question. Excessive test failures shall be subject to the back-charging provisions in Section 01 91 13.

Test Method A – Contractor Written and Conducted with CxA Oversight

The test plan and test data sheets are developed by the contractor responsible for the system and submitted to the CxA for approval. These can be the system manufacturer's stock test forms if appropriate. The CxA shall assist contractor in development of test forms if requested to do so. The contractor shall conduct the tests on 100% of the equipment per the plan, document results and submit completed test forms to the CxA for review and approval.

Test Method B – CxA Written and Conducted, Contractor Supports

The test plan and test data sheets are developed by the CxA. The CxA shall conduct the tests per the plan, document results and notify contractor of any issues found.

Test Method C – CxA Written, Contractor Conducts

The test plan and test data sheets are developed by the CxA. The CxA shall turn over the test plan and test data sheets to the contractor. The contractor shall conduct the tests on 100% of the equipment per the plan, document results and submit completed test forms to the CxA for review and approval.

Domestic Water Systems
Functional Test and Verification Outline

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule - B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Will Sample or Witness
C.1	CxA	Contractor	N/A	100%

Functional Tests:

- 1) Distribution
 - a) Pump Operation
- 2) Water Heater
 - a) Temperature control
 - b) Relief
- 3) Mixing Valves
 - a) Temperature control

Gas & Utility Meters
Functional Test and Verification Outline

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule-B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Will Sample or Witness
C.3	CxA	Contractor	100%	N/A

Functional Tests:

- 1) Demonstrate and document the following:
 - a) Two point calibration at zero and at a known consumption equal to at least a third of the system maximum load. This can be accomplished by applying a known load or by measuring the actual load (volts & amps) at the panel being metered.
 - b) Communication with Building Automation System and/or data acquisition and display system.
 - c) All features and functions of the meter

PART 4 – SAMPLE FUNCTIONAL TEST DOCUMENTS

- 4.1 Sample functional test procedures and data forms are provided in this section to demonstrate the rigor of the process, test procedures and documentation that will be required from the contractor. These forms and procedures will be amended, augmented and updated in the final commissioning plan based on the final project documents, addendums and submittal information. This sample section does not contain all functional test procedures and data forms that are required to be executed by the contractor. Schedule - B of Part 3 provides a full list of the functional tests that will be required to be executed by the contractor.

Domestic Hot Water – BAS Controlled with BAS Aquastat and Pump Proof

Occupied Mode

1. Place the system in the occupied mode.
2. Create a demand for hot water by increasing the temperature set point if necessary or using hot water.
3. If circulation pump is equipped with an aqua-stat, verify aqua-stat set point is high enough to cause pump to circulate.
4. Return set point to original value at end of test.

Hot water tank set point at start of test _____

	1	2
Hot water circulation pump is enabled.		
Combustion air damper is open.		
Water heater burner is enabled and firing.		
Hot water tank set point returned to original setting.		

Unoccupied Mode:

1. With the system in the occupied mode, create a demand for hot water at the hot water tank (or continue from previous test).
2. Adjust the return water temperature set point to well below the return water temperature.
3. Place the system in the unoccupied mode.
4. Verify pump is disabled, combustion damper is closed and hot water is disabled.
5. Return hot water tank to original set point as needed.

	1	2
Hot water circulation pump is disabled		
Combustion air damper is closed		
Water heater burner is disabled		
Hot water tank set point returned to original setting		

BAS Aqua-Stat Operation:

1. Verify system is in the occupied mode.
2. Start test with return water temperature above set point, adjust set point as needed.
3. Record initial parameters.
4. Turn the aqua-stat set point up higher than the return water temperature.
5. Verify pump is commanded on, status is on and pump is observed on.
6. Turn off the pump at the disconnect and verify pump failure alarm is generated.
7. Turn power to pump back on and verify alarm clears.
8. Turn the aqua-stat set point down to lower than the return water temperature.
9. Verify pump is commanded off, status is off and pump is observed off.
10. Return set point to original setting.

	1	2
PRE-TEST:		
System in occupied mode		
Return water temperature.		
Return water temperature set point		
Pump command/status is OFF		
TEST:		
Return water set point changed to		
Pump command/status are ON		
Pump failure alarm received		
Pump failure alarm cleared		
Pump observed ON		
Return water set point changed to		
Pump command/status are OFF		

Tests are complete and performance is acceptable.

Commissioning Authority:

Date:

Comments:

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Domestic water piping.
 2. Piping Accessories.
 3. Circuit balancing valve.
 4. Water sub-meters
 5. Water pressure reducing valves.
 6. Double check valve assembly
 7. Reduce pressure backflow assembly.
 8. Thermostatic mixing valves.
 9. Pressure balanced mixing valves.

1.2 SCOPE

- A. This section includes hot and cold water supply, equipment and accessories.
- B. This section includes domestic hot and/or cold water consumption metering with data collection and billing software.

1.3 GENERAL REQUIREMENTS

- A. Comply with Federal "Reduction of Lead in Drinking Water Act" – 2011. Pipes, pipe fittings, plumbing fittings and fixtures shall be "Lead Free" meaning not more than a weighted average of 0.25% lead in wetted surfaces.

1.4 SITE MAINS

- A. Provide connections to Site water mains as indicated on drawings.

1.5 QUALITY ASSURANCE

- A. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)
- B. The mechanical press fitting manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of press fittings and crimping tools. The representative shall periodically visit the jobsite and review installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)
- C. LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.
- D. Plastic welding and solvents must comply with VOC limits per SCAQMD Rule #1168, IEQ Credit 4.2. VOC limits are no more than 510 g/L for PVC; 490 g/L for CPVC; and 325g/L for ABS.

PART 2 PRODUCTS

2.1 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Tubing: Type K hard drawn or annealed. ASTM B88.
 - 1. Fittings: ASME B16.22, ASTM B75, wrought copper.
 - 2. Joints: Brazed
 - a. Copper to copper: Silver/phosphorus/copper alloy (15 percent silver). AWS A5.8 BCuP-5.
 - b. Copper to brass or steel: AWS Bag-5 Silver (45 percent silver)

2.2 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Tubing: Type L hard drawn seamless. ASTM B88.
 - 1. Fittings:
 - a. Wrought copper and bronze. ASME B16.22, ASTM B75.
 - b. Copper press with EPDM O-ring, ASME B16.22, 200 psi.
 - 2. Joints:
 - a. Solder, lead free, 95-5 tin-antimony, or tin and silver. ASTM B32.
 - b. Press connection, Viega ProPress or approved equal.
- B. Copper Tubing: Type L hard drawn, rolled grooved ends. ASTM B88.
 - 1. Copper Grooved-End Fittings: ASME B75 copper tube or bronze ASTM B584 bronze castings, with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).
 - 2. Joints: Grooved mechanical couplings meeting ASTM F1476. Victaulic or approved equal.
 - a. Housing Clamps: ASTM A395 and ASTM A536 ductile iron cast with offsetting, angle-pattern bolt pads, copper-colored enamel coated, compatible with copper tubing sizes, to engage and lock designed to permit some angular deflection, contraction, and expansion.
 - b. Gasket: Grade "EHP" EPDM.
 - c. Accessories: Steel bolts, nuts, and washers.
 - d. Design: "Installation Ready" designed for direct 'stab' installation onto roll grooved copper tube without prior field disassembly and no loose parts. Victaulic Style 607 QuickVic™.
- C. Stainless Steel Piping: ½" through 2" Vic-Press Type 304/304L, Schedule 10S, ASTM A312.
 - 1. Fittings: Austenitic stainless steel, Type 304/304L, complete with synthetic rubber HNBR o-rings (UL classified in accordance with ANSI/NSF-61 for hot (+180°F) and cold (+86°F) potable water service) and pipe stops.
 - 2. Use a Victaulic "PFT" series tool with the proper sized jaw for pressing.
 - 3. Joints: Stainless steel, pressure-sealed, Victaulic Vic Press 304™
- D. Stainless Steel Piping: 2" and larger, Type 304/304L, Schedule 10, grooved ends, ASTM A312.
 - 1. Fittings: Stainless steel, factory grooved ends, Type 304/304L, ASTM A312.
 - 2. Joints: Two or more segment cast stainless steel, ASTM A351, A743 and A744. Synthetic rubber gaskets, UL ANSI/NSF-61. Stainless steel, Type 316 bolts.
 - 3. 2 inches through 4 inches may be "Installation Ready" stab-on design, for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. Gasket shall be Grade "EHP" EPDM suitable for hot water up to +250 deg F. Victaulic Style 89.

4. Use Victaulic specific "RX" roll sets when grooving schedule 5 or 10 stainless steel pipe.

2.3 TRAP PRIMER PIPING

- A. Copper Tubing: ½" Type L soft annealed seamless, ASTM B88
 1. Fittings: Flared compression.
- B. PEX: ½" Uponor, Viega or approved equal
 1. PEX-a (Engel-Method Crosslinked Polyethylene) Piping: NSF 61, ASTM F 876 and F877.

2.4 PRESSURE GAUGES

- A. Manufacturers: Marsh, Trerice, Weiss or approved equal.
- B. Gauge: Rotary stainless steel movement, 316 stainless steel socket, front calibration adjustment, black scale on white background. ASME B40.1. Trerice 700.
 1. Case: 304 stainless steel
 2. Bourdon Tube and wetted parts: 316 stainless steel.
 3. Dial Size: 4 inch diameter within 7' of floor, 6 inch diameter over 7'.
 4. Mid-Scale Accuracy: 1/2 percent.
 5. Scale: PSI.

2.5 PRESSURE GAUGE TAPS

- A. Needle Valve: 316 stainless steel, 1/4 inch NPT for minimum 300 psi. Trerice 735.
- B. Pulsation Damper: 316 stainless steel, 1/4 inch NPT connections. Trerice 870
- C. Pressure Snubber: 316 stainless steel, 1/4 inch NPT connections. Trerice 872
- D. Siphon: 316 stainless steel, 1/4 inch NPT angle or straight pattern. Trerice 885.

2.6 STEM TYPE THERMOMETERS

- A. Manufacturers: Marsh, Trerice, Weiss or approved equal.
- B. Thermometer: Blue appearing organic, lens front tube, cast aluminum case with epoxy finish, adjustable angle. ASTM E1. Trerice AX/BX.
 1. Size: 7-inch scale within 7' of floor, 9-inch scale mounted over 7'.
 2. Window: Clear.
 3. Stem: 304SS, 3/4 inch NPT.
 4. Accuracy: 2 percent.
 5. Calibration: Degrees F.

2.7 AUTOMATIC FLOW BALANCING VALVE

- A. Manufacturers: Caleffi 127 or approved equal.
- B. Construction: Low-lead brass body, anti-scale polymer flow cartridge, stainless steel spring, EPDM seals. 200 psi max working pressure. 200 F max temperature.
- C. Control: Working pressure ranges 2-14 psid or 2-32 psid for flows from 0.5 gpm to 5 gpm.

2.8 WATER PRESSURE REDUCING VALVES

- A. Manufacturers: Watts or equal by Apollo/Conbraco, Wilkens, Victaulic or approved equal.
- B. 2 inches and Smaller: Lead-Free cast copper silicon body with stainless steel inlet strainer, reinforced EPDM diaphragm, replaceable stainless steel seat, adjustable outlet pressure between 25-75 psi, 300 psi working pressure, 33F-160F operating temperature range. Watts LFU5B.
- C. 2-1/2 & 3 inch: Lead-Free brass body, inlet strainer with stainless steel screen, reinforced Buna-N diaphragm, EPDM valve disc, replaceable stainless steel seat, adjustable outlet pressure between 25-75psi, 300 psi working pressure, 33F-160F operating temperature range. Watts LFN223S.

2.9 STRAINERS

- A. Manufacturers: Apollo/Conbraco, Metraflex, Titan, Nibco or approved equal.
- B. 4 inch and Smaller: Threaded or Solder, 400 PSI CWP, lead-free bronze body, Y-pattern with 20 mesh stainless steel perforated screen. Apollo 59LF.

2.10 DOMESTIC WATER SUB METERS

- A. Manufacturers: Norgas, Carlon or approved equal.
- B. Positive displacement disc type with bronze case, hermetically sealed register, remote reading.
- C. Meter: Brass body turbine meter with magnetic drive register.
 - 1. Service: Cold water up to 105F; hot water up to 194 F.
 - 2. Pressure Drop at Nominal Flow: 5 psi.
 - 3. Maximum Operating Pressure: 150 psi.
 - 4. Accuracy: 1-1/2 percent.
- D. Counter: Solid state remote indicator in high impact polycarbonate housing with LCD display. Maximum counter reading: 10 million gallons up to 2"; 100 million gallons 2 1/2" and larger.

2.11 REDUCED PRESSURE BACKFLOW PREVENTERS (RPBA)

- A. Manufacturers: Watts or equal by Apollo/Conbraco, Wilkens or approved equal. Must be listed as acceptable by the State of Washington Cross Connection Manual.
- B. 2 inches and Smaller: Lead-Free. Comply with ASSE 1013. Cast copper silicone body with internal pressure differential relief valve located between two positive seating captured spring check valves, inlet Y-strainer, inlet and outlet shutoff ball valves, ball valve test cocks, replaceable polymer seats and silicone seat discs, air gap drain fitting, 175 psi working pressure, 33-180 F operating temperature range. Watts model LF919.
- C. 2-1/2 inches and Larger: Lead- Free. Comply with ASSE 1013. Ductile iron body with internal pressure differential air-in/water-out relief valve located between two positive seating captured spring check valves, 100% fused epoxy coating inside/outside, epoxy coated inlet Y-strainer, inlet and outlet epoxy coated gate valves, ball valve test cocks,

stainless steel internal parts, replaceable stainless steel seats, air gap drain fitting, 175 psi working pressure, 33-110 F operating temperature range. Watts model LF909.

- D. 2-1/2 inches and Larger: Lead- Free. Comply with ASSE 1013. 300 stainless steel body with internal pressure differential air-in/water-out relief valve located between two positive seating captured spring check valves, epoxy coated inlet Y-strainer, inlet and outlet epoxy coated gate valves, ball valve test cocks, stainless steel internal parts, replaceable stainless steel seats, air gap drain fitting, 175 psi working pressure, 33-110 F operating temperature range. Watts model 994.

2.12 WATER HAMMER ARRESTORS

- A. Manufacturers: Wade, PPP or approved equal.
- B. ASSE 1010; stainless steel or copper construction, pre-charged, bellows or piston type sized in accordance with PDI WH-201.

2.13 THERMOSTATIC MIXING VALVE (ELECTRONIC)

- A. Manufacturers: Heat-Timer ETV Platinum Plus, equal by Leonard or approved equal.
- B. The control shall operate on 120VAC. The control shall be pre-engineered and programmed for the direct valve actuator operation in a domestic hot water heating system. It shall incorporate the following components:
- C. Control: A microprocessor Electronic Tempering Valve control with PID-type logic, built-in transformer, digital display of temperature and set point, and LED indicator. It shall be capable of controlling a set point range from 40°F to 200°F. It shall display the valve opening percentage to match actuator percent. The control shall maintain set point temperature within $\pm 2^\circ$ during a domestic draw of 0.5 gpm to full flow capacity in accordance with ASSE 1017.
- D. Actuator: An actuator/Motor and linkage capable of traveling the complete valve stroke from fully OPEN to fully CLOSE in less than 20 seconds. It shall calibrate to the actual valve stroke. The actuator is also capable of operating in the reverse direction, allowing the interchangeability of the HOT and COLD connections to the valve body.
- E. Stainless Steel Valve: An NPT threaded 3-way mixing valve with 304 stainless steel body and trim. The maximum operating temperature of the valve shall be 300°F (149°C) with a maximum working pressure of 225 psi.
- F. Sensor: Temperature sensor of the thermistor type that can measure from -30°F to 250°F.
- G. Features:
 - 1. The control shall modulate the mixing valve to match the set point.
 - 2. Setpoint: The control shall offer the user the ability to adjust the setpoint using a menu option and it shall display the setpoint at all times on the default screen.
 - 3. Modes of Operation: The control shall operate as an electronic tempering valve with high temp alarm/safeguard.
 - 4. Schedules: The control shall offer the user the ability to set a schedule where the control overrides the setpoint and sets an absolute water temperature. The control shall offer schedules for each day, every day, weekdays only, and weekends only. Up to four periods can be configured per day.
 - 5. Flow Switch: The control shall offer an input that can accept a dry-contact flow switch to detect when no water flow is detected.

6. Auto Calibration: After initial startup calibration, the actuator/motor shall automatically calibrate itself to the valve attached.
7. Multiple Actuator Connection: The control shall be capable of operating multiple valves piped in parallel with a single 0–10Vdc output signal.
8. Display: The control shall have an alphanumeric display. All control operation information shall be available for display.
9. Memory and Backup: The control shall store all configuration and settings on EEPROM. In case of power failure, the control shall be able to retrieve all of its latest settings when power is restored.
10. Sensor Inputs: The control shall be capable of supporting three standard sensor inputs. The sensor inputs shall be of the thermistor type. Thermistor operating temperature range shall be -30°F to 250°F. Should the sensor show a fault condition, the control shall automatically close the hot port of the valve until the situation is rectified. The sensors shall monitor inlet CW, HW and outlet mixed water temperatures. Locate the CW and HW inlet sensors at least 6 feet from the valve. The CW sensor shall also be downstream of the HWC connection. Locate the mixing outlet sensor between 1 and 3 feet from the valve.
11. Alarm / Safeguard Option: The control shall have a manual reset button that will exit the control from its alarm status. The reset function shall only work when the temperature has dropped below the alarm setpoint. The control will turn on an alarm indicator and energize both alarm relays for optional external alarms. When the alarm is corrected the control is reset.
12. Power Failure: The control shall automatically shut off the flow of hot water in the event of a power failure.

2.14 TEMPERING VALVE (EMERGENCY)

- A. Manufacturers: Haws, Lawler, Powers, Acorn or approved equal.
- B. General: Prepackaged, fully engineered and tested system for providing tempered water to emergency showers and/or eyewashes. Mixing valve to close on cold water failure and bypass cold water on hot water failure. Haws TWBS.EWE, TWBS.SHE
- C. Construction: NSF 61 Lead-Free brass
- D. Assembly: Valve and piping assembly with wall bracket, thermostatic mixing valve, high temperature limit valve, bypass valve, outlet temperature gauge with stainless steel stem, pipe unions. Certified to ASSE 1071 standard.

2.15 TEMPERING VALVE (PUBLIC LAV)

- A. Manufacturers: Symmons, Leonard, Powers, Acorn or approved equal.
- B. General: Lead-Free brass and bronze body with brass and stainless steel flow control components with check stops, vandal resistant lockable handle, rough [bronze] [chrome] finish. Certified to ASSE 1070 standard.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

- C. Prepare piping connections to equipment with groove couplings, flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.
- B. Provide connections to site mains as indicated on drawings.
- C. Grade piping at 1/4" per foot where possible, but in no case less than 1/8" per foot. Install all main vertical soil and waste stacks with provisions for expansion and extend full size to roof line as vents.
- D. Backfill trenching with pea-gravel if available at site for other purposes. If pea-gravel is unavailable, native soil may be used for backfill if all the following conditions are met.
 - 1. All broken concrete and sharp stones (+1" dia.) to be removed from backfill soil.
 - 2. All large stones (3' dia. or bigger) to be removed from backfill soil.
 - 3. Piping shall be bedded on min. 2" thickness of replaced "rock free" soil and then checked for grade.
- E. Establish elevations of buried piping with not less than 3 ft of cover.
- F. Establish minimum separation from other services piping in accordance with Code.
- G. Route pipe in straight line.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Install plastic ribbon tape continuous over top of pipe.
- J. Install trace wire continuous over top of pipe.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Install piping on interior side of building insulation.
- E. Provide heat tape for all piping in unheated areas.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Protection: Where piping, other than cast iron or steel, is installed in a concealed location through holes or notches in framing (i.e. studs, joists, rafters, etc.), less than 1-1/2 from

framing edge, provide shield plates. Shield plates shall be 16 gauge steel and cover the piping area within framing plus 2" on each side along framing.

- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.
- J. Grooved Joints: Install in accordance with the manufacturer's (Victaulic) guidelines and recommendations. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
- K. Provide access panel where valves and fittings are not accessible.
- L. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- M. Slope piping and arrange systems to drain at low points. Provide hose bibb if low point is not at a plumbing fixture.
- N. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- O. Insulate piping. Refer to Section 22 07 00.
- P. Install pipe identification in accordance with Section 22 05 00.

3.4 INSTALLATION – VIC-PRESS STAINLESS STEEL

- A. Victaulic's factory trained representative shall provide on-site training for contractor's field personnel prior to installation in the use of PFT tools, application, and installation of products.
- B. Use Vic-Press in lieu of soldered copper for pipe sizes ½" through 2".
- C. Use Vic-Press end valves where possible. Install Vic-Press 304 flange or threaded adapters where flanged or threaded valves are required.
- D. Victaulic's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

3.5 INSTALLATION - DOMESTIC WATER PIPING SYSTEMS

- A. Install domestic water piping system in accordance with ASME B31.9.
- B. Grade piping to drain at low points. Provide hose bibb if low point is not at plumbing fixture.
- C. Install water piping on interior side of building insulation. Provide heat tape for all piping in unheated areas.
- D. Install water hammer arrestors on hot and cold water of each fixture group (e.g.: one arrestor may serve each service to a toilet). Select unit sizes and install in accord with PDI Standard WH-201.

3.6 VALVES

- A. Use ball valves for up to 4" piping. Gate valves are not approved for use up to 4" piping. Gate valves are for 6" piping and larger only.
- B. Gate valves which are part of a valve assembly are acceptable.

3.7 INSTALLATION - THERMOMETERS AND GAUGES

- A. Install pressure gauges on each side of domestic water service assembly (i.e double check, PRV, etc.).
- B. Install one pressure gauge for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gauge.
- C. Install gauge taps in piping.
- D. Install pressure gauges with pulsation dampers. Provide needle valve or ball valve to isolate each gauge.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- F. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- G. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- H. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.8 INSTALLATION - SERVICE CONNECTIONS

- A. Provide new water service complete with approved double check back-flow preventer, pressure reducing valve, by-pass valves, pressure gauges and strainer.
- B. Provide sleeve in wall for service main and support at wall with reinforced-concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.
- C. Provide 18 gauge galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.9 FIELD QUALITY CONTROL

- A. Test domestic water piping system at 100 psig minimum for a period of not less than 4 hours.

3.10 CLEANING

- A. Flush system with water for minimum of 60 minutes to remove all dirt and foreign materials. Use minimum of 80 psi flushing pressure.

- B. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.
- C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
- D. Bleed water from outlets to obtain distribution and test for disinfectant residual at a minimum of 15 percent of outlets.
- E. Maintain disinfectant in system for 24 hours.
- F. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Sanitary sewer piping, buried within 5 feet of building.
 2. Sanitary sewer piping, above grade.
 3. Condensate drains
 4. Floor drains.
 5. Trench drains.
 6. Cleanouts.
 7. Garbage disposals.
 8. Sumps.
 9. Interceptors.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe & Fittings: ASTM A888, CISPI 301, hub-less. Made in USA by AB&I, Charlotte or Tyler marked with collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
1. Fittings: ASME B16.45 or ASSE 1043, long pattern cast iron, hubless.
 2. Joints: Heavy-Duty, Shielded, Stainless-Steel coupling with all type 304 stainless steel shield and band assembly, 80 in/lbs worm drive. ASTM C-564 Neoprene gasket. CISPI 310 and certified by NSF international. Minimum 4 clamps up to 4", 6 clamps for 5" and larger. Husky SD (Super-Duty) 4000, Clamp-All 125, Ideal Tridon Super Heavy-Duty, Mifab QXHUB Heavy Duty or approved equal.
- B. PVC Pipe: Schedule 40 solid wall PVC, bell and spigot solvent sealed ends. NSF Standard 14, ASTM D1785, ASTM D1784.
1. Fittings: Schedule 40, PVC, ASTM D2665.
 2. Joints: Solvent weld with ASTM D2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe & Fittings: ASTM A888, CISPI 301, hub-less. Made in USA by AB&I, Charlotte or Tyler marked with collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
1. Fittings: ASME B16.45 or ASSE 1043, long pattern cast iron, hubless.
 2. Joints: Heavy-Duty, Shielded, Stainless-Steel coupling with all type 304 stainless steel shield and band assembly, 80 in/lbs worm drive. ASTM C-564 Neoprene gasket. CISPI 310 and certified by NSF international. Minimum 4 clamps up to 4", 6 clamps for 5" and larger. Husky SD (Super-Duty) 4000, Clamp-All 125, Ideal Tridon Super Heavy-Duty, Mifab QXHUB Heavy Duty or approved equal.
- B. Copper Tube (Use only for short piping sections where dimensional constraints require thin wall pipe): ASTM B306 DWV.
1. Fittings: Long Pattern, ASME B16.23, cast bronze, or ASME B16.29, wrought copper.
 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver.
- C. Steel Pipe (water closet connections only): Schedule 40, galvanized. ASTM A53.

1. Fittings: Cast Iron, ASME B16.4, threaded fittings.
2. Joints: Threaded.

D. **[VENT ONLY]** PVC Pipe: Schedule 40 solid wall PVC, bell and spigot solvent sealed ends (If approved by local authorities). NSF Standard 14, ASTM D1785, ASTM D1784. **Not for use in air plenum.**

1. Fittings: Schedule 40, PVC, ASTM D2665.
2. Joints: Solvent weld with ASTM D2564 solvent cement.

2.3 SANITARY SEWER PIPING, FORCE MAIN

A. Steel Pipe: Schedule 40, galvanized. ASTM A53.

1. Fittings: Steel, grooved, hot dipped galvanized.
2. Joints: Mechanical Coupling, hot dipped galvanized, elastomeric sealing gasket, steel bolts and washers. Victaulic or approved equal.

B. PVC Pipe: Schedule 40 solid wall PVC, ASTM D1785, ASTM D1784.

1. Fittings: Schedule 40, PVC, ASTM D2665.
2. Joints: Solvent weld with ASTM D2564 solvent cement.

2.4 NO-HUB TRANSITION COUPLING FOR JOINING CAST IRON AND PVC PIPE

A. Coupling shall be Tested and Certified to ASTM C 1460 and be constructed with type 304 stainless steel shield, thickness 0.015, gasket material to meet ASTM C564, 1-1/2" - 4" will be 3" wide with four (4) 304 stainless steel bands and 6" - 10" will be 4" wide with six (6) 304 stainless steel bands and 3/8" 305 stainless steel hex head screws torqued to 80 inch pounds. Husky SD 4000 PVC x CI or approved equal.

2.5 EQUIPMENT DRAINS (CONDENSATE)

A. Copper Tubing: Type L, hard drawn. ASTM B88.

1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

B. CPVC Pipe: Schedule 40. ASTM D2846. **Not for use in air plenum.**

1. Fittings: Schedule 40 CPVC. ASTM D2846.
2. Joints: Solvent weld with ASTM F493 solvent cement. ASTM D2846.

2.6 FLOOR DRAINS

A. Manufacturers: Zurn, Josam, J.R. Smith, Wade or approved equal.

B. General Service: Cast iron body, membrane clamp, adjustable collar, polished nickel bronze strainer, trap primer connection. Provide funnel where scheduled.

C. Garage: Square top heavy duty parking deck drain with coated cast iron body, gasketed drain support flange, heavy duty slotted grate, underdeck clamp.

2.7 GARAGE DRAIN/SAND INTERCEPTOR

A. Manufacturers: Rockford or approved equal.

B. Heavy duty garage drain with sand containment, integral deep seal trap, removable sediment pan, wide concrete anchor flange, double vent connections, heavy-duty traffic grate (H-20 rated).

2.8 TRENCH DRAIN

- A. Manufacturers: Zurn, J.R. Smith or approved equal.
- B. 6" wide, sloped modular channel sections with interlocking end and radiused bottom, HDPE, extra heavy duty frame with anchor studs and grate lockdown, ductile iron cast bar grate with H-20 rating.

2.9 CLEANOUTS

- A. Manufacturers: Zurn, J.R. Smith, Josam, Wade or approved equal.
- B. Exterior or interior vehicle areas: Heavy-Duty round coated cast iron body and cover with bronze plug.
- C. Exterior Surfaced Areas: Round cast nickel bronze access frame with bronze gasket threaded plug and non-skid cover.
- D. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and bronze gasket threaded plug.
- E. Interior Finished Floor Areas: Type of ferrule, top and cover as required for the type of floor construction, finish surface and traffic conditions. Cleanout construction material to match waste piping with anchor flange, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas. For carpet provide marker. For cast iron construction provide bronze gasket threaded plug.
- F. Interior Finished Wall Areas: Cleanout construction material to match waste piping, line type with round gasket threaded plug, and round stainless steel access cover secured with machine screw. For cast iron construction provide bronze gasket threaded plug.
- G. Interior Unfinished Accessible Areas: Threaded type. Provide bolted stack cleanouts on vertical waste stacks.

2.10 GARBAGE DISPOSAL

- A. Manufacturers: In-Sink-Erator or approved equal.
- B. Commercial: Heavy duty quiet induction motor, auto-reverse grinding system, insulated outer shell, stainless steel grinding chamber and components, permanently lubricated bearings, dishwasher connection, 1 hp.

2.11 HAND HOLE ACCESS VAULT

- A. Manufacturers: Utility Vault or approved equal.
- B. Construction: Minimum 2' W x 3' L pre-cast concrete vault with side knockouts, galvanized diamond plate cover w/locking latch. Provide risers as required to meet grade.

2.12 FLASHING AND COUNTERFLASHING

- A. 3lb. lead soldered joints and seams, 24 x 24 base pad and counterflashed into pipe.

2.13 TRAP PRIMER

- A. Manufacturers: PPP, Wade, J.R. Smith, Josam, Watts, Zurn or approved equal.
- B. Construction: Automatic, bronze body, integral vacuum breaker.
- C. See 221100 for trap primer piping.

2.14 TRAP PRIMER TAIL PIECE

- A. Manufacturers: PPP or approved equal.
- B. Construction: 1-1/2" tail piece trap primer assembly with 1/2" stainless steel flexible priming water line and chrome plated escutcheon.
- C. See 221100 for trap primer piping.

2.15 AIR GAP FITTING

- A. Manufacturers: Zurn Z-1025 or equal by J.R. Smith or approved equal.
- B. Construction: Inline, fixed air gap, coated cast iron.

2.16 OIL AND SAND INTERCEPTOR

- A. Manufacturers: Oldcastle or approved equal.
- B. Construction: Precast concrete or welded steel construction with sludge retaining weir, two (2) oil retaining baffles, inlet and outlet sampling tees and cover with galvanized diamond plate access covers. Where installed in vehicle traffic areas provide H-20 rated covers. Provide risers as required to meet grade.

PART 3 EXECUTION

3.1 PREPARATION

- A. Remove scale and dirt, on inside and outside, before assembly.
- B. Prepare piping connections to equipment with flanges or unions.
- C. Verify and provide required extensions, clamps and drain styles to match floor construction and finish.

3.2 INSTALLATION

- A. Coordinate location of floor drains in mechanical spaces with mechanical contractor equipment layout.
- B. Protect floor drain strainer during construction.
- C. Traps:
 - 1. Install trap seal maintenance devices only where called for on plans or approved by engineer; at all other drain locations provide automatic trap primers.
 - 2. Install automatic trap primers throughout at site drains and floor drains except those located in showers or provided with trap seal maintenance devices.

3. Provide access panels for automatic trap primers.
 4. Adjust automatic trap primer pressure setting for proper operation.
- D. Align square floor drains with floor tiles or parallel with walls.
- E. Install interceptors with top flush with adjacent surface or grade. Provide quantity and size of vents as indicated in manufacturer's literature. Terminate vents minimum 10 feet above grade or through roof at a location determined by the architect.

3.3 CONDENSATE PIPING

- A. Provide condensate piping for air-conditioning and high-efficiency gas fired equipment. Coordinate quantity required with mechanical contractor. Provide minimum 3" deep p-trap at equipment.
- B. Determine best routing to nearest indirect waste using minimum 3/4" piping with minimum 1/8" per foot slope. Acceptable indirect waste locations are service sink, laundry sink, floor drain or air gap fitting into waste pipe. Provide open drain box or access panel for air gap fitting as approved by local authority. Discharge onto roof or at grade is acceptable if allowed by local code, provide splash block.
- C. If proper slope cannot be achieved advise Mechanical Contractor to provide condensate pump.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.
- B. Provide connections to site mains as indicated on drawings.
- C. Grade piping at 1/4" per foot where possible, but in no case less than 1/8" per foot. Install all main vertical soil and waste stacks with provisions for expansion and extend full size to roof line as vents.
- D. Install buried ABS piping per ASTM D2321 and ASTM F1668.
- E. Backfill trenching with pea-gravel if available at site for other purposes. If pea-gravel is unavailable, native soil may be used for backfill if all the following conditions are met.
1. All broken concrete and sharp stones (+1" dia.) to be removed from backfill soil.
 2. All large stones (3' dia. or bigger) to be removed from backfill soil.
 3. Piping shall be bedded on min. 2" thickness of replaced "rock free" soil and then checked for grade.
- F. Establish elevations of buried piping with not less than 3 ft of cover.
- G. Establish minimum separation from other services piping in accordance with Code.
- H. Provide piping layout to satisfy the UPC requirements for suds relief.
- I. Route pipe in straight line.
- J. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- K. Install plastic ribbon tape continuous over top of pipe.

- L. Install trace wire continuous over top of pipe.

3.5 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient at 1/4" per foot where possible, but in no case less than 1/8" per foot. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Install piping on interior side of building insulation.
- E. Provide heat tape for all p-traps in unheated areas.
- F. Sleeve pipe passing through partitions, walls and floors.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Protection: Where piping, other than cast iron or steel, is installed in a concealed location through holes or notches in framing (i.e. studs, joists, rafters, etc.), less than 1-1/2 from framing edge, provide shield plates. Shield plates shall be 16 gauge steel and cover the piping area within framing plus 2" on each side along framing.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- J. Provide access panel where valves and fittings are not accessible.
- K. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- L. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Provide 1/8 inch per foot only where necessary and allowed by local jurisdiction. Maintain gradients.
- M. Provide piping layout to satisfy the UPC requirements for suds relief.
- N. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- O. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- P. Insulate piping. Refer to Section 22 07 00.
- Q. Install pipe identification in accordance with Section 22 05 00.

3.6 INSTALLATION - SANITARY WASTE AND VENT SYSTEMS

- A. Install sanitary waste and vent piping systems in accordance with ASME B31.9 and local plumbing code.
- B. Support cast iron drainage piping at every joint.

- C. Flash and counterflash. Install vents passing through roof with roof flashing and counterflashing assemblies. 3lb. lead soldered joints and seams, 24 x 24 base pad and counterflashed into pipe.
- D. Install automatic trap primers throughout at floor drains except those located in showers. Provide access panel for trap primers.
- E. Provide piping layout to satisfy the UPC requirements for suds relief.
- F. Provide cleanouts every 50 feet and install at all locations required by code and to permit cleaning of all waste piping. Provide cleanouts full size of pipe, but no larger than 4". Coordinate with Architect when cleanouts are located in finished rooms. Install cleanout threads with graphite. Locate cleanouts to clear cabinet work and to be easily accessible.

3.7 FIELD QUALITY CONTROL

- A. Obtain written approval of local Plumbing Authority prior to covering or concealing any work.
- B. Test sanitary waste and vent piping system to hydrostatic test of 10 feet head of water.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Storm water piping, buried within 5 feet of building.
 2. Storm water piping, above grade.
 3. Roof drains.
 4. Parapet drains.
 5. Cleanouts.

PART 2 PRODUCTS

2.1 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe & Fittings: ASTM A888, CISPI 301, hub-less. Made in USA by AB&I, Charlotte or Tyler marked with collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
1. ASME B16.45 or ASSE 1043, long pattern cast iron, hubless.
 2. Joints: Heavy-Duty, Shielded, Stainless-Steel coupling with all type 304 stainless steel shield and band assembly, 80 in/lbs worm drive. ASTM C-564 Neoprene gasket. CISPI 310 and certified by NSF international. Minimum 4 clamps up to 4", 6 clamps for 5" and larger. Husky SD (Super-Duty) 4000, Clamp-All 125, Ideal Tridon Super Heavy-Duty, Mifab QXHUB Heavy Duty or approved equal.
- B. PVC Pipe: Schedule 40 solid wall PVC, bell and spigot solvent sealed ends. NSF Standard 14, ASTM D1785, ASTM D1784.
1. Fittings: Schedule 40, PVC, ASTM D2665.
 2. Joints: Solvent weld with ASTM D2564 solvent cement.

2.2 STORM WATER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888, CISPI 301, hub-less. Made in USA by AB&I, Charlotte or Tyler marked with collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.
1. Fittings: ASME B16.45 or ASSE 1043, long pattern cast iron, hubless.
 2. Joints: Heavy-Duty, Shielded, Stainless-Steel coupling with all type 304 stainless steel shield and band assembly, 80 in/lbs worm drive. ASTM C-564 Neoprene gasket. CISPI 310 and certified by NSF international. Minimum 4 clamps up to 4", 6 clamps for 5" and larger. Husky SD (Super-Duty) 4000, Clamp-All 125, Ideal Tridon Super Heavy-Duty, Mifab QXHUB Heavy Duty or approved equal.

2.3 NO-HUB TRANSITION COUPLING FOR JOINING CAST IRON AND PVC PIPE

- A. Coupling shall be Tested and Certified to ASTM C 1460 and be constructed with type 304 stainless steel shield, thickness 0.015, gasket material to meet ASTM C564, 1-1/2" - 4" will be 3" wide with four (4) 304 stainless steel bands and 6" - 10" will be 4" wide with six (6) 304 stainless steel bands and 3/8" 305 stainless steel hex head screws torqued to 80 inch pounds. Husky SD 4000 PVC x CI or approved equal.

2.4 ROOF DRAINS

- A. Manufacturers: Zurn, Josam, J.R. Smith, Wade or approved equal.
- B. Coated cast iron body with aluminum dome, membrane flange and clamp, underdeck clamp, roof sump receiver, waterproofing flange, adjustable extension sleeve for roof insulation. On overflow drains provide 2" internal water dam.

2.5 CLEANOUTS

- A. Manufacturers: Zurn, J.R. Smith, Josam, Wade or approved equal.
- B. Exterior Surfaced Areas: Round cast nickel bronze access frame with bronze gasket threaded plug and non-skid cover.
- C. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and bronze gasket threaded plug.
- D. Interior Finished Floor Areas: Type of ferrule, top and cover as required for the type of floor construction, finish surface and traffic conditions. Cleanout construction material to match waste piping with anchor flange, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas. For carpet provide marker. For cast iron construction provide bronze gasket threaded plug.
- E. Interior Finished Wall Areas: Cleanout construction material to match waste piping, line type with round gasket threaded plug, and round stainless steel access cover secured with machine screw. For cast iron construction provide bronze gasket threaded plug.
- F. Interior Unfinished Accessible Areas: Threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify and provide required extensions, clamps and drain styles to match deck or roof construction and finish.

3.2 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.
- B. Provide connections to site mains as indicated on drawings.
- C. Grade piping at 1/4" per foot where possible, but in no case less than 1/8" per foot. Install all main vertical soil and waste stacks with provisions for expansion and extend full size to roof line as vents.
- D. Backfill trenching with pea-gravel if available at site for other purposes. If pea-gravel is unavailable, native soil may be used for backfill if all the following conditions are met.
 - 1. All broken concrete and sharp stones (+1" dia.) to be removed from backfill soil.
 - 2. All large stones (3' dia. or bigger) to be removed from backfill soil.

3. Piping shall be bedded on min. 2" thickness of replaced "rock free" soil and then checked for grade.
- E. Establish elevations of buried piping with not less than 3 ft of cover.
- F. Establish minimum separation from other services piping in accordance with Code.
- G. Route pipe in straight line.
- H. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- I. Install shutoff and drain valves at locations indicated on Drawings.
- J. Install plastic ribbon tape continuous over top of pipe.
- K. Install trace wire continuous over top of pipe.

3.3 INSTALLATION - ABOVE GROUND PIPING

- A. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Install piping on interior side of building insulation.
- E. Sleeve pipe passing through partitions, walls and floors.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Protection: Where piping, other than cast iron or steel, is installed in a concealed location through holes or notches in framing (i.e. studs, joists, rafters, etc.), less than 1-1/2 from framing edge, provide shield plates. Shield plates shall be 16 gauge steel and cover the piping area within framing plus 2" on each side along framing.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- I. Establish invert elevations, slopes for drainage to 1/4 inch per foot minimum. Provide 1/8 inch per foot only where necessary and allowed by local jurisdiction. Maintain gradients.
- J. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- K. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- L. Insulate piping. Refer to Section 22 07 00.
- M. Install pipe identification in accordance with Section 22 05 00.

3.4 INSTALLATION - STORM DRAINAGE PIPING SYSTEMS

- A. Install storm drainage piping systems in accordance with ASME B31.9 and local plumbing code.
- B. Support cast iron drainage piping at every joint.
- C. Provide cleanouts every 50 feet and install at all locations required by code and to permit cleaning of all waste piping. Provide cleanouts full size of pipe, but no larger than 4". Coordinate with Architect when cleanouts are located in finished rooms. Install cleanout threads with graphite. Locate cleanouts to clear cabinet work and to be easily accessible.

3.5 INSTALLATION - PUMPS

- A. Provide pumps operating at specified system fluid temperatures without vapor binding and cavitation, non-overloading in parallel or individual operation, and operating within 25 percent of midpoint of published maximum efficiency curve.
- B. Provide shaft length allowing ejector pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
- C. Provide air cock and drain connection on horizontal pump casings.
- D. Provide line sized ball valve and line sized soft seated check valve on pump discharge.
- E. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump independently of pump casings. Install supports under elbows on pump discharge line sizes 4 inches and larger.
- F. Check, align, and certify alignment of pumps prior to start-up.

3.6 FIELD QUALITY CONTROL

- A. Obtain written approval of local Plumbing Authority prior to covering or concealing any work.
- B. Test storm piping system to hydrostatic test of 10 feet head of water.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Compressed air piping and accessories.
 2. Compressed air outlets.
 3. Air compressor and filters.
 4. Air pressure reducing valve.
 5. Pressure regulators.
 6. Hose connectors.

1.2 SCOPE

- A. Furnish and install air compressor, piping and accessories for a complete compressed air system.

1.3 MAINTENANCE MATERIALS

- A. Furnish two quart containers of compressor oil for each compressor.

PART 2 PRODUCTS

2.1 COMPRESSED AIR PIPING

- A. Steel Pipe: ASTM A53, Schedule 40 black, seamless. Manufactured in the USA.
1. Fittings: ASME B16.3, malleable iron Class 150, or ASTM A234, forged steel welding type, Class 150.
 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.
- B. Copper Tubing: ASTM B88, Type K drawn.
1. Copper Press Fittings: Conforming to ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze with EPDM O-ring seals.
 2. Joints: Compression type made with manufacturer's tool. 200 psi working pressure.
- C. Stainless Steel Piping: Vic-Press Type 304/304L, Schedule 10S, ASTM A312
1. Fittings: Austenitic stainless steel, Type 304/304L, complete with synthetic rubber HNBR o-rings and pipe stops.
 2. Use a Victaulic "PFT" series tool with the proper sized jaw for pressing.
 3. Joints: Stainless steel, pressure-sealed, Victaulic Vic Press 304™

2.2 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
1. Ferrous Piping: Class 150, 300 psi CWP, malleable iron, threaded.
 2. Copper Piping: Class 150, 300 psi CWP, bronze unions with brazed joints.
 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
1. Ferrous Piping: Class 150, 300 psi CWP, forged steel, slip-on flanges.

2. Copper Piping: Class 150, 300 psi CWP, slip-on bronze flanges.
3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

2.3 BALL VALVES

- A. Manufacturers: NIBCO or equal by Apollo, Hammond, Milwaukee, Stockham or approved equal.
- B. 2 inches and Smaller: MSS SP 110, 600 psi CWP, bronze, two piece body, type 316 stainless steel ball, full port, Teflon (TFE) seats, blow-out proof stem, solder or threaded ends with union, lever handle. Nibco Model 585-70-66.

2.4 BALL VALVES – STAINLESS STEEL

- A. Manufacturers: Victaulic (for specific use with Vic-press stainless steel piping system) or approved equal.
- B. Stainless steel body, ball, and stem, PTFE seats, 304 stainless steel handle, nut, and stem washer, with Schedule 10S stainless steel type 316 Vic-Press™ and/or grooved ends. Victaulic Series P569.

2.5 CHECK VALVES

- A. Swing Check Valves:
 1. Manufacturers: NIBCO or equal by Apollo, Hammond, Milwaukee, Stockham or approved equal.
 2. 2 inches and Smaller: MSS SP 80, Class 125, 200 psi CWP, bronze body and cap, bronze disc with TFE seat, Y-pattern design, solder or threaded ends. Nibco Model T/S-413-Y.
- B. Spring Loaded Check Valves:
 1. Manufacturers: NIBCO Model 480, W-910 or equal by Apollo, Hammond, Milwaukee, Stockham or approved equal.
 2. 2 inches and Smaller: MSS SP 80, Class 125, 250 psi CWP, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, solder or threaded ends. Nibco Model T/S-480.

2.6 STRAINERS

- A. Manufacturers: Apollo/Conbraco, Metraflex, Titan or approved equal.
- B. 2 inch and Smaller: Class 250, ASTM B62 bronze body, 400 psi CWP, Y pattern with 60 mesh stainless steel perforated screen.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Mason Industries, Metraflex or approved equal.
- B. 2 inches and Smaller: Braided stainless steel hose with single layer of stainless steel exterior braiding, maximum working pressure 170 psig. Mason Industries BSS/Braided Stainless Steel Hose, GU-MN ¾" by 10" or approved.

2.8 RELIEF VALVES

- A. Relief Valves: Bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated capacities ASME certified and labeled.

2.9 COMPRESSED AIR OUTLETS

- A. Manufacturers: Lincoln #815 or approved equal.
- B. Compressed Air Outlets: Quick Connector: 3/8 \ 1/4 inch brass, snap on connector with self closing valve.

2.10 HOSE REELS

- A. Manufacturers: Graco XD, Reelcraft or approved equal.
- B. Heavy duty type, steel construction, dual pedestal frame, powder coat finish, spring retractable, 1/2" inlet, 1/2" outlet, 300 psi rated.
- C. Hose: 1/2", 250 psi rated.
- D. Accessories:
 - 1. Mounting bracket and stainless steel hardware.
 - 2. Hose ball stop kit.
 - 3. Hose inlet kit.

2.11 AIR COMPRESSOR

- A. Two-stage, reciprocating compressor unit mounted on horizontal ASME receiver with air-cooled after cooler, dry-type filter silencer, auto condensate drain safety valve, isolation valve, pressure gauge, motor starter and belt guard. Ingersoll-Rand, Joy Dresser-LeRoi or approved equal.
- B. Air Compressor: Simplex tank mounted compressor unit consisting of air-cooled compressor, air receiver, after cooler, and operating controls.
- C. Reciprocating Compressors:
 - 1. Unit: Reciprocating compressor with positive displacement oil pump lubrication system, suction inlet screen, discharge service valves, on cast iron or welded steel base for motor and compressor with provision for V-belt adjustment.
 - 2. Automatic Capacity Reduction Equipment: Suction valve unloading device with lifting mechanism operated by oil pressure \ gas discharge pressure \ solenoid valve \ centrifugal force. Furnish unloaded compressor start.
 - 3. Motor: Constant speed 1800 rpm with electronic overheating protection in each phase with full voltage starting.
 - 4. Control Panel: Factory mounted and wired, NEMA 250 Type 1 enclosure, steel construction, with power and control wiring, molded-case disconnect switch, factory wired for single point power connection.
 - a. Starter: Furnish with manual reset current overload protection, starter relay, control power transformer, terminal strip for connection to interface equipment.
 - b. Safety Controls: Manually reset low oil pressure cutout.
 - c. Panel Face: Compressor run light, start-stop switch, elapsed time meter.
- D. Controls:
 - 1. Pressure Switch: Line voltage contactor to break at 100 psi with minimum differential of 20 psi.
 - 2. Compressor Regulation: Lead-lag switch with time delay relay.
 - 3. Electrical Alternation: Operate lead compressor for 12 hour time period. When lead compressor fails, start second compressor to automatically maintain air pressure.

- E. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box.
- F. Disconnect Switch: Factory mount in control panel.

2.12 AIR PRESSURE REDUCING VALVE

- A. Manufacturers:
- B. Air Pressure Reducing Valve: Consisting of automatic reducing valve and bypass, and low pressure side relief valve and gauge. Furnish oil separator.
- C. Valve Capacity: Reduce pressure from 200 psi to 30 psi, adjustable upward from reduced pressure.

2.13 PRESSURE REGULATORS

- A. Manufacturers: Parker, Norgren or approved equal.
- B. Pressure Regulators: Diaphragm \ Pilot operated, bronze body, direct acting, spring loaded, manual pressure setting adjustment, rated for 250 psig inlet pressure.
- C. Pressure Regulators: Aluminum alloy or plastic body, diaphragm operated, direct acting, spring loaded, manual pressure setting adjustment, and rated for 250 psig inlet pressure.

2.14 PRESSURE GAUGE

- A. Manufacturers: Marsh, Terice, Weiss or approved equal.
- B. Gauge: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Cast aluminum.
 - 2. Bourdon Tube: Phosphor bronze or Type 316 stainless steel.
 - 3. Dial Size: 4-1/2 inch diameter within 7' of floor, 6 inch diameter over 7'.
 - 4. Mid-Scale Accuracy: 1/2 percent.
 - 5. Scale: 0-200 Psi.

2.15 COMBINATION FILTER/REGULATOR/LUBRICATOR

- A. Manufacturers: Parker, Norgren or approved equal.
- B. Lubro-psig control unit, 3/4" port, auto-drain filter with guard, 5 to 125 psig regulator with pressure gauge. Micro-Fog lubricator with 1/2 pint bowl with guard.

2.16 COMPRESSED AIR FILTERS

- A. Manufacturers: Parker Finite H, Norgren or approved equal.
- B. Size filter housing using manufacturer's sizing chart base on total compressor SCFM plus 25% and scheduled pressure. Aluminum housing, chromate heads and bowls, powder painted exterior, 500 PSIG rated, nitrile seals.
- C. Provide housing with differential pressure gauge and automatic drain valve.
- D. Dryer Pre-Filter: Coalescing Grade 6C, epoxy saturated, borosilicate glass micro-fiber media.

- E. Post Dryer Filter: Interceptor Grace 3P, pleated cellulose, 3 micron absolute rating.
- F. Outlet Filter: Coalescing Grade 6C, epoxy saturated, borosilicate glass micro-fiber media.

2.17 FLEXIBLE HOSE CONNECTORS

- A. Hose Connectors: Corrugated stainless steel tubing with stainless steel wire braid covering and ends welded to inner tubing.
- B. Working Pressure: 250 psig minimum.
- C. End Connections:
 - 1. 2 inches and Smaller: Threaded steel pipe nipple.
 - 2. 2-1/2 inches and Larger: Class 150 Flanges.

2.18 ISOLATORS

- A. Mason industries ND-C Green 140-160 pounds 0.50" maximum static deflection.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION - ABOVE GROUND PIPING - COMPRESSED AIR SYSTEMS

- A. Slope main piping to compressor or additional system low points at 0.5-1.0% grade.
- B. Install drip legs at low points of piping system with drain valves. Locate drain valves in accessible locations.
- C. Install take-off to outlets from top of main, with shut off valve after take off. Slope take-off piping to outlets.
- D. Install compressed air couplings, female quick connectors, and pressure gauges where outlets are indicated.
- E. Install tees instead of elbows at changes in direction of piping. Fit open end of each tee with plug.
- F. Cut pipe and tubing accurately and install without springing or forcing.
- G. Stainless Steel Pipe with press-type Joints: Square cut ends to plus or minus 0.030 inches tolerance. Remove burrs and clean ends. Fully insert tubing into fitting and mark pipe ends to ensure full insertion into coupling or fitting during assembly. Press joint using manufacturer's tool with proper sized jaw.

- H. Copper Pipe with press-type Joints: Remove burrs and clean ends. Fully insert tubing into fitting and mark pipe ends to ensure full insertion into coupling or fitting. Check alignment against mark to assure tubing is fully inserted. Press joint using manufacturer's tool.
- I. Install pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions.
- J. Protection: Where piping, other than cast iron or steel, is installed in a concealed location through holes or notches in framing (i.e. studs, joists, rafters, etc.), less than 1-1/2 from framing edge, provide shield plates. Shield plates shall be 16 gauge steel and cover the piping area within framing plus 2" on each side along framing.
- K. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- L. Install pipe identification.
- M. Except where indicated, install manual shut off valves with stem vertical and accessible for operation and maintenance.
- N. Install strainers on inlet side of pressure reducing valves. Install pressure reducing valves with bypasses and isolation valves to allow maintenance without interruption of service.
- O. Install strainers on inlet side of pressure regulators.

3.3 INSTALLATION – VIC-PRESS STAINLESS STEEL

- A. Victaulic's factory trained representative shall provide on-site training for contractor's field personnel prior to installation in the use of PFT tools, application, and installation of products.
- B. Use Vic-Press in lieu of brazed copper or threaded black iron for pipe sizes ½" through 2".
- C. Use Vic-Press end valves where possible. Install Vic-Press 304 flange or threaded adapters where flanged or threaded valves are required.
- D. Victaulic's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

3.4 INSTALLATION - EQUIPMENT

- A. Install system in accord with manufacturer's requirements and recommendations.
- B. Install air compressor on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than compressor base on each side.
- C. Install air compressor unit on vibration isolators. Level, grout, and bolt in place.
- D. Install air valve and drain connection on horizontal casing.
- E. Install line size shut-off valve and anti-return check valve on compressor discharge.
- F. Install replaceable cartridge type filter silencer for each compressor.

- G. Install condensate drain piping to nearest floor drain. Determine best pipe routing.
- H. Install bypass with valves around air dryer. Use factory insulated inlet and outlet connections.
- I. Provide bypass with valves, around receivers.
- J. Make air cock and drain connection on horizontal casing.
- K. Provide each air outlet with a filter. Locate filter at a sufficient height and orientation so that it can be easily serviced. Locate quick-connect fittings for ease of connection of air hoses.

3.5 FIELD QUALITY CONTROL

- A. Compressed Air Piping Leak Test: Prior to initial operation, clean and test compressed air piping in accordance with ASME B31.1 or ASME B31.9.
- B. Verify for atmospheric pressure in piping systems, other than system under test.
- C. Test entire system with dry compressed air or dry nitrogen at 150 psig for a minimum duration of 2 hours, prove tight. If loss of pressure occurs, determine cause and remake joints. Caulking or patching not permitted.

3.6 CLEANING

- A. Blow systems clear of free moisture and foreign matter.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Natural gas piping buried within 5 feet of building.
 - 2. Natural gas piping above grade.
 - 3. Coordination with local gas company
 - 4. Valves & Strainers.
 - 5. Natural gas pressure regulators.

1.2 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- C. Use ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.3 QUALITY ASSURANCE

- A. Comply with requirements and recommendations of NFPA 54 and the International Fuel Gas Code.
- B. Perform work in accordance with applicable code and local gas company requirements.
- C. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

1.4 COORDINATION

- A. Refer to plans for meter location and coordinate with the Gas Company for installation and size. Facilitate application for gas service and pay all charges necessary for complete installation.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53, Schedule 40 black, seamless. Manufactured in the USA.
 - 1. Fittings: ASTM A234, forged steel welding type.
 - 2. Joints: ASME B31.9, welded.
 - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2.2 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53, Schedule 40 black, seamless. Manufactured in the USA.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234, forged steel welding type.
 - 2. Joints: 2 inch and smaller pipe - Threaded.

3. Joints: 2-1/2 inches and larger pipe – welded.

- B. Steel Pipe: ASTM A53, Schedule 40 black, seamless. Manufactured in the USA.
1. Fittings: Compression type, Viega MegaPress G, ANSI LC4-2012, zinc and nickel coating, HNBR sealing element, 420 stainless steel grip ring, 304 stainless steel separator ring and smart connect feature.
 2. Joints: 2 inch and smaller pipe - Viega MegaPress G Ridgid tool press.

2.3 BALL VALVES

- A. Manufacturers: Nibco, Stockham, Milwaukee, or approved equal.
- B. 1/2 inch to 3/4 inch (appliance shutoff valve): 1/2 psi rated for indoor appliance connections per ANSI Z21.15. Forged brass body, chrome plated brass ball, fluorocarbon o-rings, brass stem, painted aluminum lever handle. (Nibco G10)
- C. 1/4 inch to 1 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port. (Nibco T585-70-UL)
- D. 1-1/4 inch to 3 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome plated bronze ball, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port. (Nibco T580-70-UL)

2.4 FLEXIBLE PIPE CONNECTIONS

- A. Tubing: Annealed, 304 stainless steel, ASTM A240
- B. Fittings: Brass or stainless steel.
- C. Coating: Yellow polymer.

2.5 QUICK CONNECT FITTING

- A. Manufacturers: T&S or approved equal.
- B. 3/4" one-way shut-off coupling and plug body. Bass body construction with stainless steel internal parts.

2.6 SOLENOID VALVE

- A. Manufacturers: Alcon, Asco or approved equal.
- B. Aluminum body, nitrile seal, normally closed, zero pressure rated, NEMA 2 metal enclosure, UL Listed, 24 Volt.
- C. Manual push button wall mounted reset. Coordinate with alerting system.

2.7 EARTHQUAKE VALVE

- A. Manufacturers: California Seismic Valves 300 series or approved equal.
- B. Valve shall be full size of pipe off meter. No external electrical power required. Swing check valve arrangement with an acceleration sensitive triggering mechanism. Trip mechanism consists of steel ball. Horizontal motion of an earthquake triggers shut off. Manual reset. Sight glass indicates open or closed.

2.8 EXTERIOR WALL OUTLET

- A. Manufacturer: Burnaby #GR0101-SS or approved equal.
- B. Recessed stainless steel gas outlet box with brushed finish, 1/2" NPT pipe connection, shutoff valve, 3/8" quick disconnect plug, lockable access door.

2.9 STRAINERS

- A. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- B. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.10 NATURAL GAS PRESSURE REDUCING VALVES

- A. Manufacturers: Fisher or approved equal.
- B. Product Description: Quick-reacting, low-shock natural gas, spring loaded pressure regulator, ductile Iron body, aluminum casings and orifice, nitrile diaphragm and o-rings, full internal relief, 125 psi inlet rated. Threaded or flanged ends depending on size.

2.11 NATURAL GAS PRESSURE REDUCING VALVES (VENTLESS)

- A. Manufacturers: Maxitrol 325-L Series or approved equal.
- B. Product Description: High leverage linkage assembly with positive dead-end lockup pressure regulator. Aluminum housing, threaded ends. Provide with VLimitter vent limiting devise.

PART 3 EXECUTION

3.1 GAS METERS AND DISTRIBUTION

- A. Refer to plans for meter location and coordinate with the Gas Company for installation and size. Facilitate application for gas service and pay all charges necessary for complete installation.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside of pipe, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION - BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54 and the International Fuel Gas Code.
- B. Verify connection to existing piping system size, location, and invert.
- C. Establish elevations of buried piping with not less than 2 ft of cover.

- D. Establish minimum separation from other services piping in accordance with code.
- E. Install pipe on prepared bedding.
- F. Route pipe in straight line.
- G. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- H. Install plastic ribbon tape continuous over top of pipe and buried 6 inches below finish grade, above pipe line.

3.4 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54 and the International Fuel Gas Code.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Provide flexible pipe at connections to all equipment. Use sufficient length to allow for 4" of movement.
- D. Grade horizontal pipe not less than 1/4" in 15 feet.
- E. Route piping in orderly manner and to conserve building space and not interfere with use of space.
- F. Group piping whenever practical at common elevations.
- G. Provide 6" long drip leg at bottom of vertical pipe.
- H. Take from top or side of horizontal pipe.
- I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- J. Sleeve pipe passing through partitions, walls and floors.
- K. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping.
- L. Provide clearance for access to valves and fittings.
- M. Provide access doors where valves and fittings are not exposed.
- N. Do not embed any building service low pressure pipe in concrete, in masonry, or below grade. Install such pipe in Schedule 40 welded pipe sleeves and vent to roof.
- O. Provide support for utility meters in accordance with requirements of utility company.
- P. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.
- Q. Install identification on piping systems.
- R. Install valves with stems upright or horizontal, not inverted.

- S. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

3.5 INSTALLATION – APPLIANCES

- A. Range: Align gas piping with recess behind appliance. Coordination size and location of recess with range manufacturer's installation instructions. Gas piping installation shall not prevent range from being fully installed against wall.

3.6 PRESSURE REDUCING VALVES

- A. Install per manufacturer's recommendations. If PRV is installed indoors determine routing to an approved location and provide independent relief pipe to outside. Size relief vent pipe full port size, $\frac{3}{4}$ " minimum. Increase vent pipe size one pipe size for lengths greater than 15'. Increase vent pipe size two pipe sizes for lengths greater than 25'.

3.7 FIELD QUALITY CONTROL

- A. Pressure test natural gas piping in accordance with NFPA 54 and the International Fuel Gas Code.
- B. Subject pipe to air pressure of 60 psig for 30 minutes with no perceptible drop in pressure.
- C. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Water heaters.
 2. Diaphragm-type expansion tanks.
 3. System lubricated circulators.
 4. Water heater venting (Plastic)

VENTING

- B. Provide plastic venting and combustion air for water heaters and boilers in this section.

1.2 COORDINATION

- A. For equipment which requires metal venting coordinate required material and location with Division 23.

1.3 QUALITY ASSURANCE

- A. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by Washington State Energy Code and scheduled on drawings.

PART 2 PRODUCTS

2.1 COMMERCIAL GAS FIRED WATER HEATERS

- A. Manufacturers: Laars "U.H.E." or approved equal.
- B. Type: Automatic, natural gas-fired, condensing, sealed combustion, vertical storage.
- C. Tank: Steel with glass lining; minimum 2" polyurethane thermal insulation (R-14), encased in corrosion-resistant jacket; zero clearance to combustibles. 95%-99% thermal efficiency.
- D. Controls: Electronic water thermostat with adjustable temperature range from 120 to 180 degrees F with LCD display; Automatic reset high temperature limiting thermostat, low water cutoff, upper hot water sensor, lower cold water sensor, gas pressure regulator, electronic direct spark ignition system.
- E. Factory-Installed Appurtenances:
1. Four replaceable magnesium anode rods.
 2. Brass drain valve.
 3. T&P relief valve.
 4. Zero clearance to combustibles.
 5. Bolted hand hole cleanout.
 6. Sediment reducing cold water inlet tube.
 7. Dielectric fittings.
- F. Accessories:
1. Direct venting concentric termination kit.
 2. Thermometers and pressure gauge taps on water inlets and outlets.

2.2 DIAPHRAGM-TYPE EXPANSION TANKS

- A. Manufacturers: Amtrol, Armstrong or approved equal.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; with pre-charged flexible EPDM diaphragm sealed into tank; steel ring base (vertical) or saddles (horizontal)
- C. Accessories: Pressure gage and air-charging fitting, tank drain.
- D. Installation: Before installation, charge tank with Nitrogen gas to equal domestic water line pressure at tank. Permanently mark fill pressure on tank.

2.3 SYSTEM LUBRICATED CIRCULATORS

- A. Manufacturers: Armstrong Astro 2, TACO, Grundfos or approved equal.
- B. Type: Horizontal shaft, single stage, direct connected with wet rotor motor for in-line mounting, for 150 psig maximum working pressure, 230 degrees F maximum water temperature.
- C. Casing: Lead-Free bronze or stainless steel with flanged pump connections. NSF 372 certified.
- D. Impeller: Polyether Imide (PEI)
- E. Shaft: Ceramic
- F. Bearings: Ceramic
- G. Bearing Seal: EPDM
- H. Motor: 3-speed
- I. Accessories:
 - 1. 24 hour time clock with on/auto/off switch.
 - 2. Clip-on aquastat with bi-metal disc, 85F on, 105F off.

2.4 FLUE AND COMBUSTION AIR PIPING

- A. PVC Pipe: ASTM D1785, Schedule 40 solid wall, polyvinyl chloride (PVC) material.
 - 1. Fittings: ASTM D2665, Schedule 40, PVC.
 - 2. Joints: Solvent weld with ASTM D2564 solvent cement. Prime joints with a contrasting color.
- B. CPVC Pipe: ASTM F441/F441M, Schedule 40 solid wall, chlorinated polyvinyl chloride (CPVC) material.
 - 1. Fittings: ASTM F438, CPVC, Schedule 40, socket type.
 - 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement. Prime joints with a contrasting color.

PART 3 EXECUTION

3.1 INSTALLATION – WATER HEATER

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install water heater on concrete housekeeping pad, minimum 4 inches high and 6 inches larger than water heater base on each side. For electric water heaters include incompressible insulated surface (R-10 min).
- C. Anchor or strap to structure to resist horizontal displacement due to earthquake. IAPMO listed, galvanized steel, double body straps, Hubbard Quick Strap or approved equal.
- D. Connect domestic hot water and domestic cold water piping to water heater connections. Provide integral heat traps at connections.
- E. Install the following piping accessories. Refer to Section 22 11 00.
 - 1. On cold water:
 - a. Thermometer well and thermometer.
 - b. Strainer.
 - c. Pressure gage.
 - d. Shutoff ball valve.
 - 2. On hot water:
 - a. Thermometer well and thermometer.
 - b. Shutoff ball valve.
- F. Install discharge piping from relief valves and drain valves to nearest floor drain or indirect waste location. Determine best routing.
- G. Provide pan where required or specified.
- H. Install water heater trim and accessories furnished loose for field mounting.
- I. Install electrical devices furnished loose for field mounting.
- J. Install control wiring between water heater control panel and field mounted control devices.

3.2 INSTALLATION – NATURAL GAS FUEL FIRED

- A. Connect natural gas piping to water heater in accordance with NFPA 54, full size of water heater gas train inlet. Arrange piping with clearances for burner removal and service.
- B. Install the following piping accessories on natural gas piping connections. Refer to Section 22 23 00.
 - 1. Strainer.
 - 2. Shutoff valve.
- C. Connect flue to water heater outlet, full size of outlet.

3.3 INSTALLATION - FLUE AND COMBUSTION AIR PIPING

- A. Install flue and vent piping per manufacturer's installation instructions. Note maximum allowable venting length.

- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Protection: Where piping, other than cast iron or steel, is installed in a concealed location through holes or notches in framing (i.e. studs, joists, rafters, etc.), less than 1-1/2 from framing edge, provide shield plates. Shield plates shall be 16-gauge steel and cover the piping area within framing plus 2" on each side along framing.
- G. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- H. Provide factory vent and combustion air terminations. Flash and seal piping penetrating building exterior to maintain integrity of assembly.
- I. Install pipe identification in accordance with Section 22 05 00.

3.4 INSTALLATION - PUMPS

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.
- C. Provide line sized shut-off valve and strainer on pump suction, and line sized check valve, balancing valve, and shut-off valve on pump discharge.
- D. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump, so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.
- E. Provide P/T test plugs.
- F. Provide air cock and drain connection on horizontal pump casings.
- G. Provide drains for bases and seals.
- H. Where appropriate, lubricate pumps before start-up.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General Plumbing Fixtures: Water closets, Urinals, Lavatories, Sinks, Service sinks, Showers, Drinking fountains, Electric water coolers.
 2. Faucets and valves
 3. Emergency Fixtures: Emergency Eye and Face Wash.
 4. Hose bibbs & Hydrants.
 5. Accessories.

1.2 SCOPE

- A. This section includes all plumbing fixtures, trim and installation, to include owner furnished equipment.

1.3 REQUIREMENTS

- A. All china fixtures shall be white or manufacturer's standard unless otherwise indicated.
- B. Ensure that that all china fixtures install in a room or area are the exact same color and hue, especially if from different manufacturers.
- C. Fixtures by type and material shall be of the same manufacturer except when scheduled or approved otherwise.
- D. Fixtures shall be designed or equipped to meet the following water use efficiency standards:
- | | |
|--------------------------------|---------------------------|
| 1. Water closets (flush valve) | 1.1/1.6 GPF (Dual) |
| 2. Urinals | 0.125 GPF |
| 3. Shower heads | 1.5-1.75 GPM (WaterSense) |
| 4. Lavatory faucets (Private) | 1.0 GPM |
| 5. Lavatory faucets (Public) | 0.5 GPM |
| 6. Kitchen Sink faucets | 1.5-1.75 GPM |
| 7. Sink faucets | 1.0 GPM |

PART 2 PRODUCTS

2.1 FLUSH VALVE WATER CLOSETS

- A. Manufacturers: Kohler, Toto, Eljer, American Standard or approved equal.
- B. Wall Mount: white, vitreous china, 1-1/2" top spud, elongated bowl, siphon jet, 2-1/4" passageway, china bolt caps. Provide wall carrier.

2.2 WALL HUNG URINALS

- A. Manufacturers: Kohler, Toto, Eljer, American Standard or approved equal.
- B. Urinal: white, vitreous china, wall mount, 3/4" top spud, siphon jet, integral trap. Provide wall carrier.

2.3 FLUSH VALVES

- A. Manufacturers: Sloan, Zurn, no equal.
- B. Water Closet (Dual Flush): Dual flush, quiet, exposed, diaphragm type, chrome plated flush valve with antimicrobial coated handle, synthetic rubber diaphragm, dual filtered fixed bypass, ADA compliant non-hold open triple seal handle, angle stop, adjustable tailpiece, back pressure vacuum breaker, escutcheon, metal wall plates with usage instructions, 1.6 gpf/1.1 gpf.
- C. Urinal (Manual): Quiet, exposed, diaphragm type, chrome plated flush valve with synthetic rubber diaphragm, dual filtered fixed bypass, ADA compliant non-hold open triple seal handle, angle stop, adjustable tailpiece, back pressure vacuum breaker, escutcheon.

2.4 WATER CLOSET SEATS

- A. Manufacturers: Bemis, Olsonite or approved equal.
- B. Open Front: Heavy duty solid plastic, white, large molded-in bumpers, external check hinges with stainless steel posts, without cover.

2.5 LAVATORIES

- A. Manufacturers: Kohler, Eljer, American Standard or approved equal.
- B. Wall Hung: white, vitreous china, wall mounted, drilled for concealed arm carrier, overflow, ADA compliant. Provide with wall carrier.
- C. Undercounter: white, vitreous china, unglazed rim for under counter mount with overflow.

2.6 SINKS

- A. Manufacturers: Elkay, Just, Acorn or approved equal.
- B. Single Compartment: Seamless 18 gauge. Type 304 stainless steel, self-rimming, radius corners, sound deadening undercoat.
- C. Double Compartment: Seamless 18 gauge. Type 304 stainless steel, self-rimming, radius corners, sound deadening undercoat.
- D. Scullery: 14 gauge stainless steel, welded construction ground smooth, 1/4" radius corners, wall and floor mounted with tubular stainless steel legs, 8" high full length backsplash with 45 deg. slope top, 1-1/2" wide inward slopping top channel rims, integral drainboards sloped to drain, drilled for faucet and drain outlets, satin finish.

2.7 SERVICE SINKS

- A. Manufacturers: Fiat, Florestone, Kohler or approved equal.
- B. Floor: Molded stone, 10" deep, stainless steel drain body with strainer and lint basket, vinyl bumperguards, stainless steel wall guards, mop hanger, hose clamp hanger, 5 feet of hose.

2.8 DRINKING FOUNTAINS

- A. Manufacturers: Elkay, Oasis, Haws, Acorn, Murdock or approved equal.
- B. Wall hung, hi-low stations, barrier-free ADA compliant, front controls, lead-free, stainless steel basins, support arms and wall cover, safety bubbler.

2.9 FAUCET, LAVATORY

- A. Manufacturers: Chicago, Geberit, Delta HDF, Symmons or approved equal and as specifically noted below.
- B. Centerset:
 - 1. Single Handle: Polished chrome plated cast brass, deck mount, metal lever handle, ceramic mixing cartridge, temperature limit stop, 0.5-1.0 gpm aerator. Spout length, drain and hole spacing as scheduled.

2.10 FAUCET, SINK

- A. Manufacturers: Chicago, Delta HDF, Symmons or approved equal.
- B. Swing Spout:
 - 1. Single Handle: Polished chrome plated cast brass, deck mount, metal lever handle, ceramic mixing cartridge, temperature limit stop. Spout length, drain and hole spacing as scheduled.
- C. Gooseneck:
 - 1. Dual Handle: Polished chrome plated cast brass, deck mount, metal indexed wristblade handles. Spout height, reach, drain and hole spacing as scheduled.

2.11 FAUCET, SERVICE

- A. Manufacturers: T&S Brass, Chicago, Delta HDF, Symmons, or approved equal.
- B. Wall Mount: Chrome plated brass, vacuum breaker spout with pail hook and wall brace, indexed level handles, hose thread outlet, adjustable supply arms, integral stops and supply check valves.

2.12 FAUCET, DECON

- A. Manufacturers: Chicago or approved equal.
- B. Polished chrome plated brass, wall mount, 12" swing spout, with hot and cold knee valve.

2.13 SHOWER/TUB VALVES

- A. Manufacturers: Chicago, Delta HDF, Symmons or approved equal and as specifically noted below.
- B. Shower: Pressure balancing valve that cycles from cold to hot, lever handle, chrome plated brass, intergral service stops, complete with shower head, arm and flange.

2.14 SHOWER HEADS

- A. Manufacturers: Speakman, Symmons or approved equal.

- B. Solid brass construction, polished chrome finish, 6-jet showerhead, infinitely adjustable spray streams with operating handle, pressure-compensating auto-flow limit to 1.5-1.75 gpm.
- 2.15 SHOWER HAND SPRAY
- A. Manufacturers: Symmons or approved equal.
 - B. Personal hand held shower with push button, on-off control, 60" double spiral metal hose, 36" stainless steel slide/grab bar, ADA adjustable slide, chrome plated vacuum breaker, chrome plated wall supply elbow.
- 2.16 INSTANTANEOUS HOT WATER DISPENSER
- A. Manufacturers: In-Sink-Erator or approved equal.
 - B. ½ gallon insulated tank, 1.75 gal/hour capacity @ 190 F, 140-200 F adjustable thermostat, instant self-closing valve, chrome, UL listed.
- 2.17 EMERGENCY EYE AND FACE WASH
- A. Manufacturers: Haws, Bradley, Guardian, Speakman, Acorn or approved equal.
 - B. Deck mounted eye/face wash with pull-down activation, wall bracket, twin soft anti-surge eyewash heads, stainless steel face spray ring, hand flag control, dust cover, brass stay-open ball valve, in-line 50x50 mesh brass strainer, CSA certified to meet ANSI Z358.1. Include universal emergency signage 8"x11".
- 2.18 HOSE BIBBS
- A. Manufacturers: Woodford, Zurn, JR Smith or approved equal.
 - B. Interior: Bronze or brass with integral mounting flange, automatic draining, anti-siphon vacuum breaker, 3/4" hose thread, wheel handle.
 - C. Exterior (Freeze Proof): Automatic draining, freezeless, hose connection backflow protection, two check valves, 3/4" hose thread, loose key handle, wall clamp.
 - D. Yard Hydrant (Freeze Proof): 3/4" brass male nozzle hose connection with two check valve backflow protection, automatic drain plunger, air vent, internal operation rod with guide and adjustable link, Teflon impregnated packing.
- 2.19 HOSE STATION
- A. Manufacturers: Leonard or approved equal.
 - B. Hot & Cold: Panel-type recessed stainless steel cabinet with stainless steel cover, inlets with stops, check valves and color coded handles, outlet dial thermometer, vacuum breaker hose connection, stainless steel hose rack, [10] feet of 3/4" heavy duty EPDM hose with industrial rubber coated bronze nozzle.
- 2.20 HOSE REELS
- A. Manufacturers: Reelcraft or approved equal.

- B. Heavy duty type, steel construction, dual pedestal frame, powder coat finish, spring retractable, 3/4" inlet, 3/4" outlet, 300 psi rated.
- C. Hose: 3/4" 125 psi rated.
- D. Accessories:
 - 1. Mounting bracket and stainless steel hardware.
 - 2. Hose inlet kit, for connection to hose bibb.

2.21 RECESSED VALVE BOX

- A. Manufacturers: Guy Gray, Acorn, Oatey, Sioux Chief or approved equal.
- B. General: Box construction shall match fire rating of wall.
- C. Washing Machine: 2" drain socket, 3/4" hot & cold brass valves, wall brackets, face plate.
- D. Water: 1/4 turn brass ball valve with recessed wall box, wall brackets, face plate.

2.22 FIXTURE SUPPLIES

- A. Manufacturers: Brass Craft, McGuire or approved equal.
- B. Chrome plated all brass angle stops with brass stems (no plastic). Fixed key metal handle and chrome plated escutcheon. Chrome plated copper flexible supplies for exposed connections, braided supplies acceptable where concealed. Provide stop and supply type as applicable to specific fixtures. Supply shall be marked with manufacturer's name and comply with ANSI NSF 61 "No Lead".

2.23 TRAPS

- A. Manufacturers: Brass Craft, Dearborn Brass, McGuire or approved equal.
- B. Adjustable type, polished chrome plated cast brass, 17 gauge, with escutcheon. Provide type as applicable to specific fixture installation. PVC acceptable only where concealed.

2.24 LAVATORY INSULATION KIT

- A. Manufacturers: Truebro, Plumberex, McGuire or approved equal.
- B. Where lavatories or sinks have exposed traps or supplies furnish the following for ADA compliance: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers, antimicrobial, with flush reusable fasteners.

2.25 CARRIERS

- A. Manufacturers: Wade, J.R. Smith, Zurn, Josam or approved equal.
- B. Water Closet: Adjustable, coated cast iron assembly with neoprene closet gasket, integral drain hub and vent, lugs for floor and wall attachment, suitable for type of closet and connecting pipe.
- C. Urinal: Adjustable, coated cast iron assembly with neoprene closet gasket, tubular legs, lugs for floor and wall attachment, suitable for type of closet and connecting pipe.

- D. Lavatory: Provide concealed arm carriers for all wall mounted lavatories. Coated steel uprights with welded feet, cast iron adjustable headers, concealed arms, lugs for floor and wall attachment, steel sleeves, alignment truss.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify electric power is available and of correct characteristics.
- C. For all lavatories and sinks verify required number of holes and hole spacing before ordering.
- D. Verify finish floor elevation and flooring material for shower stall installation.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures and in accordance with manufacturer's details.
- B. Locate fixtures in accordance with architectural drawings, details on structural drawings and/or Engineer's direction in field. Mount ADA fixtures according to dimensions on architectural drawings.
- C. If drain, tailpiece, strainer or other accessories are not furnished by fixture manufacturer then provide accessories by Brass Craft or approved equal.
- D. Provide vandal proof features on faucets, aerators, bubblers and pop-up waste assemblies on fixtures in public areas.
- E. Coordinate shower enclosure floor recess for ADA threshold height or hidden mounting flange on polished concrete floors.

3.3 INSTALLATION

- A. Install shut-off valves on water lines servicing a fixture group.
- B. Support piping at stop, valve or flush valve.
- C. Align fixtures and equipment installed in accord with architectural drawings.
- D. Locate shower head mounting height 80" minimum from drain to centerline of head pipe.
- E. Locate shower curtain rod minimum 6'-3" AFF (verify with architect).
- F. Locate floor service sink (mop sink) faucet rough-in at 36" AFF.
- G. Locate water recessed valve boxes for refrigerators at 18" AFF.
- H. Locate water recessed valve boxes for coffee makers per architectural plans.
- I. Seal fixtures to wall and floor surfaces with silicon sealant, color to match fixture.

- J. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- K. For ADA accessible water closets, install flush valve with handle to wide side of stall.
- L. For ADA showers, recess shower enclosures into floor to obtain required accessible threshold dimension. Coordinate with architect on finish floor material and height. Provide the threshold with a finished appearance.
- M. For showers installed on polished concrete floors, recess tile flange into floor for a finished threshold appearance.
- N. Provide grout bedding beneath shower pans, shower enclosures and floor mounted mop sinks. Bedding shall support base of fixture and provide level installation.

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and ordering.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.
- B. Adjust flush lever or valve for intended flow rate and operation.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Conform to General Conditions, Supplementary Conditions, the modifications thereto and Division 01 - General Requirements for all work in Division 23.

1.2 SUMMARY

- A. Provide labor, materials and appliances necessary for satisfactory installation of mechanical work ready to operate in strict accordance with these specifications and drawings. Work of Division 23 includes, but is not limited to, that as delineated in the following specification sections:

23 00 00	HVAC General Conditions
23 05 00	Common Work Results for HVAC
23 05 93	Testing, Adjusting and Balancing
23 07 00	HVAC Insulation
23 08 00	Commissioning (<i>Welsh</i>)
23 09 00	Instrumentation and Control for HVAC
23 23 00	Refrigerant Piping
23 31 00	HVAC Ducts and Casings
23 33 00	Air Duct Accessories
23 34 00	HVAC Fans
23 35 16	Engine Exhaust Systems
23 37 00	Air Outlets and Inlets
23 38 00	Ventilation Hoods
23 40 00	HVAC Filters
23 51 00	Chimneys and Stacks
23 55 00	Fuel-Fired Heaters
23 72 00	Energy Recovery Units
23 81 43	Air-Cooled Variable Refrigerant Flow, Heat Pump System
23 83 16	Electric Duct Coils

23 83 23 Electric Terminal Heating Units

- B. Related Sections:
 - 018100 Jobsite Indoor Air Quality Construction Plan
 - 018113 Sustainable Design Requirements

1.3 CODES AND STANDARDS

- A. Conform to following code and agency requirements having jurisdictional authority over mechanical installation.
 - 1. Uniform Plumbing Code (UPC) with local amendments.
 - 2. International Mechanical Code (IMC) with local amendments.
 - 3. International Building Code (IBC) with local amendments.
 - 4. International Fuel Gas Code (IFGC) with local amendments.
 - 5. National Electrical Code (NEC) NFPA 70.
 - 6. Requirements of OSHA and EPA.
 - 7. National Fire Protection Association (NFPA) Codes and Standards.
 - 8. ASME code for construction of pressure vessels.
 - 9. American Gas Association (AGA) Standards.
 - 10. ASTM, ANSI and NEMA standards, as referenced in subsequent sections.
 - 11. Local Sewer District Requirements.
 - 12. Local Water District Requirements.
 - 13. Local Health Department Requirements.
 - 14. Washington State Energy Code.
 - 15. LEED Requirements
 - 16. SMACNA IAQ Guidelines for Occupied Buildings Under Construction, and ASHRAE Standard 52.2.

1.4 SUSTAINABLE DESIGN REQUIREMENTS:

- A. Comply with project requirements to achieve LEED Certification.
- B. Comply with Construction Waste Management plan. Refer to Division 01.
- C. LEED-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC, per referenced standards and no added urea-formaldehyde. Cleaning products used during construction and close-out procedures shall meet Green Seal standards GS-34, GS-37, and SG-40, or the California Code of Regulations, Title 17 Section 94509, VOC standards for cleaning products.
- D. Commissioning activities and submittals: Refer to Divisions 1, 22, and 23.
- E. Refer to Division 1 for more information on related LEED Credits.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to International Building Code with local amendments, FM, and UL for fire resistance ratings and surface burning characteristics.
- B. Provide vibration isolation on motor driven equipment over 0.5 hp, plus connected piping and ductwork.
- C. Provide minimum static deflection of isolators for equipment as follows:
 - 1. 5 hp and less: 1 inch

2. Over 5 hp: 2 inch

1.6 PRODUCT SUBSTITUTIONS

- A. Manufacturers and models of equipment and material indicated herein and on drawings are those upon which mechanical design is based. Other manufacturers with products considered equal in general quality may be listed without specific model designation. Manufacturers not listed shall be submitted for approval, see Division 01.
- B. Substitutions will be evaluated based on product manufacturer only. Specific product model, specifications, options and accessories will be evaluated during submittals. Approval of a manufacturer substitution does not constitute approval of the submitted product.
- C. Any equipment other than the basis of design is considered a substitution.
- D. In selecting substitute equipment, the Contractor is responsible for and shall guarantee equal performance and fit. Cost of redesign and all additional costs incurred to accommodate the substituted equipment shall be borne by the Contractor.
- E. Unless indicated otherwise, "or approved" may be assumed for all products in Division 23.

1.7 SUBMITTALS

- A. Provide one electronic copy of product data submittals for all products listed under "Part 2 Products" of Division 23 and all additional products noted on drawings or required for completion of sequence of operations.
- B. **Electronic: All sections of Division 23 shall be submitted together in one complete PDF file with bookmarks for each section. Multi-part submittals will be returned without review.**
 1. First Page: Name of Project, Owner, Location & Contracting Company.
 2. Index Page: List of specification sections with contents by Tag or item.
 3. Bookmarks: Electronic bookmark of each specification section corresponding to listing in index.
- C. Clearly indicate on each page the equipment schedule designation (Tag) and/or specification section, as applicable. Indicate selected model and all accessories intended for use.
- D. Equipment vendor cover page with contact information shall precede submittal by that vendor.
- E. Submitted product information shall include (as applicable) but not be limited to the following information:
 1. Product description
 2. Manufacturer and model
 3. Dimensions
 4. Performance Ratings (i.e. capacity, rpm, HP, temperature)
 5. Construction Materials
 6. Ratings (i.e. UL, ASTM, NEMA, etc)
 7. Electrical data
 8. Sound level data (corresponding to scheduled values)
 9. Vibration Isolation

10. Controls and wiring diagrams
 11. Accessories
 12. Engineering technical data (i.e. pressure drops, leakage rates, pump curves, fan curves)
- F. If requested by Architect or Engineer, submit Manufacturer's Installation Instructions on any equipment, procedures, or certifications so requested.
- G. Do no ordering, fabrication or manufacturing of products until return of approved submittals.

1.8 LEED RELATED DOCUMENTATION AND ACTIVITIES

- A. Provide commissioning documentation as the Commissioning Authority (CxA) requests.
- B. Provide list of all filters used during construction and installed immediately before occupancy, including product manufacturer, model number, location, MERV rating, and date installed.
- C. Comply with IAQ Management Plan by the general contractor. This includes, but is not limited to:
1. Maintain clean and sealed ductwork: from the point of fabrication, shipping, delivery and jobsite storage, keep ductwork wrapped, covered, clean and free of moisture and debris at all times. Clean any contaminated components after construction is complete.
 2. When duct protection is removed for air balancing, immediately reinstall when balancing is complete.
 3. During construction and before occupancy, maintain installation of MERV 8 filters on return air grilles and exhaust / negative side of system.
- D. Submit the LEED VOC Form, for any VOC-containing material to be used inside the building envelope, including materials for patching, touch-up and cleaning.
- E. Construction Waste Management: Retain and submit all trip and tip tickets for all construction debris and waste removed from site, indicating material content, tonnage, date hauled and facility to where materials were hauled. This submittal is to the general contractor only.

1.9 SHOP DRAWINGS

- A. The Contractor shall submit drawings and/or diagrams for review and for job coordination in all cases where deviation from the Contract Drawings are contemplated because of job conditions, interference or substitution of equipment, or when requested by the Engineer for purposes of clarification of the Contractor's intent.
- B. Submit detailed drawings, rough-in sheets, etc., for all special or custom-built items or equipment. Drawings and details under the section shall include (but not be limited to) the following, where applicable to this project:
1. Electrical interlock wiring diagrams.
 2. Piping layout plans and interference details.
- C. By submission of piping and ductwork shop drawings, the Contractor acknowledges that coordination has been done to ensure that all piping and ductwork fits and that no conflicts exist.

- D. The Architect's review of shop drawings shall not relieve the Contractor of responsibility for deviations from the Contract drawings or specifications, unless he has, in writing, called the attention of the Architect to such deviations at the time of the submission, nor shall it relieve him from responsibility for errors or omission in such shop drawings.

1.10 COMMISSIONING

- A. See Division 01 and Section 23 08 00 for roles and responsibilities of commissioning.
- B. Provide all necessary commissioning assistance, equipment and documentation as required by the Commissioning Plan.
- C. The duty and responsibility for mechanical commissioning work shall be assigned to a specific individual. Inform the General Contractor and Certified Commissioning Professional (CCXP) of the contact information for the person so assigned.
- D. Perform corrective actions needed to resolve deficiencies identified during commissioning. Record action taken on commissioning deficiency log.

1.11 HVAC PERMIT

- A. HVAC contractor shall prepare all documents for mechanical permit application, submit for, and obtain the permit. HVAC Contractor shall pay all costs and fees to obtain the permit.
- B. Contractor shall not commence work until permit is obtained. Contractor is solely responsible to insure that the permit application and any revisions are submitted in a timely manner so as not to impact project schedule.
- C. Contractor shall retain services of a third party structural engineer to provide support, anchoring and seismic calculations for all applicable equipment.

1.12 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.9 – Building Services Piping for installation of piping systems and ASME Section IX – Welding and Brazing Qualifications for welding materials and procedures.
- B. Perform Work in accordance with the International Mechanical Code including State and local amendments.
- C. Provide products requiring electrical connections listed and classified by UL as suitable for purpose specified and indicated.
- D. Perform Work in accordance with Washington State Energy Code.

1.13 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.14 SEQUENCING

- A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.15 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect all equipment, materials, and insulation from weather, construction traffic, dirt, water, chemicals, and damage by storing in original packaging and under cover. Where original packaging is insufficient, provide additional protection. Maintain protection in place until installation.
- C. Inspect all products and materials for damage prior to installation.
- D. Protect piping from all entry of foreign materials by providing temporary end caps or closures on piping and fittings. Furnish temporary protective coating on cast iron and steel valves.
- E. Protect heat exchangers and tanks with temporary inlet and outlet caps. Maintain caps in place until installation.
- F. Protect dampers from damage to operating linkages and blades.
- G. Protect materials and finishes during handling and installation to prevent damage.
- H. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.
- I. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- J. Comply with contractor's construction Indoor Air Quality (IAQ) Plan.

1.16 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply fire stopping materials when temperature of substrate material and ambient air is below 60 degrees F. Maintain this minimum temperature before, during, and for minimum 3 days after installation of fire stopping materials.
- B. Provide ventilation in areas to receive solvent cured materials.
- C. Do not install underground piping, tanks, or tank foundations when bedding is wet or frozen.
- D. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer. Maintain temperature during and after installation for minimum period of 24 hours.
- E. Do not install instruments when areas are under construction, except rough in, taps, supports and test plugs.

- F. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers. Maintain temperatures during and after installation of duct sealant.
- G. Maintain water integrity of roof during and after installation of chimney or vent.
- H. Do not install condensing unit foundation pad when ground is frozen or muddy.

1.17 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
- B. Verify by field measurements, sizes and configurations are compatible with wall construction and layout.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.

1.18 COORDINATION

- A. Visit the site and become familiar with existing conditions affecting work.
- B. Verify locations of any overhead or buried utilities on or near site. Determine such locations in conjunction with all public and private utility companies and with all authorities having jurisdiction.
- C. Existing systems and utility lines indicated on drawings are in accordance with information furnished to the Architect and may not be complete. Contractor is responsible for locating, uncovering, disposing of or maintaining existing systems.
- D. HVAC drawings are diagrammatic and do not indicate all possible site conditions. The contractor shall verify all measurements, dimensions and connections on site and coordinate between trades to preclude interferences. The contractor shall provide adjustments to piping or ductwork as necessary to fit conditions including but is not limited to relocation, offsets, and transitions.
- E. In the event of a conflict with other trades of work, the following priority from highest to lowest shall be followed: Structural, lighting, HVAC, plumbing/piping and sprinklers. Starting with the lowest priority, the HVAC, plumbing, and sprinkler contractors shall provide whatever materials, offsets, labor etc. is required to resolve the conflict.
- F. When discrepancies occur between plans and specifications, the Architect will determine which takes precedence and the Contractor shall perform the selected requirement at no additional cost.
- G. Prior to ordering equipment cross-check mechanical and electrical drawings and specifications to assure proper location and electrical characteristics of connections serving mechanical and electrical equipment.
- H. Advise the Architect of any modifications required to suit equipment furnished. Costs for modifications due to equipment substitution will be borne by the contractor.

- I. Wherever conflicts occur between different parts of the Contract Documents the greater quantity, the better quality, or larger size shall prevail unless the Architect informs the Contractor otherwise in writing.
 - J. The scale of each drawing is relatively accurate, but the Contractor is warned to obtain the necessary dimensions for any exact takeoffs from the Architect. No additional cost to the Owner will be considered for failure to obtain exact dimensions where not clear or in error on the drawings. Any device or equipment roughed in improperly and not positioned on implied centerlines or as required by good practice shall be repositioned at no cost to the Owner.
 - K. Where the word 'verify' is used on the documents, the contractor shall field verify the existing conditions and modify the scope of the installation as required to meet the verified conditions without additional cost to the Owner.
 - L. Coordinate trenching, excavating, bedding, backfilling of buried systems with requirements of this specification.
 - M. Coordinate wall openings, piping rough-in locations, concrete housekeeping pads, and electrical rough-in locations to accommodate Work of this Section.
 - N. Coordinate all equipment with building control work.
 - O. Coordinate installation of
 - 1. Condensing units with concrete pad and roof structure.
 - 2. Air handling units with building structure.
 - 3. Unit installation with roof structure, piping systems, and ceiling for unit access.
 - 4. Roof curbs with roof structure, roof deck and roof membrane installation.
- 1.19 CUTTING, FITTING, REPAIRING AND PATCHING
- A. Arrange and pay for all cutting, fitting, repairing, patching and finishing of work by other trades where necessary for installation of mechanical work. Perform work only with craftsmen skilled in their respective trades.
 - B. Avoid cutting, where possible, by setting sleeves, frames, etc., and by coordinating for openings in advance. Assist other trades in securing correct location and placement of rough-frames, sleeves, openings, etc. for ducts and piping.
 - C. Cut all holes neatly and as small as possible to admit work. Perform cutting in manner so as not to weaken walls, partitions or floors. Drill holes required to be cut in floors without breaking out around holes.
- 1.20 SALVAGE
- A. Remove excess piping and ductwork, plug or cap any unused branch connections. Remove scrap pipe and all other excess materials from the site.
 - B. Comply with contractor's Construction Waste Management Plan. Retain and submit all trip and tip tickets for all construction debris and waste hauling, indicating material content, tonnage, date hauled and facility to where materials were hauled.

1.21 ELECTRICAL

- A. Short-Circuit Current Rating (SCCR): All HVAC and refrigeration equipment with multi-motor or combination electrical loads shall comply with NEC 110.10 & 440.4 and must include a SCCR greater than the Available Interrupting Current (AIC) of the electrical circuit serving the equipment. See electrical drawings for required AIC kA rating. Equipment SCCR may be presented in writing from the manufacturer or shown on the unit nameplate. Refrigeration or air-conditioning equipment over 60 Amps MOCP must list the SCCR on the unit nameplate. If the AIC rating is unavailable or cannot be determined provide equipment with a minimum SCCR of 10kA.
- B. Motor Starters: By mechanical equipment manufacturer where factory mounted controls are provided. Variable frequency drives by Division 23, all other starters provided by Electrical Contractor.
- C. Power Wiring: By Electrical Contractor.
- D. Control Wiring: Responsibility of Division 23, including all line and low voltage control wiring. Owner will not entertain additional cost due to lack of coordination between HVAC Contractor and Electrical Contractor.

1.22 EXTRA MATERIALS

- A. Furnish
 - 1. Two refrigerant oil test kits each containing everything required for conducting one test.
 - 2. Three sets of disposable filters for each unit.
 - 3. One set of fan belts for each unit.

1.23 PROJECT CLOSEOUT

- A. Completion, submission and approval of the following is required for final project closeout.
 - 1. Execution of Architect's and Engineer's final observation reports (punchlist)
 - 2. Operating and Maintenance Instructions
 - 3. Operating and Maintenance Manual
 - 4. Equipment and Pipe Cleaning
 - 5. Record Drawings
 - 6. Testing
 - 7. Commissioning
 - 8. Warranty
- B. See Division 01 for additional requirements.

1.24 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. General: In addition to requirements of Division 01, following initial operation of HVAC systems and prior to acceptance by the Architect, perform the following services.
- B. At least two weeks prior to each instruction period, give written notification of readiness to proceed to the Architect and Owner, and obtain mutually acceptable dates.
- C. Conduct demonstrations and instructions for the Owner's representatives, pointing out requirements for operating, servicing and maintaining equipment and systems. Describe

general system operation and specific equipment functions. Cover all equipment calibration, setpoint adjustment, safeties and alarms.

- D. Furnish qualifications of Contractor's personnel in charge of the instruction; foreman position is minimum acceptable. Where equipment startup is performed by supplier's or manufacturer's personnel, those personnel should also provide training on that equipment.
- E. During demonstrations and instructions include and reference information from maintenance manuals and contract drawings.
 - 1. Provide documentation of all instruction which includes:
 - a. Date and time of instruction
 - b. Name, affiliation and qualifications of the instructor
 - c. Name and affiliation of the attendees
 - d. Topics, systems, and equipment covered
 - e. Length of instruction
- F. Minimum duration of instruction periods:
 - 1. HVAC Systems 4 hours
 - 2. Control Systems 4 hours

1.25 OPERATING AND MAINTENANCE MANUALS

- A. Contents: Furnish, in accord with Division 1, one PDF and one bound copy of operating and maintenance manuals to include the following:
 - 1. Manufacturers, suppliers, contractor names, addresses and phone numbers.
 - 2. Warranty service contractors' names, address and phone numbers (if different from above).
 - 3. Schedule and description of routine maintenance for each component to include oiling, lubrication and greasing data.
 - 4. Manufacturer's cuts and rating tables, including brochures for all submittal items.
 - 5. Part numbers of all replaceable items.
 - 6. Control diagrams and operation sequence.
 - 7. Written guarantees.
 - 8. Record drawings corrected and completed.
 - 9. Completed equipment start-up forms and checklists.
 - 10. Final copy of testing, adjusting, and balancing report.
- B. Operation and Maintenance Data:
 - 1. Include, spare parts lists, exploded assembly views for all equipment.
 - 2. Submit installation instructions, adjustment instructions, spare parts lists, exploded assembly views for all equipment.
 - 3. Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
 - 4. Submit manufacturer's descriptive literature, operating instructions, and maintenance and repair data. Include directions for resetting constant volume regulators.
- C. Filters: Operation and Maintenance Data: Submit instructions for operation, changing, and periodic cleaning.
- D. Binders:
 - 1. Furnish typewritten or printed index and tabbed dividers between principal categories.

2. Bind each manual in a hard-backed loose-leaf binder.
- E. Imprint on cover:
1. Name of project.
 2. Owner.
 3. Location of project.
 4. Architect.
 5. Contractor.
 6. Year of completion.
- F. Imprint on backing:
1. Name of project.
 2. Year of completion.
- G. Submittals:
1. Preliminary Copies: Prior to scheduled completion of the project, submit one PDF copy for review by the Architect.
 2. Final Copies: After approval of the preliminary copy, submit one PDF and one bound copy to the Owner.
- 1.26 EQUIPMENT AND PIPE CLEANING
- A. Clean interior and exterior of all equipment. Equipment shall be free of dirt, construction debris, corrosion, etc.
- B. Adequate provisions shall be made during construction to eliminate dirt, debris or other material from entering and collecting inside of pipe, ductwork and equipment. Any collection of material shall be thoroughly cleaned before equipment startup and if necessary again before owner occupancy.
- C. Clean exterior of all exposed pipe and ductwork.
- D. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.
- 1.27 RECORD DRAWINGS
- A. Submit one digital file with all drawings in PDF format.
- B. Make all notes and revisions on PDF set in red.
- C. Show location of equipment, location and size of piping, location and size of ductwork. Locate all valves, control dampers and similar equipment with tag or label identification. Indicate locations and elevations of exterior pipe and utility connections. Maintain continuously updated drawings during progress of project.
- D. Record actual locations of tagged valves and control dampers; include valve tag numbers. Record actual locations of flexible connectors and expansion joints.
- E. Record actual locations of equipment, clean-outs, controlling devices, and all above grade, under-floor, and buried piping and ductwork. Provide dimensions from gridline or walls to indicate specific locations.

1.28 TESTING

- A. Provide completed start-up forms and checklists.
- B. Perform testing and balancing of HVAC systems as described in this Division and as required by applicable codes and ordinances.
- C. Provide changes in sheaves, belts, and dampers as required for correct balance.
- D. Provide commissioning of Control System, and all mechanical components in compliance with the applicable Energy Code, the commissioning notes on the drawings and commissioning specifications of this Division. Written verification of test to be signed by Owner's Representative

1.29 WARRANTIES AND CONTRACTOR'S GUARANTEE

- A. All work, material and equipment shall be free of defect, complete and in perfect operating order at time of delivery to Owner.
- B. Furnish one year warranty from date of substantial completion for all systems unless specifically noted otherwise.
- C. Without cost to Owner, **correct all defects and failures discovered within one year from date of final acceptance**, except when in the opinion of the Architect a failure is due to neglect or carelessness of the Owner.
- D. The guarantee of the Contractor is independent of shorter time limits by any manufacturer of equipment furnished. Submit with Operation and Maintenance Manual all guarantees which exceed one year.
- E. Make all necessary balancing and control adjustments during first year of operation.
- F. The presence of any inspector or observer during any construction does not relieve the Contractor from responsibility for defects discovered after completion of the work.

PART 2 NOT USED

PART 3 EXECUTION

3.1 DOCUMENTATION

- A. Additional plan submittals to reviewing authority: If additional drawing submittals are required at any time during construction contractor shall submit drawings, review with authority, and pick up subsequent approved drawings. Engineer will revise and/or prepare drawings for submittal.

3.2 INSPECTION

- A. Do not allow any work to be covered up or enclosed until inspected, tested and approved by the Architect and all authorities having jurisdiction over the work.
- B. Should any work be enclosed or covered up before such inspection and test, Contractor shall at his own expense uncover work, and after it has been inspected, tested and

approved, make all repairs as necessary to restore all work disturbed by him to its original condition.

- C. Energy Code C104 specifically requires the following inspections.
 - 1. Mechanical Equipment Efficiency and Economizer: To be made after all equipment and controls required by the Energy Code and this specification are installed and prior to the concealment of such equipment or controls.
 - 2. Mechanical Pipe and Duct Insulation: To be made after all pipe and duct insulation is in place, but before concealment.
 - 3. Motor Inspections: To be made after installation of all equipment covered by the Energy Code and this specification but before concealment.

3.3 FIELD QUALITY CONTROL

- A. Inspect isolated equipment after installation for proper movement clearance.

3.4 CLEANING

- A. Clean adjacent surfaces of fire stopping materials.
- B. Clean ductwork and equipment.
- C. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

3.5 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hangers and Supports.
 - 2. Vibration and Seismic Controls.
 - 3. Motors
 - 4. Firestopping.
 - 5. Condensate Pumps
 - 6. Access Panels
 - 7. Tags and Identification.

1.2 GENERAL REQUIREMENTS

- A. Comply with requirements and recommendations of Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58 and SP-69.
- B. Comply with requirements and recommendations of Sheetmetal and Air Conditioning Contractors National Association (SMACNA) HVAC Duct Construction Standards.
- C. Conform to requirements of IBC 1613 and SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems".

1.3 MATERIALS AND EQUIPMENT

- A. Where two or more units of same class of equipment are required, use products of a single manufacturer. All equipment shall be new and free from damage.
- B. Protect stored material and equipment against weather, corrosion and dirt. Protect installed mechanical components, including but not limited to piping, ductwork, and equipment against weather damage, corrosion, dirt and construction dust. Seal equipment and ductwork where and when necessary to be kept clean.
- C. Provide major equipment components with manufacturer's name, address, catalog number and capacity indicated on a nameplate, securely affixed in a conspicuous place.
- D. Furnish standard and fabricated hangers and supports complete with necessary inserts, bolts, nuts, rods, washers and other accessories.

1.4 REQUIREMENTS

- A. Provide incompressible inserts and shields at all piping supports on pipe to be insulated per 23 07 00.
- B. Provide vibration isolation on motor driven equipment, plus connected piping.
- C. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.
- D. Firestopping Materials: Provide to achieve fire ratings as noted on architect's drawings for adjacent construction, but not less than 1 hour fire rating. ASTM and UL.

1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
 2. Surface Burning: UL 723 with maximum flame spread / smoke developed rating of 25/50.
 3. Firestop interruptions to fire rated assemblies, materials, and components.
- E. Prevent contact between dissimilar metals, such as copper tubing and steel, by use of copper-plated, plastic coated, or flexible materials. All supports which contact copper tubing shall be copper plated.
- F. Firestop interruptions to fire rated assemblies, materials and components.

1.5 QUALITY ASSURANCE

- A. Installed products shall have surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
- B. Perform work in accordance with local jurisdiction's requirements and AWS D1.1 for welding hanger and support attachments to building structure.
- C. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

PART 2 PRODUCTS

2.1 DUCT HANGERS AND SUPPORTS

- A. Hanger straps and rods shall be in accord with SMACNA Duct Construction Standards.
- B. Fasten bracing to ductwork, including riveting, bolting, and tack welding per SMACNA.
- C. Provide galvanized steel band or fabricated angle iron brackets for wall supports.
- D. Exposed ducts shall be supported/anchored to structure at closer spacing and using heavier materials, wherever so indicated on drawings.
- E. Hanger Rods: Carbon Steel, with hex nuts and flat washers.
- F. Concrete Inserts:
 1. Continuous channel - Unistrut or approved.
 2. Universal, malleable iron - Type 18, FS WW-H-171.
- G. Beam Clamps and Attachments as required.

2.2 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports with incompressible insulation inserts and shields for all piping to be insulated per 230700.
 1. Manufacturer: Pipe Shields, INC or approved equal.
 2. Material: Calcium Silicate or Urethane per temperature application.
 3. Thickness: Insert thickness shall match required insulation thickness per 230700.
- B. Refrigerant Piping:

1. Hangers for rigid pipe: Carbon steel, adjustable swivel, split ring with Armacell Armafix insulated rigid insert.
2. Hangers for flexible pipe: Carbon steel, adjustable, clevis with Armacell Armafix insulated rigid insert and saddle.
3. Hangers for paired flexible pipe: Carbon steel, adjustable, clevis with 1" wide overlapping steel band and saddle.

2.3 HANGER ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.4 INSERTS

- A. Malleable iron case of steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.5 PIPE ROOF SUPPORT

- A. Manufacturers: Erico Caddy or approved equal.
- B. General: Pyramid 50, polyethylene closed-cell form, electro-galvanized 16 gauge steel metal cover pipe clamp support.
- C. 1-1/2" and smaller pipe: Pyramid EZ, UV stabilized EPDM, adjustable height.
- D. 2"-6" or general use: Pyramid ST, strut support with galvanized finish, fixed or adjustable height, UV stabilized thermoplastic base with rubber mat.

2.6 ACCESS PANELS

- A. Milcor or approved equal.
- B. Include an allowance for a minimum of 12 access panels.
- C. Architectural grade, 14 gauge frame and door, painted steel or stainless steel based on application.

2.7 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 1. Ferrous Piping: Class 150, 300 psi CWP, malleable iron, threaded.
 2. Copper Piping: Class 150, 300 psi CWP, bronze unions.
 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 4. PVC Piping: PVC.
 5. CPVC Piping: CPVC.

2.8 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.

- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gauge minimum; 16 gauge at fire resistant elements.

2.9 EQUIPMENT CURBS

- A. Manufacturers' curbs where indicated on drawings.
- B. Fabricated: Welded 18 gage galvanized steel shell and base, mitered 3-inch cant, variable step to match roof insulation, 1-1/2 inch thick insulation, wood nailer.

2.10 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Ductwork: 18 gage thick galvanized steel.
- D. Sealant: Acrylic
- E. Size large enough to allow for movement due to expansion and to provide for continuous insulation or installation of fire sealant at fire-rated walls. Note that insulation is discontinuous at fire walls.

2.11 MECHANICAL SLEEVE SEALS

- A. Manufacturers: Metraflex Metraseal, Thunderline Link-Seal or approved equal.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.12 FORMED STEEL CHANNEL

- A. Manufacturers: Allied Tube & Conduit, B-Line Systems, Unistrut or approved equal.
- B. Product Description: Galvanized 12 gage thick steel, with holes 1-1/2 inches on center.

2.13 SUPPORT ACCESSORIES

- A. Pipe Alignment Guides: Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch thick insulation, minimum 3 inch travel.
- B. Swivel Joints: Steel / Bronze body, double ball bearing race, field lubricated, with rubber (Buna-N) o-ring seals.

2.14 MOTORS

- A. General:
 - 1. Temperature Rating: Rated for 40 degree C environment with maximum 50 degree C temperature rise for continuous duty at full load.
 - 2. Starting Capability: Not less than 12 starts per hour.
 - 3. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
 - 4. Enclosure Type: Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation, and guarded drip-proof motors where exposed to contact by employees or building occupants. Weather-protected Type I for outdoor use, Type II, where not housed.
 - 5. Overload Protection: Built-in thermal overload protection.
 - 6. Name Plate: Indicate full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
- B. Motors \leq 1 hp:
 - 1. Provide ECM motor with speed control.
- C. 1 hp > Motors < 7.5 hp:
 - 1. Provide ECM or NEMA Premium efficiency motor.
- D. Motors \geq 7.5 hp:
 - 1. Provide NEMA Premium efficiency motor rated for VFD usage.
 - 2. Provide with Variable Frequency Drive.
- E. All motor efficiencies shall conform to Washington State Energy Code and NEMA MG-1.

2.15 FIRESTOPPING-APPLIED

- A. Manufacturers: RectorSeal, Dow Corning, 3M Fire Protection or approved equal.
- B. General:
 - 1. Fire stopping materials shall conform to Flame (F) and Temperature (T) ratings as required by applicable building codes and tested by nationally accepted test agencies per ASTM E 814 or UL 1479 fire tests for through penetrations, and ASTM E 1966 or UL 2079 for construction joints, and UL 2307 for perimeter edge joints.
 - 2. Fire stopping material shall be free of asbestos, PCBs, ethylene glycol, and lead.
 - 3. Do not use any product containing solvents or that requires hazardous waste disposal.
 - 4. Fire stopping shall be performed by a contractor trained or approved by firestop manufacturer.
 - 5. Select products with rating not less than rating of wall or floor being penetrated.
- C. Single Source Responsibility: Provide firestop systems for all conditions from a single supplier.
- D. Product Description: Provide Latex caulk/sealant, Silicone caulk/sealant, Intumescent Wrap Strip, Firestop Putty, Firestop Collar or Intumescent Sleeve to meet each specific application and performance requirement.
- E. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

- F. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
 - 1. Forming/Damming Materials: Mineral fiberboard, backer rod or other type recommended by Manufacturer's tested system.
- 2.16 FIRE STOPPING-CAST IN PLACE
- A. Manufacturers: Presealed Systems "Hydro Flame" or approved equal.
 - B. Product Description: Factory assembled for use in concrete floors, outer sleeve lined with intumescent strip, radial extended flange, waterstop gasket/mid-body seal.
 - C. General: UL listed system with 3 hour fire rating. Watertight, Class 1 with 3 feet head pressure for 72 hours.
 - D. Installation: Provide device based upon pipe type, size and concrete thickness. Align with penetration layout and nail in place. Secure cap prior to pouring concrete. Deburr and clean debris from pipe prior to installation. Coat pipe end with compatible lubricant as necessary.
- 2.17 PENETRATIONS OF NON-RATED SURFACES
- A. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - B. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.
- 2.18 CONDENSATE PUMP
- A. Manufacturer: BlueDiamond MicroBlue or approved equal.
 - B. GyRok pump technology, 1.3 gal/hr, 16 feet hd, 6 feet lift, 17 dba. Thermistor level sensing. Capable of running dry. Provide with reservoir and fascia kit (where noted).
- 2.19 CONDENSATE PUMP
- A. Manufacturer: BlueDiamond MaxiBlue or approved equal.
 - B. Rotary elastomer diaphragm technology, 3.7 gal/hr, 23 feet hd, 16.5 feet lift, 21 dba. Thermistor level sensing. Capable of running dry. Provide with reservoir and accessories.
- 2.20 CONDENSATE OVERFLOW SWITCH
- A. Manufacturer: Rectorseal Safe-T-Switch or approved equal.
 - B. Sealed, waterproof reed/magnet float switch installed on the overflow outlet of drain pans or on an auxiliary drain pan. UL 508, 24 volt AC.
- 2.21 VIBRATION ISOLATORS
- A. Manufacturers: Metraflex, Mason, Amber Booth or approved equal.

- B. Restrained Closed Spring Isolators:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 - 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
- C. Spring Hanger:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 - 3. Housings: Incorporate [neoprene isolation pad meeting requirements for neoprene pad isolators] [rubber hanger with threaded insert].
 - 4. Misalignment: Capable of 20 degree hanger rod misalignment.
- D. Neoprene Pad Isolators:
 - 1. Rubber or neoprene-waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs: not to exceed 0.7 times width.
- E. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

2.22 SPRING ISOLATION ROOF CURB (SEISMIC)

- A. Manufacturers: Mason Type SRSC, Amber Booth, Vibro-Acoustics or approved.
- B. Spring isolation type with rectangular steel tube lower member, continuous upper frame within "captive: guides to resist wind and seismic forces, adjustable and removable rust-resistant steel springs mounted on 1/4" neoprene pads and having minimum deflection of 2", plated or galvanized hardware, flexible aluminum seal weatherproofing and 2" insulation on lower curb.
- C. Curb shall be built to seismically contain the rooftop unit.

2.23 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inches high.
- B. Metal Tags: Brass, Aluminum or Stainless Steel with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges. Plain English designations.

- C. Information Tags: Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- D. Tag Chart: Plain English designations so no tag or valve chart is required.

2.24 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1. Specific examples are noted in the table below.

Service	Background Color	Letter Color	Legend
Refrigerant	Purple	White	R-{TYPE} REFRIGERANT (EXAMPLE: R-410A REFRIGERANT)
Condensate	Black	White	CONDENSATE

- B. Plastic Pipe Markers: Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.25 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color-coded head.
- B. Color code as follows:
 1. HVAC equipment: Yellow.
 2. Fire dampers/smoke dampers: Red.
 3. Heating/cooling valves: Blue.

2.26 LOCKOUT DEVICES

- A. Lockout Hasps: Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.
- B. Valve Lockout Devices: Nylon device preventing access to valve operator, accepting lock shackle.

2.27 PAINT

- A. Factory Finished Equipment: See individual equipment specification.
- B. Ductwork: Paint interior of ductwork visible through grilles and diffusers with a flat black paint. Prepare and paint surfaces in accord with Division 9.
- C. Use LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

2.28 SEISMIC SUPPORTS

- A. Provide seismic support as required by IBC 1613 and local authorities.
- B. Sway bracing for ductwork, piping, and equipment shall consist of steel angles, rods or pipes. Shapes, lengths and methods of attachment shall be in accord with SMACNA "Guidelines for Seismic Restraints of Mechanical Systems".

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Provide access to existing piping, ductwork, equipment and other installations remaining active and requiring access.
- B. Extend existing piping and ductwork installations using materials and methods compatible with existing installations.

3.2 SURFACE PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond of adhesives or firestopping.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- E. Degrease and clean surfaces to receive adhesive for identification materials.

3.3 INSTALLATION-CLEARANCE

- A. Appliances and equipment shall be accessible for inspection, service, repair and replacement.
- B. Clearance shall be provided for the replacement of filters.
- C. A minimum of 30" of clearance shall be provided in front of the control side of appliances and equipment. Provide additional space when required by NEC.
- D. All control components shall be accessible for inspection and replacement.

3.4 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.5 INSTALLATION - VALVES

- A. Install valves with clearance for installation of insulation and allowing access.
- B. Provide access panels where valves and fittings are not accessible.
- C. Insulate valves according to application in Section 23 07 00.

3.6 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as scheduled.
- B. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- C. Place hangers within 12 inches of each horizontal elbow.
- D. Use hangers with 1-1/2 inch minimum vertical adjustment.
- E. Support vertical piping at every floor.
- F. Where piping is parallel and at same elevation, provide multiple pipe or trapeze hangers.
- G. Support riser piping independently of connected horizontal piping.
- H. Provide copper plated hangers and supports for copper piping.
- I. Design hangers for pipe movement without disengagement of supported pipe.
- J. Adjust hangers and supports as required to bring system to proper line and grade. Piping shall be plumb with floor and parallel/perpendicular to building structure.
- K. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Insulated piping shall have insulation run continuous through hangers and supports with use of rigid inserts. Insulation shall be glued to both sides of insert at hangers and supports, no insulation gaps are allowed. Refer to Section 23 07 00.
- M. Support of pipe, tubing and equipment shall be accomplished by means of engineered products, specific to each application. Makeshift, field devised methods shall not be allowed.

3.7 INSTALLATION-PIPING PROTECTION

- A. Provide protective shield plates in concealed locations where piping, other than cast-iron or steel, is installed in studs, joists or rafters. Plates shall be 16 gage steel and cover the pipe area plus 2". Shields may be omitted if piping is more than 1-1/2" from nearest edge of structural member.

3.8 INSTALLATION – DUCTWORK

- A. Locate hangers, supports and accessories to handle loads imposed by ductwork, and air distribution devices and with maximum spacing noted.
- B. Support all ductwork to prevent sag, undue play and swing.
- C. Maximum support spacing per SMACNA standards. Spacing shall not exceed 10 feet.
- D. Before concrete is placed, install embedded inserts and secure firmly to form work.
- E. Assemble and install hangers and supports on ductwork.
- F. All supports and attachments for exposed ducts shall have non-removable fasteners.
- G. Attachments to fireproofed steel structure shall be made prior to spraying of fireproofing material. If necessary to disturb fireproofing after initial spraying, provide respraying or repairs necessary to restore the integrity of the fireproofing.
- H. Adjust hangers and supports as required to bring system to proper line and grade. Ductwork shall be plumb with floor and parallel/perpendicular to building structure.

3.9 INSTALLATION – SEISMIC CONTROLS

- A. Provide seismic restraints and hangers in compliance with IBC 1613 and ASCE 7.
- B. Seismic Bracing is specifically required for but not limited to:
 - 1. All smoke control ductwork.
 - 2. All ductwork associated with life safety systems (Including stair and elevator pressurization).
 - 3. All ductwork with a cross sectional area of 6 square feet or a diameter of 34 inches or greater.
- C. Seismic Bracing: Follow IBC 1613, ASCE 7, SMACNA Seismic Restraint Manual and the following.
 - 1. Bracing shall be bidder designed to resist seismic loading in accord with Chapter 16 of the International Building Code, ASCE 7 or the SMACNA guideline.
 - 2. Provide seismic calculations as required for $I_p = 1.5$.
 - 3. Transverse bracing shall occur at a maximum interval of 30 feet, at each duct turn and at the end of a duct run.
 - 4. Longitudinal bracing shall occur at a maximum interval of 60 feet.
 - 5. Bracing may be omitted where duct hangers are less than 12 inches in length.

3.10 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 4 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed steel channel or steel pipe and fittings. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.11 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Provide curbs for roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.12 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with insulation and caulk or fireproof airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

3.13 INSTALLATION – ACCESS PANELS

- A. Furnish access panels for installation at all concealed equipment which requires service, maintenance or adjustment to include but not limited to equipment, dampers, control valves, filters and controls.
- B. Provide location layout and required size for all access panels to general contractor. Layout shall be regular and consistent, maintain a uniform wall panel height of 24" center line above finished floor, unless noted otherwise.
- C. Furnish fire rated access panels where installed in fire rated assembly.
- D. Provide stainless steel access panels where installed in tile surfaces.
- E. Furnish access panels to general contractor for installation
- F. Paint installed access panels to match wall or ceiling. Verify that panels are not painted shut.

3.14 INSTALLATION – FIRESTOPPING AND SEALS AT PARTITIONS

- A. Installation of Firestop shall be performed by either a specialty contractor specializing in firestop application (FM G 4991 or UL Qualified Firestop Contractor), or general or sub-contractors with experience in similar applications and projects with installers qualified,

trained, and certified by the firestop manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.

- B. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- C. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- D. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- E. Install dams when required to properly contain Fire stopping materials within openings and as required to achieve required fire resistance rating. Combustible damming material must be removed after appropriate curing. Incombustible damming materials may be left as a permanent component of the Firestop system.
- F. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- G. Place intumescent coating in sufficient coats to achieve rating required.
- H. Clean adjacent surfaces of firestopping materials.
- I. Seal openings at surface as follows:
 - 1. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - 2. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - 3. Pack void with backing material.
 - 4. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

3.15 INSTALLATION - PENETRATIONS OF NON-RATED SURFACES

- A. Seal opening through non-fire rated wall, partition, floor, ceiling, and/or roof opening as follows:
 - 1. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - 2. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
- B. Install escutcheons where piping penetrates non-fire rated surfaces in occupied spaces.
- C. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
- D. Interior partitions: Seal pipe penetrations air tight. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.16 INSTALLATION-VIBRATION ISOLATION

- A. Lag ductwork, where indicated by wrapping with insulation and covering. Apply covering to be airtight. Do not attach covering rigidly to ductwork.

- B. Install isolation for motor driven equipment.
- C. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other ends. Install in horizontal plane unless indicated otherwise.
- E. Adjust equipment level.
- F. Install spring hangers without binding.
- G. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- H. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- I. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector or as follows:
 - 1. Up to 4 inch Diameter: First three points of support.
 - 2. 5 to 8 inch Diameter: First four points of support.
 - 3. 10 inch Diameter and Over: First six points of support.
 - 4. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

3.17 INSTALLATION - SPRING ISOLATION ROOF CURB (SEISMIC)

- A. Unit supported must be solidly fastened to the top floating rail and the lower section anchored to the roof structure. Mechanical contractor to hire third party structural engineer to provide exact number and size of bolts/fasteners and provide equipment seismic calculations.
- B. Provide acoustical materials in bottom of curb as shown on plan detail.

3.18 INSTALLATION – CONDENSATE

- A. For all cooling coils, high efficiency gas burners and other equipment requiring condensate drainage, provide appropriately sized condensate pumps where gravity drainage is not possible or where scheduled.
- B. Coordinate number and type of condensate pumps required with Plumbing Contractor.
- C. Provide condensate overflow switches on cooling coils where damage to building components could occur as a result of overflow as required by IMC.
- D. For wall mounted fan coils, condensate pump, reservoir, wiring and piping shall not be exposed to view. Field fabricated concealment is not acceptable.
- E. For pumps located in equipment cabinet, above ceiling, fascia kit or unfinished space, obtain power for condensate pump directly from electrical terminal block on unit served. Coordinate with electrical contractor.

- F. For wall mount fan coils with pumps located above a ceiling, obtain power from electrical circuit. Coordinate with electrical contractor.
- G. Connect condensate pump alarm wiring to unit served power terminals per manufacturer's installation instructions. Coordinate with electrical contractor. Unit served shall shut down when condensate reservoir is full to prevent overflow.

3.19 INSTALLATION-IDENTIFICATION

- A. Install identifying devices after completion of coverings and painting.
- B. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- D. Install tags using corrosion resistant chain. Use plain English designations so no index or chart is required.
- E. Nameplates: Identify mechanical equipment (air handling units, air terminal units, pumps, heat transfer equipment, tanks, and water treatment devices) with plastic nameplates.
 - 1. Identify in-line pumps and other small devices with name tags.
 - 2. Identify control panels and major control components outside panels with plastic nameplates.
 - 3. Identify description should be as numbered on drawings or plain English description. i.e. "EF-1" or "Boiler Controls".
 - 4. Label automatic controls, instruments, and relays. Key to control schematic.
 - 5. Label wall controls and switches with associated equipment designation and control function, i.e. "EF-1 Switch".
- F. Valve Tags: Identify valves in main and branch piping and radiator valves with tags.
 - 1. Do not provide numbered tags.
 - 2. Provide tags with plain English description of service and function. i.e. "Hot Water Supply, 2nd Floor"
- G. Pipe Labels: Identify piping, concealed or exposed, with plastic tape pipe markers.
 - 1. Identify service, flow direction, and pressure.
 - 2. Install in clear view and align with axis of piping.
 - 3. Locate identification on straight runs including risers and drops with spacing not to exceed 20 feet.
 - 4. Locate adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- I. Equipment and Valve Tag Index: Plain English designations so no chart or index is required.

3.20 CLEANING

- A. Contractor shall make all mechanical components free of dust and dirt prior to startup.

- B. Use LEED Compliant Products: Materials intended for use inside the building envelope including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

3.21 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

3.22 SCHEDULES

- A. Copper and Steel Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING HANGER ROD DIAMETER Inches	STEEL PIPE HANGER ROD DIAMETER Inches
1/2	5	7	3/8	3/8
3/4	5	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	7	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8

3.23 SCHEDULES

- A. Pipe Isolation Schedule:

Pipe Size Inch	Isolated Distance from Equipment diameters
1	120 diameters
2	90 diameters
3	80 diameters

END OF SECTION

PART 1 GENERAL

1.1 SCOPE

- A. Testing, adjusting and balancing of air systems.
- B. Testing, adjusting and balancing of Division 22 domestic water systems.
- C. Measurement of final operating conditions of above systems.
- D. Duct pressure (leakage) testing as required by 23 31 00.
- E. Preparation of formal report.

1.2 PERFORMANCE CRITERIA

- A. Work shall be performed by approved independent testing and balancing agency.
- B. Perform testing and balancing in accordance with Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB). All work shall be supervised.
- C. Calibrate instruments used for testing and balancing within a period of six months of start of work.
- D. Mechanical contractor shall assist Balancing Agency in testing and balancing of mechanical system.

1.3 SUBMITTAL

- A. Provide three (3) copies of typed and bound report to be included in Preliminary Commissioning Report.
- B. Provide three (3) additional copies of updated and/or corrected report for Final Commissioning Report.

1.4 FORMAT

- A. Report shall consist of test sheets similar to AABC Standard Forms for Diffusers and Grilles, Air Handling Equipment, Exhaust Fans, and Pumps (i.e., Form 12666 for Diffusers and Grilles).
- B. Report shall include the following.
 - 1. Preface suggesting abnormalities and problems encountered.
 - 2. Instrumentation List including type, model, manufacturer, serial number, and calibration dates.
 - 3. System Identification reporting location of equipment, zones, supply, return, and exhaust openings.
 - 4. Record following for each piece of air handling equipment.
 - a. Manufacturer, model number, and serial number.
 - b. Design and manufacturer rated data.
 - c. Actual CFM
 - d. Suction and discharge static pressure of each fan.
 - e. Outside-air and return-air total CFM.

- f. Actual operating current, voltage, and brake horsepower of each fan motor.
- g. Final RPM of each motor.
- h. Fan and motor sheave manufacturer, model, size, number of grooves and center distance.
- i. Belt size and quantity.
- j. Static-pressure controls final operating set points.

1.5 QUALIFICATIONS

- A. Work of this section shall be performed by independent Air Testing and Balance Agency specializing in testing and balancing of heating, ventilating, and cooling systems to balance, adjust, and test air moving equipment, air distribution, and exhaust systems.
- B. Agency shall provide proof of having successfully completed at least five years of specialized experience in air and hydronic system balancing. Work by this Agency shall be done under direct supervision of qualified heating and ventilating engineer employed by Agency.
- C. Agency shall be approved in writing by Architect.
- D. Neither Architect's engineering consultant nor anyone performing work on this Project under Division 23 shall be permitted to do this work.

1.6 ACCEPTABLE TEST AND BALANCE COMPANIES

- | | | |
|----|---------------------------|--------------|
| A. | AIRTEST Co., Inc. | 425-313-0172 |
| B. | Neudorfer Engineers, Inc. | 206-621-1810 |
| C. | Hardin & Sons | 253-862-6645 |

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify systems are complete and in good working order before commencing work. Then, put all systems and equipment into operation and continue operation until all adjusting, balancing, testing, demonstrations, instructions and cleaning of systems have been completed. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.

11. Duct system leakage is minimized.
12. Hydronic systems are flushed, filled, and vented.
13. Pumps are rotating correctly.
14. Proper strainer baskets are clean and in place or in normal position.
15. Service and balancing valves are open.

3.2 PREPARATION

- A. If requested, conduct tests in presence of Architect.
- B. Instruments used by Agency shall be accurately calibrated and maintained in good working order.
- C. Furnish instruments required for testing, adjusting, and balancing operations including ladders, scaffolding, additional dampers and clean filters.
- D. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- E. During balancing technician's initial test of air handling systems, the Mechanical Contractor shall have his sheetmetal foreman present to assist in any drive changes or dampers necessary.

3.3 INSTALLATION TOLERANCES

- A. Diffuser, register and grille air flow rates shall be measured and adjusted to deliver final flow rates within 10% and within 50 cfm of design rates, whichever is less.
- B. Fan air flow rates shall be measured and adjusted to deliver final flow rates within 10% and within 100 cfm of design rates, whichever is less.
- C. Water flow rates shall be measured and adjusted to deliver final flow rates within 10% and within 5 gpm of design rates, whichever is less.
- D. Pump flow rates shall be measured and adjusted to deliver final flow rates within 10% and within 25 gpm of design rates, whichever is less.
- E. Two-speed fans: Balance fans and airflow control devices at both minimum and maximum airflow settings.

3.4 ENERGY RECOVERY VENTILATION (ERV) SYSTEM TOLERANCE

- A. Test and balance ERVs to maintain scheduled airflow differential between outside air and exhaust air quantities. The tested differential in airflows shall not be less than scheduled.
- B. Spaces which have both outside air and exhaust air from an ERV shall maintain tolerance on the differential between the air quantities. Outside air and exhaust air flow rates shall be measured and adjusted to deliver final flow rates whose differential is within 10% and within 50 cfm of design rates, whichever is less.
- C. ERV systems with supply air duct static pressure control for Demand Control Ventilation: Balance system airflows and set supply duct static pressure setpoint based on minimum design airflow. Adjust DCV control(s) to provide maximum design airflow(s). Verify that supply fan speed increases in response to duct pressure loss when DCV controls are at maximum airflow.

- D. Two-speed systems: Balance fans and airflow control devices at both minimum and maximum airflow settings.

3.5 ADJUSTING

- A. Ensure that clean filters, of the type specified, are installed prior to air balancing.
- B. Provide additional volume dampers as necessary to accomplish design balances.
- C. Set minimum position of motorized dampers for scheduled minimum outside air.
- D. Pumps shall be proportionally balanced to minimize throttling losses, and then the pump impeller shall be trimmed or the pump speed modified to meet design flow conditions.
- E. Check motors for proper rotation, coupling and drive alignment, belt tension and freedom from vibration, etc.
- F. Provide belt drive/sheave changes to adjust fan rpm as necessary to accomplish design balances.
- G. Verify recorded data represents actual measured or observed conditions.
- H. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- I. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- J. Report defects and deficiencies noted during performance of services, preventing system balance.
- K. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- L. After completion of testing and balancing, operate systems under normal conditions for at least two days of 8 hours each to demonstrate specified performance.

3.6 AIR SYSTEM PROCEDURE

- A. Perform soloing testing and balancing functions in accordance with Associates Air Balance Council National Standards.
- B. Adjust air handling and air distribution systems to obtain design supply, return, and/or exhaust air quantities.
 - 1. Test and adjust total system CFM by adjustment of fan speeds. Provide sheave drive changes as necessary.
 - 2. Perform tests at high and low speeds of variable speed systems.
 - 3. Adjust branch air quantities by damper regulation. Multi-diffuser branch ducts shall have at least one outlet or inlet volume damper completely open to minimize throttling losses.
 - 4. Make air quantity measurements in main ducts and for outside air by Pitot tube traverse of entire cross sectional area of duct.
 - 5. Measure air quantities at air inlets and outlets.
- C. Diffusers, Registers and Grilles:

1. Adjust air distribution to obtain uniform space temperatures free from objectionable drafts.
 2. Use volume control devices to regulate air quantities only to the extent that the adjustments do not create objectionable air motion or sound levels.
 3. Effect volume control by using volume dampers located in ducts.
- D. Provide system schematic:
1. Identify the location and area of each grille, diffuser, register, and terminal box.
 2. Record the required and actual air quantities at each outlet or inlet.
 3. Record size, type, and manufacturer of each diffuser, grille, and register on air outlet data sheets.
- E. Air Temperature:
1. Measure wet and dry bulb air temperatures on entering and leaving side of each cooling coil and unit in cooling mode.
 2. Measure dry bulb temperatures on entering and leaving side of each heating coil and unit in heating mode.
- F. Pressure:
1. Measure static pressure conditions on air units, including filter and coil pressure drops, and total pressure across fan with suction and discharge pressures.
 2. Make air balancing allowances for 50 percent loading of filters.
 3. Measure building static pressure.
- G. Electrical:
1. Record nameplate motor current and voltage.
 2. Measure actual motor current and voltage at balanced condition.
- H. Dampers:
1. Adjust outside air, return air, and exhaust dampers for design conditions.
 2. At modulating damper locations, take measurements and balance at extreme conditions.
- I. Permanently mark all outside air, supply air, and return air damper positions after balancing has been completed.
- J. Smoke testing, or some other approved means, may be required to determine leak locations if air balance report indicated that any system's CFM total is less than 10 percent of design CFM. Prior to test, verify that system's duct joints have been sealed as specified and that air moving device in question is supplying required design system air flow. Architect will approve test method required. If smoke test is selected, use following procedure. Provide necessary precautions to protect those performing or observing test from being exposed to smoke.
1. Use zinc chloride smoke candles, titanium tetrachloride ampules or sticks, or other devices acceptable to Architect to generate smoke.
 2. Close openings in duct except for one opening at farthest end of duct run.
 3. If re-balancing is required, submit revised air test and balance reports to Architect before Substantial Completion.
 4. Spot balance and rebalance shall be performed at no additional cost to Owner.

3.7 PLUMBING PROCEDURE

- A. Domestic pump circulators:
1. Test total system GPM and head.
 2. Adjust branch flows by circuit setters for equal flow distribution.

3.8 KITCHEN HOOD SYSTEM

- A. Test and balance hood exhaust system to be equal to or greater than scheduled value. Under balance is not acceptable.
- B. Test and balance make-up air system to be at least 90% of exhaust air quantity.

3.9 FINAL INSPECTION AND ADJUSTMENTS

- A. System shall be balanced and reports submitted before substantial completion inspection.
- B. Balancing Agency shall be represented at inspection meeting(s) by qualified testing personnel with balancing equipment and two copies of current air balancing test report.
 - 1. Architect will choose and direct spot balancing. Differences greater than specified tolerance between the spot balance and test report will be justification for requiring repeat of testing and balancing for entire building and submission of a new test report. In such case a new inspection will be made.
 - 2. Perform rebalancing in presence of Architect/Engineer and subject to their approval.
 - 3. If re-balancing is required, submit revised air test and balance reports to Architect before Substantial Completion.
 - 4. Spot balance and rebalance shall be performed at no additional cost to Owner.
- C. Where systems provides over 5 percent more air than schedule requirements, rooms supplied by that system shall have their supply air quantities increased by ratio of actual total air quantity supplied to minimum air quantity required by system schedule.

3.10 SUPPLEMENTAL WARRANTY

- A. Test and balance agency shall include an extended warranty of 90 days, after occupancy, during which the Owner's representative, at his discretion, may request a recheck or resetting of any outlet, supply air or exhaust fan, as listed in test report.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Piping system insulation.
 - 2. Pipe insulation jackets.
 - 3. Insulation accessories including vapor retarders and accessories.
 - 4. Ductwork insulation.
 - 5. Ductwork insulation jackets.
 - 6. Duct liner.

1.2 QUALITY ASSURANCE

- A. Insulation must have maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. All systems components subject to heat loss or gain, such as, piping, storage tanks, vessels, valves etc. shall be insulated to conform with the Washington State Energy Code (as minimum) and this section.
- C. LEED Compliant Products: Materials intended for use inside the building envelope, including those used for patching, painting, touch-up, and cleaning, must contain acceptable levels of VOC's and contain no added urea-formaldehyde.

1.3 IDENTIFICATION

- A. Insulation shall bear a manufacturer's mark indicating the product R-value, or K-value and thickness. This mark shall be visible after installation and shall be repeated at an interval of no greater than 10 feet.
- B. External duct insulation shall be legibly printed or identified at intervals not greater than 36 inches with name of manufacturer, R-value, thickness, flame spread and smoke-developed index.
- C. R-values shall be based on insulation at 75 F mean temperature difference.
- D. For rigid or spray foam the aged R-value per inch shall be provided in submittals.

PART 2 PRODUCTS

2.1 POLYOLEFIN INSULATION

- A. Manufacturers: IMCOA or similar.
- B. Polyolefin or Polyethylene pipe insulation is **NOT ACCEPTABLE** for any application.

2.2 ELASTOMERIC CELLULAR FOAM (PIPE)

- A. Manufacturers: Armacell AP/Armaflex, Aeroflex Aerocel or approved equal.

- B. Preformed flexible, closed-cell, elastomeric thermal insulation: Type I, Tubular form, self-seal or continuous, 25/50-rated, CFC free, low VOC, 'K' factor: 0.27 at 75 degrees F. ASTM C534.
- C. Rigid clamp/hanger insert: Armacell Armafix, polyurethane insert and aluminum jacket, single piece with self-adhering closure.

2.3 FLEXIBLE GLASS FIBER DUCT LINER (SOUND LINER)

- A. Manufacturers: Johns Manville Linacoustic RC or equal by Knauf, Manson or approved equal.
- B. Description: Flexible duct liner, glass fiber bonded with thermosetting resin, airstream surface protected with reinforced coating.
 - 1. ASTM E84, UL 723
 - 2. Installed R Value: 1" R-4.2, 2" R-8.0
 - 3. Maximum service temperature: 250 degrees F.
 - 4. Maximum Velocity on Coated Air Side: 6,000 fpm.
 - 5. Acrylic polymer coating to prevent dust incursion and biological growth.
- C. Liner Fasteners: Galvanized steel, impact applied or welded with integral head.
- D. Field coat edges with Superseal edge treatment.

2.4 ELASTOMERIC CELLULAR FOAM DUCT LINER (SOUND LINER)

- A. Manufacturers: Armacell AP/Coilflex or approved equal.
- B. Description: Fiber-free, non-particulating, formaldehyde-free, low VOC elastomeric form roll which conforms to duct corners without compression. Microban antimicrobial protection inhibits mold and mildew.
 - 1. ASTM E84, UL 723
 - 2. Installed R Value: 1" R-4.2, 1-1/2" R-6.0
 - 3. Maximum service temperature: 180 degrees F
 - 4. Maximum velocity: 10,000 fpm.
- C. Install as a cross-section single piece fitting around corners.
- D. Apply with water based adhesive.

2.5 POLYESTER DUCT LINER (SOUND LINER)

- A. Manufacturers: Ductmate PolyArmor or approved equal.
- B. Description: Fiberglass free, hypoallergenic polyester blanket with FSK facing.
 - 1. ASTM E84, UL 723
 - 2. Installed R Value: 1" R-4.2, 1-1/4" R-5, 1-1/2" R-6.0, 2" R-8.0
 - 3. Maximum service temperature: 250 degrees F
 - 4. Maximum velocity: 4,000 fpm.
- C. Provide metal nosing and water based edge coating.
- D. Apply with water based adhesive and pins.

2.6 GLASS FIBER ROUND DUCT LINER (SOUND LINER)

- A. Manufacturers: Johns Manville Spiracoustic Plus or equal by Knauf, Manson or approved equal.
- B. Description: High-density fiber glass board with kerfs; acrylic polymer meeting ASTM G21 impregnated surface coat. ASTM C1071.
 - 1. 'K' factor: 0.23 at 75 degrees F.
 - 2. Installed R Value: 1" R-4.3, 2" R-8.4
 - 3. Maximum service temperature: 250 degrees F.
 - 4. Maximum Velocity on Coated Air Side: 4,000 fpm.

2.7 ELASTOMERIC CELLULAR FOAM ROUND DUCT LINER (SOUND LINER)

- A. Manufacturers: Armacell AP/Spiralflex or approved equal.
- B. Description: Fiber-free, non-particulating, formaldehyde-free, low VOC elastomeric form roll which is self-supporting and conformable to round duct. Microban antimicrobial protection inhibits mold and mildew.
 - 1. ASTM E84, UL 723
 - 2. 'K' factor: 0.28 at 75 degrees F
 - 3. Installed R Value: 1" R-4.2
 - 4. Maximum service temperature: 180 degrees F
 - 5. Maximum velocity: 10,000 fpm.

2.8 GLASS FIBER DUCT WRAP

- A. Manufacturers: Johns Manville Microlite XG 75 or equal by Owens-Corning, Knauf, Manson or approved equal.
- B. Description: Formaldehyde-free, flame-attenuated glass fibers bonded with thermosetting acrylic resin, FSK facing.
 - 1. ASTM E84, UL 723
 - 2. Installed R Value: 1-1/2" R-4.2, 2" R-5.6, 2.5" R-6, 3" R-8.3, 4.5" R-12, 5.75" R-16.
 - 3. Maximum Service Temperature: 250 degrees F.
 - 4. Density: 0.75 lb/cu ft
- C. Vapor Retarder Jacket: Reinforced FSK facing. Seal with pressure sensitive 2" tape.
- D. Identification: At intervals not greater than 36" print the name of manufacturer, the thermal resistance R-value at insulation thickness, the flame spread and smoke developed indexes.

2.9 PIPE INSULATION AND EQUIPMENT JACKETS

- A. PVC Plastic Pipe Jacket:
 - 1. Product Description: One piece molded type fitting covers and sheet material, white color. ASTM D1784.
 - 2. Thickness: 15 mil indoor, 30 mil outdoor.
 - 3. Connections: Brush on welding adhesive.
- B. Canvas Equipment Jacket:
 - 1. Fabric: 6 oz/sq yd, plain weave cotton.
 - 2. Composite of insulation, jacket and laces.

- C. Aluminum Pipe Jacket:
 - 1. Thickness: 0.016 inch thick sheet. ASTM B209.
 - 2. Finish: Embossed
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.10 DUCT LAGGING

- A. Manufacturers: Sound Seal B-10 LAG/QFA-9 or approved equal.
- B. Description: Loaded vinyl noise barrier with FSK facing and quilted fiberglass decoupler.
 - 1. STC: 30
 - 2. Thickness: 2"
 - 3. Density: 0.4 lb/sq ft.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify piping and equipment has been tested before applying insulation materials.
- B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Apply insulation when building is thoroughly dry to prevent shrinkage.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulate entire piping system including fittings, valves, unions, flanges, strainers, flexible connections, pump fittings, connections to equipment and expansion joints. Use canvas jackets for valves and other irregular shapes.
- D. Insulate flanges and unions with removable sections and jackets.
- E. Piping Inserts and Shields:
 - 1. Insulation shall be continuous through supports and hangers with incompressible inserts and shields. Do not directly clamp/support pipe scheduled to be insulated.
 - 2. Shields: Galvanized steel saddle between pipe clevis hangers or pipe rollers and insulation. Minimum 6 inches long, of contour matching adjoining insulation; may be factory fabricated.
 - 3. Inserts: Between pipe clamps, hangers or rollers and piping.
 - 4. Insert material: Compression resistant insulating material suitable for insulation type and planned temperature range and service.
 - 5. Glue insulation to both sides of insert.
 - 6. Shields without inserts may be used at clevis hangers on refrigerant piping 5/8" and smaller with continuous insulation.
- F. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.

- G. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.
- H. Exterior Piping Applications: Use only elastomeric closed-cell foam insulation. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with sealant. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.
- I. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- J. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- K. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- L. Finish insulation at supports, protrusions, and interruptions.
- M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation/lagging with removable sections for easy removal and replacement without damage. Label removable sections indicating access type, i.e. "Filter Access".
- O. Insulate exhaust air ductwork where it is outside the insulated building envelope to prevent condensation.
- P. For all insulated ductwork:
 - 1. Provide insulation with vapor retarder jackets.
 - 2. Finish with tape and vapor retarder jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- Q. Ductwork Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- R. Exterior Ductwork and Equipment: Provide liner. Do not provide exterior insulation on ductwork or equipment.
- S. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 100 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. Comply with SMACNA Standards for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

A. Piping: Provide on piping as listed below.

Service	Insulation Type	PIPE SIZE			
		<1"	1" to <1-1/2"	1-1/2 to < 4"	4" to < 8"
Refrigerant Suction(1)	Elastomeric Cellular FOAM	1"	1"	1-1/2"	-
Refrigerant Hot Gas	Elastomeric Cellular FOAM	1"	1"	1-1/2"	-

- Note: Insulate Refrigerant Liquid lines same as Suction lines on all heat pump equipment, where noted by manufacturer or called for on plans.
- For all exterior piping applications use only Elastomeric Cellular Foam with Aluminum jacket.

B. Ductwork: Provide on ductwork as listed below. Insulation thickness is provided as reference; each application must meet minimum installed R-Value.

Service	Location	Insulation Type	Approx. Thickness	Min. Installed R-Value	Jacket
Supply, Return	Building Exterior (Zone 4C)	Duct Liner	3"	R-8	-
Supply, Return, Exhaust	Unconditioned space inside building envelope.	Duct Wrap	2.5"	R-6	FSK
Supply	Concealed Space (3)	Duct Wrap	1-1/2"	R-3.3	FSK
Supply	Exposed (4) in Space	Duct Liner	1-1/2"	R-3.3	FSK
Outside Air (5)	Within Building downstream of damper. <2800 cfm	Duct Wrap / Duct Liner	3"	R-8	FSK
Outside Air (5)	Within Building Between damper & building exterior.	Duct Wrap / Duct Liner	5.75"	R-16	FSK
Outside Air (ERV supply)	Between ERV & building spaces	Duct Wrap / Duct Liner	1-1/2"	R-3.3	FSK
Exhaust Air	Attic, crawlspace, parking garage or uninsulated area within building.	Duct Wrap	2.5"	R-6	FSK
Relief / Exhaust Air	Between damper & building exterior.	Duct Wrap	5.75"	R-16	FSK

1. Secure duct wrap with mechanical fasteners spaced 12” on center, minimum. For horizontal ducts 24” or more in width, duct wrap shall also be secured with mechanical fasteners spaced 18” on center, on centerline of bottom of duct.
2. Insulation is not required on sound lined ductwork with sufficient insulating value.
3. Concealed space: Any space within the insulated building envelope that is concealed from view, i.e. behind ceiling, wall, shaft, soffit, etc.
4. For exposed ductwork in finished spaces which is required to be insulated provide internal liner with equivalent R-value.
5. In addition to the insulation requirements, outside air ductwork shall meet all air leakage and building envelope insulation requirements of the WSEC C402 and building envelope vapor control requirements from the IBC.

C. Equipment: Provide on equipment as listed below.

Service	Insulation Type	Thickness	R-Value	Jacket
Valves, Strainers and other Refrigerant piping accessories	Glass Fiber BLANKET	Per pipe schedule	-	Canvas bag with wire ties.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. System specific commissioning procedures

B. Related Sections:

2. The following section specifies general commissioning activities for this project:

01 91 13 GENERAL COMMISSIONING REQUIREMENTS

3. All sections related to the following commissioned systems may contain start-up, testing and/or commissioning related activities:

All HVAC Systems
All Building Automation and Control Systems
Testing, Adjusting and Balancing Verification

1.2 DESCRIPTION OF WORK

- A. Work includes the completion and documentation of formal commissioning procedures by the Contractor on selected equipment and systems as listed under 1.1 B. Commissioning is defined as the process of verifying and documenting that the installation and performance of selected building systems meet the specified design criteria and therefore satisfies the design intent and the Owner's operational needs. The Contractor shall be responsible for participation in the commissioning process as outlined herein, and in subsequent sectional references and attachments throughout the project documents. Commissioning procedures shall be designed and conducted under the direction of the Commissioning Authority (CxA) and coordinated by the Contractor Commissioning Coordinator (CCC).
- B. This section contains the system specific commissioning requirements for the systems referenced herein.

PART 2 – PRODUCTS

- 2.1 Documentation requirements for the systems to be commissioned are specified in Section 01 91 13, Commissioning General Requirements, Part 2 – Products.

PART 3 – EXECUTION

- 3.1 Execution of the commissioning process for the systems to be commissioned is specified in Section 01 91 13, Commissioning General Requirements, Part 3 – Execution.

SCHEDULE A – Start-up Plan , Contractor Checklists and Document Tracking

A Startup Plan shall be developed as outlined in Section 01 91 13. The Startup Plan shall include manufacturer's startup procedures and Contractor Checklists (CCL) as provided by the CxA.

Sample CCLs are included in this Schedule. The Contractor responsible for delivery of the equipment and appurtenances associated with the systems listed in Table – A shall be responsible for completion of the CCL for each individual piece of equipment in the system group. The CCLs included within this Schedule are sample versions and are representative of what will be included in the final Commissioning Plan.

The Contractor is responsible to demonstrate the proper operation of all installed systems and the final CCLs shall contain the requirements to document these demonstrations. In no case shall the checklists require performance criteria more stringent than specified by the Project Documents.

The CCC is responsible for collecting the completed CCLs and start-up documents and maintaining the Startup Plan during installation and startup activities. The CCC shall review the material for completeness, then sign off on the CCLs as an indication that documents are complete. Once all CCLs and start-up documents are received, they shall be turned over to the CxA.

The following Table - A identifies the CCLs and related documents that will be included in the final Startup Plan. Listed as subcategories below each system are the documents that shall be required to be submitted as part of the system startup activities. This documentation includes installation, startup, static tests, pressure tests, cleaning, flushing, disinfecting, certifications and other miscellaneous checklists. This table shall be used as a document tracking mechanism by the CxA, CCC and Contractor for the process of submittal, review and approval of installation and startup documents and CCLs. The table shall be included in the Startup Plan, which is a subset of the Commissioning Plan.

Table-A Key:

- A. System description for each system commissioned. A Contractor Checklist is included for each commissioned system. The subcategories include required documentation to be submitted with the CCL.
- B. Contractor responsible for installation, startup, testing and submittal of documents for commissioned system. To be filled in after contract award.
- C. Date the proposed documents are received by the CxA from the responsible Contractor. NOTE: These documents shall include, but are not limited to, procedures and forms to include such activities as: manufacturer's installation and start-up, pressure testing, TAB, cleaning, flushing and disinfection. The CCL is provided by the CxA.
- D. Indicates that CxA has received and approved proposed installation and start-up documentation.
- E. Date the completed documents are received by the CxA from the responsible Contractor.
- F. Indicates that CxA has received and approved completed documentation.
- G. Notes on status of forms, irregularities and rework needed.

Table - A: System Summary and Documentation Tracking

A	B	C	D	E	F	G
System Description Documents Required	Responsible Contractor	Proposed Document Received	O K	Completed Document Received	O K	Notes
VRF Indoor Units						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
VRF Outdoor Units						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Electric Duct Coils						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Energy Recovery Ventilators						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Radiant Ceiling Panel						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Infrared Heat Units						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Exhaust Fans						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				

A	B	C	D	E	F	G
System Description	Responsible Contractor	Proposed Document Received	O K	Completed Document Received	O K	Notes
Documents Required						
Ductwork Systems						
Ductwork Pressure Test						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Energy Management Control System						
Graphical interface plan						
Point-to-point and sensor calibration verification		CxA Provided				
Manufacturer Start-up Documentation						
Sequence Confirmation Checklist		CxA Provided				
Contractor Checklist		CxA Provided				
VRF Control System						
Graphical interface plan						
Point-to-point and sensor calibration verification		CxA Provided				
Manufacturer Start-up Documentation						
Sequence Confirmation Checklist		CxA Provided				
Contractor Checklist		CxA Provided				
Testing, Adjusting, and Balancing						
TAB Agenda						
TAB Meeting Minutes						
Preliminary TAB Report						
Contractor Checklist		CxA Provided				

**SAMPLE
 Contractor Checklist**

Unit Type:	VRF Fan Coil Unit	Unit No:	
Location:		Serves:	
Manufacturer:		Model:	

Check	RC	CxA	Note
Equipment			
Area is cleaned and clear of construction debris			
Unit is clean and has no visible physical damage			
Equipment labels are installed per project documents			
Unit is accessible for service			
Mounting is appropriate with vibration isolation as specified			
Accessibility and condition of air filter			
Accessibility and condition of coil			
Accessibility and condition of fan motor			
Piping			
Refrigerant piping is complete			
Refrigerant piping is insulated			
Condensate drain installed with p-trap, clean out & piped to drain -or- Unit equipped with condensate pumping system piped to drain			
Condensate pump wired and powered up			
Ductwork			
Associated duct work is complete			
Diffuser locations per project documents			
Control Devices			
Control wires and devices are complete			
Control wire and devices are labeled per project documents			
BAS sensor installed and in appropriate location			
Thermostat installed and in appropriate location			
Electrical			
Supply power is installed and disconnect is accessible			
Disconnect is labeled			
Nameplate Minimum Circuit Amps			
Nameplate Maximum Overcurrent Protection Device Amps			
Installed overload			
Overloads and/or fusing is appropriate			
Convenience outlet within 50' of equipment			
Start-Up			
Manufacturer's installation and start-up procedures complete			
Start-up documentation submitted to CxA			
Readiness			
System is ready for functional performance testing			
Representative photograph provided			

Sign-Off:

Team Member	Name	Date
Responsible Contractor (RC):		
Commissioning Authority (CxA):		

Notes:

SAMPLE

Contractor Checklist

Unit Type:	VRF Outdoor Unit	Unit No:	
Location:		Serves:	
Manufacturer:		Model:	

Check	RC	CxA	Note
Equipment			
Area is cleaned and clear of construction debris			
Unit is clean and has no visible physical damage			
Equipment labels are installed per project documents			
Unit is accessible for service			
Mounting is appropriate with vibration isolation as specified			
Accessibility and condition of outdoor coil			
Accessibility and condition of fan and motor			
Piping			
Refrigeration piping complete with valves, sensors, strainers, filter driers and sight glasses			
Refrigerant piping is insulated			
Control Devices			
Control wires and devices are complete			
Control wire and devices are labeled per project documents			
Electrical			
Supply power is installed and disconnect is accessible			
Disconnect is labeled			
Nameplate Minimum Circuit Amps			
Nameplate Maximum Overcurrent Protection Device Amps			
Installed overload			
Overloads and/or fusing is appropriate			
Convenience outlet within 50' of equipment			
Start-Up			
Manufacturer's installation and start-up procedures complete			
Start-up documentation submitted to CxA			
Readiness			
System is ready for functional performance testing			
Representative photograph provided			

Sign-Off:

Team Member	Name	Date
Responsible Contractor (RC):		
Commissioning Authority (CxA):		

Notes:

SAMPLE

Contractor Checklist

Unit Type:	Building Automation System	Unit No:	N/A
Location:		Serves:	
Manufacturer:		Model:	

Check	RC	CxA	Note
Equipment			
Controllers mounted in panels per project documents			
Controller panels labeled per project documents			
Control wires and control devices labeled per project documents			
All control devices (actuators, sensors, etc) have been provided per the project documents			
Wires installed neatly in cable trays, D-rings, conduit, cable tied or plenum rated per requirements			
Front end computer and peripherals provided per project document specifications			
Surge protection and battery back-up devices installed per project documents			
External communication connected			
Common Sensors			
OSA sensor installation is complete			
OSA sensor location is appropriate with no artificial heat loads			
Photocell sensor installation is complete			
Photocell sensor location is appropriate with no artificial light sources			
Demand pulse meter installation is complete			
Gas pulse meter installation is complete			
Start-Up			
System graphics are complete, accurate and verified point-to-point			
Point to point testing and sensor calibration is complete			
Room temperature and other set points configured per owner			
Operating schedules have been set up per owner's direction			
Alarms have been programmed and owner's direction			
Access Security levels have been set up per owner's needs			
Trend logs have been set up as directed by the CA			
Network connection is complete & remote access confirmed			
Point-to-point and calibration documentation submitted to CxA			
Readiness			
System is ready for functional performance testing			

Sign-Off:

Team Member	Name	Date
Responsible Contractor (RC):		
Commissioning Authority (CxA):		

Notes:

SCHEDULE B – Functional Performance Tests

Functional Performance Tests

- 1 The preliminary versions of the Functional Performance Test and Verification Outline sheets contained in this Schedule define the individual systems to be tested and Contractor responsibilities based on the specific method of commissioning. These preliminary Functional Performance Test and Verification Outline sheets represent information available at the time of commissioning specification development. The final versions may be somewhat different and will be included within the Commissioning Plan as presented at the initial commissioning coordination meeting.
- 2 The methods of functional performance test and verification are listed in Table 1 of this Schedule. The Contractor shall be responsible for supporting the testing activity as indicated. This may include developing the test plan and functional performance test forms for approval by the Commissioning Authority, performing testing to be witnessed by the CxA or providing support during functional performance testing conducted by the CxA or their sub-Authority.
- 3 Contract documents state that the Contractor is responsible to demonstrate that all systems comply with contract requirements and meet the project design intent. The scope of testing outlined in the following Functional Performance Test and Verification Outline sheets in this Schedule represent the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove systems comply with the design intent. If systems fail the initial tests additional testing may be required.
- 4 The following Test Summary Table identifies the functional tests that shall be conducted on this project. This table shall be used as a document tracking mechanism for the process of submittal and review of contractor provided testing documentation.
- 5 The contractor is responsible for submitting proposed functional test documentation to the Commissioning Authority for review and approval at least one month prior to these activities. It is the Contractor's responsibility to notify the Commissioning Authority in advance of the scheduled activity, testing or startup date. A minimum of 5 working days advance notification is required. If the CxA is not notified in advance of a scheduled start-up or testing activity, the start-up or testing shall be rescheduled and repeated to the satisfaction of the CxA.
- 6 The "Responsible Contractor" column of the table shall be completed during the Initial Commissioning Coordination Meeting by assigning an individual Contractor responsible for the activities associated with each system based on what contractor provided that system.

Table – B: Functional Test Summary Table

A	B	C	D	E	F	G
System Description	Responsible Contractor	Proposed Test Forms Received	O K	Testing Complete	O K	Notes
Energy Recovery Ventilators						
VRF System						
FCU						
Radiant Ceiling Panels						
Exhaust Fans						
Infrared Heaters						
Air Distribution System						
Balancing Air and Water						
EMCS & VRF Control Systems						

Summary Table Key:

- A. System description for each system commissioned.
- B. Contractor responsible for providing testing. To be filled in after contract award.
- C. Date the proposed test forms are received by the CxA from the responsible Contractor (if applicable).
- D. Indicates that CxA has received and approved the proposed test forms.
- E. Date(s) testing was performed by contractor.
- F. Indicates that Commissioning Authority has witnessed and approved the testing and received all completed test forms.
- G. Notes on status of forms, irregularities and rework needed.

Table 1 – Functional Test and Verification Methods

The following applies regardless of test method.

The contractor shall support the CxA during testing or verification, including but not limited to: scheduling and sequencing and adequate time for testing, on-site support during testing, testing instruments and equipment, setting up trend logs, providing access to equipment (including lifts), providing access to control systems both on-site and remotely.

The CxA shall do one or a combination of the following to verify contractor testing:

1. The CxA shall witness all or portions of the tests during contractor testing.
2. The CxA shall re-conduct the functional tests on all or portions of the systems using the same test plan and data sheets.
3. The contractor shall be required to duplicate some of the testing by demonstrating a percentage of the system as selected and witnessed by the CxA.

If during the verification process inconsistencies are found that demonstrate that the functional testing conducted by the contractor was not properly executed, the CxA shall suspend verification and the contractor shall be required to correct the problems and re-conduct the entire functional test and verification for the system(s) in question. Excessive test failures shall be subject to the back-charging provisions in Section 01 91 13.

Test Method A – Contractor Written and Conducted with CxA Oversight

The test plan and test data sheets are developed by the contractor responsible for the system and submitted to the CxA for approval. These can be the system manufacturer's stock test forms if appropriate. The CxA shall assist contractor in development of test forms if requested to do so. The contractor shall conduct the tests on 100% of the equipment per the plan, document results and submit completed test forms to the CxA for review and approval.

Test Method B – CxA Written and Conducted, Contractor Supports

The test plan and test data sheets are developed by the CxA. The CxA shall conduct the tests per the plan, document results and notify contractor of any issues found.

Test Method C – CxA Written, Contractor Conducts

The test plan and test data sheets are developed by the CxA. The CxA shall turn over the test plan and test data sheets to the contractor. The contractor shall conduct the tests on 100% of the equipment per the plan, document results and submit completed test forms to the CxA for review and approval.

**VRF System (VRF Certified Installer)
Indoor Units, Outdoor Units, BC Controllers, Control System
Functional Test and Verification Outline**

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Appendix - B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Shall Sample or Witness
C.2	CxA	Contractor	N/A	100%

Functional Tests:

- 1) Unit Operation
 - a) Demonstrate operation of all features and functions
 - b) Simulate all alarm conditions and demonstrate all safeties and alarm reporting.
 - c) Demonstrate fan HOA functions
 - d) Demonstrate modulation and temperature control.
 - e) Demonstrate EMCS Interface
 - f) Demonstrate condensate pump operation

**Energy Recovery Ventilator
Functional Test and Verification Outline**

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Appendix - B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Will Sample or Witness
C.1	CxA	Contractor	N/A	100%

Functional Tests:

- 1) Unit Operation
 - a) Demonstrate and document operation of all features and functions
 - b) Simulate all alarm conditions and demonstrate and document all safeties and alarm reporting.
 - c) Demonstrate and document fan HOA functions
 - d) Demonstrate and document modulation, temperature control and heat recovery, record all parameters.
 - e) Demonstrate and document BCS Interface

**Infrared Heaters
Functional Test and Verification Outline**

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Appendix - B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Shall Sample or Witness
C.2	CxA	Contractor	N/A	100%

Functional Tests:

- 1) Unit Operation
 - a) Demonstrate operation of all features and functions
 - b) Demonstrate modulation and temperature control.

**Exhaust Fans
Functional Test and Verification Outline**

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule - B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Shall Sample or Witness
C.2	CxA	Contractor	N/A	100%

Functional Tests:

- 1) Exhaust fans
 - a) Demonstrate operation of all features.
 - b) Demonstrate on/off control and any interlocks.
 - c) Demonstrate building control system Interface.

**Balancing Air and Water Systems
Functional Test and Verification Outline**

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule - B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Shall Sample or Witness
C.2	CxA	Contractor	10%	N/A

Functional Tests:

- 1) Perform measurements to demonstrate air balance meets design tolerances.
- 2) Perform measurements to demonstrate building pressurization in various modes of operation.
- 3) Perform measurements to demonstrate room pressurization in various modes of operation.

The testing and air balancing contractor shall demonstrate a properly balanced system by measuring and verifying the specified percentage of the previously balanced systems as selected and witnessed by the Commissioning Authority. The TAB contractor shall also demonstrate the proper pressure relationship of the spaces to each other and the outside.

In the event that the testing and balance verification values are off by more than 10% of original testing values, the balancing contractor shall readjust the systems to the satisfaction of the owner and design team.

All balancing set points, including, but not limited to, outside air minimum positions, air flow measuring stations, duct static set points, and differential pressure information shall be communicated to the controls contractor for implementation into the DDC system and recorded in the final balance report.

**Energy Management Control System (EMCS)
 And Variable Refrigerant Flow Zoning (VRF) Control System
 Functional Test and Verification Outline**

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule - B details the various methods of accomplishing functional testing.

Preliminary Activities:

A Controls Integration Meeting (CIM) shall be conducted after the controls submittal is complete and the CxA has reviewed the submittal. The meeting is to be conducted prior to finalizing the functional test procedures and shall be attended by the CxA, EMCS contractor, the VRF Control System contractor/supplier, mechanical engineer and a representative of the Owner’s maintenance group at a minimum. The CIM shall include, but not be limited to, the following topics:

1. Sequence of Operations
2. Alarm Points List
3. Trend Points List
4. Displayed/Adjustable Point List
5. Graphical Interface
6. Integration with packaged equipment
7. Integration between two control systems
8. Point-to-Point Checkout and Commissioning of Existing Equipment
9. Metering system and energy dashboard integration

Prior to any functional testing, a complete and documented start-up process shall have occurred. This includes point-to-point verification, sensor calibration and operational mode verification.

Prior to any graphical system development, the control contractor is to submit a System Setup Outline to the Commissioning Authority and Owner/Owner’s representative for approval. The outline should describe the graphics to be provided along with a detailed list of the individual points to be displayed, screen linking, security levels, alarm management, schedules, trending, animation strategies, navigation, etc.

Trend logs shall be entered per the direction of the CxA to support demonstration of operation as outlined below for the performance period.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Shall Sample or Witness
C.2	CxA	Contractor	N/A	100%

The CxA shall develop a series of functional performance tests to be conducted by the contractor and as outlined below. Part 4 of this specification section includes sample

functional test documents. These are samples only and do not reflect all functional test requirements. The contractor shall conduct the functional tests and turn over the completed functional test documentation and trend logs to the CxA. The CxA shall re-conduct a portion of the tests. The contractor shall include time in their bid to support the CxA during this activity. This support does not include the normal point-to-point and operational verifications that should take place during start-up.

The EMCS and VRF control contractors shall make available to the CxA, at no additional cost, a method of interfacing with the control system at the building site. This interface shall be made available regardless of if a permanent local work station is specified in the contract documents or not. The interface shall be made available for the duration of the commissioning process and all commissioned systems are accepted. The EMCS and VRF control contractors shall also make available to the CxA, at no additional cost, a method of remotely accessing the system during the commissioning process and up to one year after system acceptance. Remote and local access shall include all software, licensing, software keys and anything else required to facilitate full access to the system. The local and remote interfaces shall include all contract required interfaces including, but not limited to, all graphics, trends and alarms. The CxA shall be given an account with full security access privileges to the system.

The contractor shall review the test plan provided by the CxA to verify the following:

1. The functional tests will not endanger the equipment or personnel in the facility.
2. The functional tests can be performed per the plan with the installed interface and equipment.

Functional Tests:

- 1) Functional testing to demonstrate proper operation of ALL modes of operation of all systems under control of the automatic temperature control system and as described in the sequence of operations including but not limited to the following equipment:
 - a) Energy Recovery Ventilators
 - b) VRF Fan Coil Units
 - c) VRF outdoor Units
 - d) Electric unit heaters
 - e) Electric radiant panel heaters
 - f) Infrared tube heaters
 - g) Electric cut heaters
 - h) Exhaust Fans
 - i) Metering Systems
 - j) Integrated systems (generator, fire, etc.)

- 2) Functional testing to demonstrate proper operation of ALL modes of operation of all systems under control of the automatic temperature control system and as described in the sequence of operations including but not limited to the following modes:
 - a) Unoccupied mode
 - b) Unoccupied limits
 - c) Occupant override mode
 - d) Optimal Start
 - i) Heating mode

- ii) Cooling mode
 - e) Warm-up mode
 - f) Occupied mode
 - i) Heating mode
 - ii) Cooling mode – including economizer
- 3) Functional testing to demonstrate operation of all sub-systems under control of the automatic temperature control system and as described in the sequence of operations including but not limited to the following categories:
 - a) Fan control
 - b) Interlocked fan operation
 - c) Zone temperature control
 - d) Thermostatic control
 - e) Automatic damper control and modulation
 - f) Heating/cooling capacity
 - g) Alarm monitoring
 - h) Graphical user interface
- 4) System stability and control verification via trending (performance period). Trend logs to be set up by control contractor to demonstrate system performance, to include, but not limited to the following performance variables. Trend logs shall be set up for all inputs/outputs, both digital and analog, for all points in the system both physical and virtual. Trend interval shall be 5 minutes unless otherwise directed by the CxA. The minimum trend period shall be 14 days. Trend log point headings as displayed on system graphs and data tables shall be adequately descriptive for the point but no longer than 12 characters unless approved by the CxA. System default names are not acceptable. The heading titles shall contain no extraneous characters that are not needed to describe the point. The contractor shall provide the trends to the Commissioning Authority in electronic format, in MS Excel or a comma delimited file.
 - a) Zone temperature control
 - b) Morning warm-up verification
 - c) Optimum start-stop verification
 - d) Water and electrical usage
- 5) Functional testing of all equipment protections monitored by the automatic temperature control system, safeties and alarms including but not limited to the following modes:
 - a) Smoked detector, fire alarm shutdown for air handling equipment
 - b) VRF parameter failures
 - c) Dirty filter status
 - d) Fan failure and alarms
 - e) Phase loss protection

PART 4 – SAMPLE FUNCTIONAL TEST DOCUMENTS

- 4.1 Sample functional test procedures and data forms are provided in this section to demonstrate the rigor of the process, test procedures and documentation that shall be required from the contractor. These forms and procedures shall be amended, augmented and updated in the final commissioning plan based on the final project documents, addendums and submittal information. **This sample section does not contain all functional test procedures and data forms that are required to be executed by the contractor.** Schedule - B of Part 3 provides a full list of the functional tests that shall be required to be executed by the contractor.

**Automatic Temperature Control Functional Test Samples
 FCU or ERV w/ Heating, Cooling & Economizer**

Unoccupied Mode

1. Place the control system in the unoccupied mode by changing the schedule.
2. Verify that all controlled points listed are off, OSA dampers are closed.
3. Verify by direct observation that all controlled points are off and dampers are in the correct position.

ERV:	1	2	3	4	5
Supply/Return fan command displayed OFF					
Supply/Return fan status displayed OFF					
Supply/Return fan, observed OFF					
Heating command displayed					
Cooling command displayed					
OSA damper position displayed CLOSED					
OSA damper position, observed CLOSED					
Return air damper position displayed OPEN					
Return air damper position, Observed OPEN					
Relief damper position displayed CLOSED					
Relief damper position, observed CLOSED					

- Set points returned to original values.
 Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Unoccupied Limits

1. Place the system in the unoccupied mode and verify all ERVs are off and heating, economizer and cooling are not locked out.
2. Simulate a zone temperature below the unoccupied low limit.
3. Verify unit comes on in full recirculation and heating system modulates to control zone temperature.
4. Verify unit stops when zone is satisfied.
5. Simulate a zone temperature above the unoccupied high limit
6. Verify unit comes on in cooling and the system modulates to control zone temperature.
7. Verify unit stops when zone is satisfied.

Unoccupied Limits

ERV:	1	2	3	4	5
Pre-Test:					
Unoccupied low limit					
Unoccupied high limit					
Zone temperature					
Test:					
Unoccupied low limit changed to:					
Supply/Return fan command displayed					
Supply/Return fan status displayed					
Heating command displayed					
Cooling command displayed					
OSA/Relief damper position displayed					
Return air damper position displayed					
Return air temperature					
Mixed air temperature					
Outside air temperature					
Discharge air temperature					
System off when satisfied					

- Set points returned to original values.
- Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Unoccupied High Limit

	ERV:	1	2	3	4	5
Unoccupied high limit changed to:						
Supply/Return fan command displayed						
Supply/Return fan status displayed						
Heating command displayed						
Cooling command displayed						
OSA/Relief damper position displayed						
Return air damper position displayed						
Return air temperature						
Mixed air temperature						
Outside air temperature						
Discharge air temperature						
System off when satisfied						

- Set points returned to original values.
- Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Unoccupied Occupant Override – ERV

1. Place the system in the unoccupied mode and verify all ERVs are off.
2. Set the override period to a minimum value.
3. Simulate a call for heating or cooling as required, test a minimum of two each for heating and cooling.
4. One at a time, press the override button for each space.
5. Verify the ERV goes into the occupied mode and system is in heating or cooling.
6. Verify unit stops at end of time period.

ERV:	1	2	3	4	5
Pre-Test:					
Override run time					
Zone temperature					
Zone set point					
Test:					
Override run time adjusted to					
Zone temperature set point adjusted to					
Heat Test or Cool Test					
Supply/Return fan command displayed					
Supply/Return fan status displayed					
Heating command displayed					
Cooling command displayed					
OSA/Relief damper position displayed					
Return air damper position displayed					
Return air temperature					
Mixed air temperature					
Outside air temperature					
Discharge air temperature					
System off at end of override					

- Set points returned to original values.
 Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Occupied Mode Tests

1. Place the system in the occupied mode by changing the schedule.
2. Verify by direct observation that the supply fan starts, the air dampers modulate to normal position (minimum air or higher), heating and cooling is set to control to current set point, relief dampers open and other parameters are normal.
3. Verify BAS displays the correct status for the units.

ERV:	1	2	3	4	5
Space temperature					
Space temperature set point					
Supply/Return fan command displayed					
Supply/Return fan status displayed					
Heating command displayed					
Cooling command displayed					
OSA/Relief damper position displayed					
Return air damper position displayed					
Return air temperature					
Mixed air temperature					
Outside air temperature					
Discharge air temperature					
System off when satisfied					

Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Zone Control - Cooling

1. Verify outside air is below economizer lockout temperature.
2. Lower the zone set point slightly below the current zone temperature.
3. Verify outside air dampers open for economizer cooling and DX cooling remains off.
4. With an increased call for cooling, verify DX cooling is activated.
5. Mixed Air Low Limit: Simulate a mixed air temperature below the mixed air low limit set point and verify mixed air low limit overrides the economizer control by closing the outside air damper. Release low limit when done.
6. Economizer Lockout1: Simulate an OSA temperature above the return air temperature and verify OSA dampers modulate to minimum position. Release when done.
7. Economizer Lockout2: Simulate an OSA temperature above the Economizer Lockout Set point and verify OSA dampers modulate to minimum position.
8. Raise set point to eliminate a call for cooling.
9. Cooling with economizer lockout: With economizer locked out. Create a demand for cooler air. Verify cooling is activated immediately.

Cooling Control:

	ERV:	1	2	3	4	5
Pre-Test:						
Zone temperature						
Zone set point						
Outside air temperature						
Economizer minimum set point						
Economizer lockout set point						
Economizer damper position						
OAT						
RAT						
MAT						
DAT						
Mixed air low limit set point						
Test:						
Zone set point lowered to						
Heating command displayed						
Cooling command displayed						
OSA/Relief damper position displayed						
Return air damper position displayed						
Return air temperature						
Mixed air temperature						
Outside air temperature						
Discharge air temperature after 3 minutes						
Economizer is first stage of cooling						
Zone set point lowered to						
Heating command displayed						
Cooling command displayed						
OSA/Relief damper position displayed						
Return air damper position displayed						
Return air temperature						
Mixed air temperature						
Outside air temperature						
Discharge air temperature						
Discharge air temperature after stabilization						
Mechanical cooling coil is second stage of cooling						

Limits:

	ERV:	1	2	3	4	5
Mixed Air Low Limit						
Mixed air low limit set point changed to						
Outside air dampers close to control to MLL						
Economizer Lockout						
Dampers to minimum position on economizer lockout based on return air						
Dampers to minimum position on economizer lockout based on outside air						
Cooling control during economizer lockout:						
Zone set point lowered to						
Cooling command displayed						
OSA damper position displayed						
Supply air temperature after stabilization.						
RAT						
MAT						
Mechanical cooling is first stage of cooling						

- Set points returned to original values.
- Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Zone Control - Heating

1. While system is still in cooling, simulate a zone temperature below the zone temperature set point.
2. Verify economizer is at minimum.
3. Verify discharge air temperature set point is reset higher in response to heating demand.
4. Verify heating operates to control to set point.

Heating Control:

ERV:	1	2	3	4	5
Pre-Test:					
Economizer minimum set point					
Zone temperature					
Zone set point					
Test:					
Set point raised to					
Heating command displayed					
Cooling command displayed					
OSA/Relief damper position displayed					
Return air damper position displayed					
Return air temperature					
Mixed air temperature					
Outside air temperature					
Discharge air temperature after 3 minutes					

- Set points returned to original values.
 Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Thermostat Calibration and Point to Point Test.

1. At each thermostat location, press override push button (or raise/lower setpoint).
2. Verify that BAS indicates correct zone in override.
3. Measure room air temperature and record actual and BAS indicated temperatures.

Unit No.	Override	Room Temp	BAS Temp	Unit No.	Override	Room Temp	BAS Temp

- Set points returned to original values.
- Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

ERV Hard Wire Shutdowns:

1. Mixed Air Low Temperature: Trip freeze stat and verify fan shuts down and dampers close.

ERV:	1	2	3	4	5
Shutdown on freeze					
Reset OK					

- Set points returned to original values.
- Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

Exhaust Fans
BAS Controlled Exhaust Fan Test (with Fan Proof)

1. Place the control system in the unoccupied mode.
2. Verify all exhaust fans under BAS control are commanded off, display an off status and are off by physical inspection (PI).
3. Place the system in the occupied mode.
4. Verify all exhaust fans under BAS control are commanded on, display an on status and are on by physical inspection (PI).
5. Turn off the exhaust fan at the disconnect and verify fan failure alarm is generated.
6. Turn power to fan back on and verify alarm clears.

	EF-	1	2	3	4	5
Unoccupied Mode:						
Exhaust fan command displayed OFF						
Exhaust fan status displayed OFF						
Exhaust fan, PI OFF						
Occupied Mode:						
Exhaust fan command displayed ON						
Exhaust fan status displayed ON						
Exhaust fan, PI ON						
Exhaust fan failure alarm received						
Exhaust fan failure alarm cleared						

- Set points returned to original values.
- Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermostats
 - 2. Timers
 - 3. Electric actuators.
 - 4. Sensors
 - 5. Magnetic Door Switches

1.2 SCOPE

- A. The mechanical contractor shall install a complete, properly adjusted, and effective temperature control system.
- B. This section includes field assembled instrumentation and temperature controls for air conditioning, heating, ventilation, and exhaust systems.
- C. See drawings for Sequence of Operation.
- D. See Equipment Schedules and associated specification sections for controls integral to HVAC equipment.
- E. Controls shall be electric/electronic systems.
- F. Manufacturers of components shall be as specified, Honeywell, or approved.
- G. Any additional parts necessary to or incidental for a complete and operating system shall be the responsibility of the contractor.

1.3 MAINTENANCE SERVICE

- A. Furnish service and maintenance of control system for one year from Date of Substantial Completion.
- B. Furnish complete service of controls systems, including callbacks and service calls.
- C. Furnish two complete inspections per year, one in each season, to inspect, calibrate, and adjust controls. Submit written report after each inspection.
- D. Include systematic examination, adjustment, and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- E. Perform work without removing units from service during building normal occupied hours.
- F. Provide emergency call back service during working hours for this maintenance period.
- G. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.

- H. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer.

1.4 QUALITY ASSURANCE

- A. Control Air Damper Performance: Test in accordance with AMCA 500.

1.5 SUBMITTALS

- A. Provide submittal to include one PDF of control components, control diagrams and operational sequences.

PART 2 PRODUCTS

2.1 THERMOSTATS

- A. Manufacturers: Honeywell (or as noted below) or approved equal.
- B. Bi-metal thermostats are not allowed for any application.
- C. Line Voltage Cooling Thermostat (Dial): T651 or equal.
 - 1. Sensor Element: Vapor filled dual diaphragm.
 - 2. Accuracy: +/- 2 degrees F.
 - 3. Load / Motor capacity rating of 22 amps, 115/208/240 volt.
- D. Line Voltage Heating Thermostat (Programmable Electronic): King ESP230, Honeywell TL8230A or equal.
 - 1. Integral manual On/Off switch, single-pole.
 - 2. Accuracy: +/- 1.5 degrees F.
 - 3. Load / Motor capacity rating of 22 amps, 208/240 volt.
 - 4. Electronic thermistor temperature sensor with 40 F to 95 F range.
 - 5. 7-day independent programmable schedules with 4 daily setpoints.
 - 6. LCD display showing day, time, room temperature and setpoint, Green LED backlight, Red LED heat on Indicator, temperature adjustment buttons.
 - 7. Positive off position/function to serve as NEC required disconnect.
- E. Low Voltage Heating/Cooling Thermostat (Electronic Programmable): TH2110D
 - 1. Sensor Element: Thermistor.
 - 2. Accuracy: +/- 1 degrees F.
 - 3. 24 VAC or 750 mV control.
 - 4. LCD backlight display.
 - 5. Dual powered battery/hardwire.
- F. Low Voltage Heating/Cooling Commercial Thermostat (Electronic Programmable): T7350M
 - 1. Sensor Element: Thermistor.
 - 2. Accuracy: +/- 1 degrees F.
 - 3. 24 VAC electrical.
 - 4. LCD backlight display.
 - 5. 365-day programming with 2 occupied and 2 unoccupied periods per day.
 - 6. Individual heat and cool setpoints for both occupied and unoccupied.
 - 7. P+I+D temperature control.
 - 8. Auxiliary subbase connection for economizer control.
 - 9. 2 modulating (4-20mA) outputs and 2 relays.
 - 10. Heat-Off-Cool-Auto system selection.

- G. Room Thermostat Accessories:
 - 1. Insulating Bases: For thermostats located on exterior walls.
 - 2. Thermostat Guards: Locking transparent plastic mounted on separate base.
 - 3. Adjusting Key: Matching device.
 - H. Air-stream Thermostats:
 - 1. Remote bulb or bimetallic rod and tube type, proportional action with adjustable setpoint in middle of range and adjustable throttling range.
 - 2. Averaging service remote bulb element: 20 feet.
- 2.2 SPRING WOUND TIMERS
- A. Manufacturers: Intermatic or approved equal.
 - B. Spring wound twist timer, 120 volt, 1 HP (20 amp inductive) rated. 'Brushed metal' gray polycarbonate faceplate. Select time range and hold as scheduled or noted in sequence.
- 2.3 DELAY TIMER
- A. Manufacturers: Airotronics THCU0300SCS or approved equal
 - B. Solid state delay-on-make timer. Totally encapsulated, sealed case. Application of input voltage starts the time delay; the delay is reset by removal of input voltage. 1 amp rated, universal voltage. Factory fixed time delay of 300 seconds (5 minutes).
 - C. Supplier: Stoneway Electric p/n STWY.
- 2.4 CONTROL AIR DAMPERS
- A. See Section 23 33 00.
- 2.5 ELECTRIC DAMPER ACTUATORS
- A. Manufacturers: Belimo or approved equal.
 - B. Operation: Two-position, proportional or reversing type as required for application, spring-return.
 - C. Enclosure Rating: NEMA 250 Type 2 Enclosure.
 - D. Mounting: Direct mount.
 - E. Stroke: 30 seconds end to end full stroke, 15 seconds return to normal for spring return.
 - F. Protection: Electronic stall protection.
 - G. Control Input: 0-10 VDC or 0-20 mA DC.
 - H. Power: Nominal 24 \ 120 volt AC.
 - I. Torque: Size for minimum 150 percent of required duty.
 - J. Duty cycle: rated for 65,000 cycles.
 - K. Accessories:
 - 1. Cover mounted transformer.

2. Auxiliary potentiometer.
3. Damper linkage.
4. Direct drive feedback potentiometer.
5. Output position feedback.
6. Field selectable rotational, spring return direction, field adjustable zero and span.
7. End switch.

2.6 CO/NO2 SENSOR

- A. Manufacturer: AirTest Technologies (1-888-855-8880) or approved equal.
- B. Controller (CT2100): Integrated dual sensing capability for two gases with two sets of relays for fan/alarm activation. LED indication of power, fault and 2 threshold indicators for each gas channel. 2-minute low on delay, 10 min low off delay and 5 minute high on delay. 24 VAC, NEMA 4X enclosure.
- C. Integrated electrochemical CO sensor head (TR2000).
- D. Remote NO2 Sensor: Electrochemical diffusion sensor in NEMA 4X enclosure, 0-10 ppm range, +/- 5% accuracy. (TR3210)

2.7 WARNING ALARM

- A. Manufacturer: Edwards Signals 874 or approved equal.
- B. Surface mount vibrating horn for heavy-duty indoor use. Corrosion resistant finish, adjustable volume, completely assembled. 24VAC

2.8 MAGNETIC DOOR SWITCHES

- A. Manufacturers: George Rick Industries, Nascom or approved equal.
- B. Steel Man Door: 180 Series, 1" recessed magnetic contract, UL listed.
- C. Rollup Door: 4700-A Series, multi-position adjustable magnet bracket, armored cable.
- D. Provide hardware, mounting brackets, adapters and plates required for magnetic contact switch installation.
- E. Coordinate and match switch color with door frame.

2.9 ENCLOSURES

- A. All enclosures to be UL listed and all metal construction. All controls and instruments logically assembled at one or more panels.

2.10 CONTROL RELAYS

- A. Manufacturers: Functional Devices RIB or approved equal.
- B. Shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dust proof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays should be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage.

2.11 WIRING

- A. Electric wiring and wiring connections required for the installation of the temperature control system as herein specified, shall be provided by the temperature control contractor. All wiring shall comply with the requirements of local and national electrical codes, and with applicable requirements of Electrical Division. Install all wiring in conduit.
- B. Line voltage wiring type and size shall be per NEC.
- C. Low voltage wiring type and size shall be per control manufacturer's recommendations based on application and length of run.

2.12 CONTROL POWER

- A. Provide transformers to supply power for control equipment operating at less than normal lighting circuit voltage. Do not connect wiring to lighting circuits.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify building systems to be controlled are ready to operate.
- B. Verify air handling units and ductwork have been accepted and air filters are in place before installing sensors in air streams.
- C. Verify location of thermostats, humidistats and other exposed control sensors with Drawings before installation.

3.2 COORDINATION

- A. Furnish all control products to accomplish the specified sequence of operation, except those products specifically furnished under other sections.
- B. Install all control products and connections, except where already installed by the equipment manufacturer.
- C. Thermostats located in electrical transformer vaults shall be model approved by electrical utility.
- D. Coordinate provision of door contacts for interface with mechanical controls.

3.3 INSTALLATION

- A. General:
 - 1. Install controls by mechanics skilled in erection of control systems employed by and under direct supervision of control manufacturer's representative.
 - 2. Mount control equipment and devices as recommended by manufacturers and as shown on drawings; in case of conflicts between manufacturer's instructions and the drawings, consult the Project Manager for direction.
 - 3. Fasten all equipment securely to structure. Install equipment and exposed piping and conduit runs parallel to building lines, plumb and level.
- B. Wiring:

1. Provide line voltage and/or low voltage wiring as required to serve the complete system; conform to code.
 2. Provide EMT or rigid conduit for exposed control wiring outside of cabinets or enclosures. Concealed low voltage wiring need not be in conduit, except in walls (see "3").
 3. Provide rigid conduit for control wiring concealed in partition walls, until conduit emerges from wall above ceilings.
 4. Run low voltage control wiring separate from line voltage wiring and segregate from other systems to avoid Electromagnetic Interference (EMI).
 5. All low voltage control wiring shall be homeruns between components without splices.
 6. Select wiring gauge based on length of run and power requirement for a maximum of 10% voltage drop.
- C. Install sleeves through concrete surfaces in minimum one-inch sleeves, extended 6 inches above floors and one inch below bottom surface of slabs.
- D. Install thermostats, humidistat, space temperature sensors, and other exposed control sensors after locations are coordinated with other Work.
- E. Install thermostats in aspirating boxes in public areas and as indicated on Drawings.
- F. Install control panels adjacent to associated equipment on vibration free walls or freestanding supports. Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- G. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.

3.4 THERMOSTATS AND SENSORS

- A. Mount thermostats and other human interface devices at 48" centerline above finished floor to comply with ADA accessibility per ANSI A117.1. Align thermostats and devices with light switches and other controls.
- B. Coordinate wall location of thermostats and other wall mount devices with light switches and controls provided by others. All devices in the same vicinity should be grouped at a common elevation with regular horizontal spacing intervals.
- C. Mount CO/NO2 sensor controllers at 54" centerline above finished floor, CO sensor at 48" centerline above finished floor and NO2 sensor at 18" centerline above finished floor.

3.5 MAGNETIC DOOR SWITCHES (HVAC HEATING AND COOLING LOCKOUT)

- A. Furnish door switches for installation by G.C. Coordinate required door locations.
- B. Coordinate control transformer power and locations with E.C.
- C. Provide all required control transformers, relays, door switches, count down timers and low voltage wiring required for a fully functional system with complies with Energy Code C403.4.1.6.
- D. Provide access panels where required for transformer, relays or other control components.

3.6 FIELD QUALITY CONTROL

- A. After completion of installation, start-up, test and adjust each system. Submit data showing set points, final adjustments of controls and compliance with sequence of operations.
- B. Conduct functional tests on complete systems, or individual portions as approved.
- C. Conduct operational tests; set controls to operating conditions, record settings and readings of each control device.
- D. Work in close coordination with testing and balancing Agency to set up control devices, set damper flow rates, and provide control system in perfect operating order. See Section 23 05 93.

3.7 DEMONSTRATION AND TRAINING

- A. Demonstrate complete operation of systems, including sequence of operation prior to Date of Substantial Completion.
- B. Not less than 60 days after beneficial occupancy by the Owner, recheck entire control system for compliance with Sequence of Operation.
- C. Recheck controls for proper operation at the start of the heating season, if other than above timing, and again during the first warm weather period following winter operation.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Refrigerant piping.
 - 2. Pipe insulation protection.
 - 3. Refrigerant moisture and liquid indicators.
 - 4. Valves.
 - 5. Refrigerant piping accessories.

1.2 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Flexible Connectors: Use at spring isolated air handlers and condensers greater than six tons.
- D. Size piping in accord with equipment manufacturer's refrigerant piping design guidelines based on actual piping installation lengths. Use long line calculations when applicable.

1.3 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.

2.2 COPPER PRESSURE-SEAL FITTINGS FOR REFRIGERANT PIPING

- A. Manufacturers: Parker Hannifin – Zoomlock, Nibco – PressACR, or approved equal.
- B. Flame-Free press fittings: UL 207 Listed. Refrigerant Grade Copper in accordance with ASTM B75 or ASTM B743. O-Rings: HNBR.
- C. Tools: Manufacturer's approved special tools.
- D. Ratings:
 - 1. Maximum Rated Pressure (MRP): 700 psig.
 - 2. Continuous Operating Temperature: 250 deg F.
 - 3. O-Ring Temperature Rating: -40 to 300 deg F.
 - 4. Minimum Burst Pressure in accordance with UL 207: 2100 psig.
 - 5. Vacuum Pressure Capability: 20 Microns.
 - 6. Complies with UL 109 for vibration resistance.
 - 7. Approved for the following oils: POE, PVE, PAG.
- E. Approved Tubing Materials: Copper-to-copper connections with the following copper tubing:
 - 1. Hard Drawn Copper, 1/4 to 1-3/8 inch (6.4 to 35 mm): Type ACR, L, K.
 - 2. Soft (Annealed) Copper 1/4 to 1-3/8 inch (6.4 to 35 mm): Type ACR, L, K.

2.3 REFRIGERANT LINE SET

- A. Copper Tubing: ASTM B280, annealed, Type ACR
 - 1. Flared ends with brass nuts and protective caps.
 - 2. Pre-insulated, dual tube, liquid and vapor lines with closed-cell elastomeric foam.
 - 3. R-410A, 700 PSI rated.

2.4 PIPE INSULATION PROTECTION

- A. Manufacturers: Airex EFlex Guard or approved equal.
- B. Construction: Non-laminated flexible PVC with, antifungal and UV resistant properties.
 - 1. Fire Performance: Testing Standard ASTM E 84 / UL 723.
 - 2. Rated Class "A" Material -25 Flame/450 smoke index
 - 3. Accelerated Weatherization and U. V. Testing Standard: ASTM G153
 - 4. Fungal resistance for interior & exterior: ASTM G21- "0" growth.
 - 5. Water/Vapor Permeability Testing Standard ASTM E96 Rated $1 \leq \text{perm}$.
 - 6. Rated Class II Vapor Retarder
 - 7. Tensile strength and Elongation for Vulcanized Rubber and Thermoplastic Elastomers ASTM D412.
- C. Fasteners: No material shall be cemented or applied by adhesives.
 - 1. Reusable, Heavy-Duty, Dual-Bonded Velcro fasteners and U. V. Cable Ties.
 - 2. Velcro fasteners construction method: Molecular Fusion bonded and double stitched.
- D. Color: Black or White
- E. Install per Airex Manufacturing Inc. Instructions.

2.5 UNIONS, FLANGES, AND COUPLINGS

- A. Copper Pipe: Bronze, soldered joints.

2.6 REFRIGERANT MOISTURE AND LIQUID INDICATORS

- A. Manufacturers: Alco Controls, Parker Hannifin, Sporlan Valve or approved equal.
- B. Indicators:
 - 1. Port: Single, UL listed.
 - 2. Body: Copper or brass, flared or solder ends.
 - 3. Sight glass: Color-coded paper moisture indicator and plastic cap.
 - 4. Maximum working pressure: 500 psig
 - 5. Maximum working temperature: 200 degrees F.

2.7 REFRIGERANT PIPING SERVICE VALVE

- A. Manufacturer: Diamondback or approved equal.
- B. Full port, forged brass ball valve with Schrader valve, flare connections, Teflon seals and gaskets. 700 psig rated, R-410A compatible, fully factory assembled and pressure tested.
- C. Provide with insulation cover of polyethylene foam with PVC cover and tape.

2.8 FLEXIBLE PIPE CONNECTORS

- A. Manufacturers: Packless Ind, Metraflex, Mason or approved equal.
- B. Braided Refrigeration Piping Connection
 - 1. Bronze flexible hose and bronze braided outer covering.
 - 2. Copper sweat connections, cleaned de-greased, and bagged.
 - 3. R410a rated, 650 psi working pressure.

2.9 ROOF PIPE PORTAL

- A. Manufacturers: RPH Vault or approved equal.
- B. Powder coated heavy gauge aluminum assembly. Vandal resistant lid. Pre-insulated housing, R4.3 insulation. Insulation extension and curb. Stainless steel screws.
- C. Weather-tight Silx14 exit seals for pipe penetrations. UV resistant, 20-year warranty.
- D. Order size based on number of pipe penetrations. Allow for additional power and control conduit penetrations.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.2 INSTALLATION PIPING SYSTEMS

- A. Route piping parallel to building structure and maintain gradient.
- B. Install piping to conserve building space, and not interfere with use of space.
- C. Group piping whenever practical at common elevations.
- D. Sleeve pipe passing through partitions, walls and floors.
- E. Protection: Where piping, other than cast iron or steel, is installed in a concealed location through holes or notches in framing (i.e. studs, joists, rafters, etc.), less than 1-1/2" from framing edge, provide shield plates. Shield plates shall be 16 gauge steel and cover the piping area within framing plus 2" on each side along framing.
- F. Use rigid Armacell Armafix pipe clamp assembly at all supports.
- G. Determine equivalent line length and size piping per manufacturer's installation instructions. Provide solenoid valve and other required piping accessories for long line installation.
- H. Refrigerant piping shall not be installed in elevators, public stairways, stair landing or means of egress spaces.
- I. Install pipe identification.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- K. Provide access where valves and fittings are not exposed.
- L. Flood refrigerant piping system with nitrogen during brazing. Keep piping open with nitrogen flow for zero pressure while brazing.
- M. Insulate piping and equipment.
- N. Fully charge completed system with refrigerant after testing.
- O. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- P. Install refrigerant piping in accordance with ASME B31.5.

3.3 INSTALLATION-EXTERIOR PIPING

- A. Protect exterior piping with application specific piping protection cover system, continuous aluminum jacket or field fabricated GSM cover with steel angle supports.
- B. Provide waterproof pipe entry into building with trim and flashing.

3.4 INSTALLATION - REFRIGERANT SPECIALTIES

- A. Refrigerant Liquid Indicators: Install line size liquid indicators in main liquid line downstream of condenser.
- B. Refrigerant Valves: Install service valves on compressor suction and discharge.

- C. Strainers: Install shut-off valves on each side of strainer.

3.5 FIELD QUALITY CONTROL

- A. Test refrigeration system in accordance with ASME B31.5.
- B. Pressure test refrigeration system with dry nitrogen to 400 psig. Perform final tests at 27 inches vacuum and 400 psig using halide torch or electronic leak detector.
- C. Repair leaks.
- D. Retest until no leaks are detected.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ductwork
 - 2. Kitchen Ductwork
 - 3. Duct Sealant
 - 4. Fabrication
 - 5. Duct Pressure Testing

1.2 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.
- B. Standards: Comply with most stringent requirements and recommendations of International Mechanical Code or SMACNA (Sheet Metal and Air Conditioning Contractors National Association) Duct Construction Standards for fabrication, construction and sealant of duct, fittings, and accessories.
- C. Construct ductwork to NFPA 90A.
- D. Construct kitchen ductwork to NFPA 96.
- E. Duct sealants shall comply with VOC limits of LEED.
- F. Paint must comply with VOC limits per Green Seal standards or SCAQMD.

1.3 ENVIRONMENTAL REQUIREMENTS

- A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures during and after installation of duct sealant.

1.4 DEFINITIONS

- A. Black Carbon Steel: Plain carbon steel which is not galvanized or oiled.

PART 2 PRODUCTS

2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90.
- B. Steel Ducts: ASTM A1008.

- C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
- D. Stainless Steel Ducts: ASTM A167, Type 304.
- E. Fasteners: Rivets, bolts, or sheet metal screws.
- F. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 INSULATED FLEXIBLE DUCTS

- A. Manufacturers: Thermaflex M-KC or approved equal.
- B. Product Description: Insulated assembly with inner duct of woven and coated fiberglass permanently bonded to coated steel wire helix, 1" fiberglass insulation and vapor barrier jacket of fiberglass reinforced metallized film laminate, UL 181 Class 1 complying with NFPA 90A & 90B.
 - 1. Pressure Rating: 10 inches wg positive and 2 inches wg negative.
 - 2. Maximum Velocity: 6000 fpm.
 - 3. Temperature Range: -20 degrees F to 250 degrees F.
 - 4. Thermal Resistance: R-4.2
- C. Accessories:
 - 1. Hanger Strap: Thermaflex FlexTie – 1-1/2" wide, adjustable, plenum rated.
 - 2. Elbow: Thermaflex FlexFlow Elbow or Malco flexible duct support – One piece adjustable design installs over flex duct.

2.3 SINGLE WALL SPIRAL ROUND DUCTS

- A. Manufacturers: McGill AirFlow, Semco or approved equal.
- B. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel.
- C. Joints: 16" and larger flange with gasket material.
- D. Elbows: Smooth radius or 5 section, 1.5D.
- E. Application: Required for all exposed round ductwork; all round ductwork 12" dia. and larger; all round ductwork with static pressure over 1" w.g.. Optional for all round ductwork.
- F. Construct duct with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24

- G. Construct fittings with the following minimum gages:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22

2.4 SINGLE WALL ROUND DUCTS

- A. Manufacturers: Ductmate GreenSeam+ or approved equal.
- B. Product Description: Snap lock round duct with self-sealing butyl rubber longitudinal seam and polyurethane gasket transverse seam. No external sealant. No VOCs.
- C. Joints: Male/Female with integral gasket.
- D. Elbows: Smooth radius, 1.5D.
- E. Application: Only allowed for low pressure ductwork with static pressure of 1" w.g. or less, less than 10" diameter and concealed. Not for use exposed.
- F. Construct duct with the following minimum gages:

Diameter	Gauge
4 inches to 10 inches	26

- G. Construct fittings with the following minimum gages:

Diameter	Gauge
4 inches to 10 inches	24

2.5 SINGLE WALL ROUND DUCTS (SNAP-LOCK)

- A. Product Description: Product not acceptable for use.

2.6 DUCT SEALANT

- A. Manufacturer: Design Polymeric, United McGill or approved equal.
- B. Sealant shall be water based and formulated to withstand working temperatures of -25°F to +200°F. All sealants shall exceed 500 hours under ASTM C 732 (artificial weathering) and pass ASTM C 734 (low temperature flexibility after artificial weathering). All sealants shall be of an elastomeric nature, have a weight per gallon not to exceed 12.5, have solids by weight of 66% ± 2%, pass UL 723 with a flame spread of 5 and smoke developed of 5.

2.7 DUCTWORK FABRICATION

- A. Fabricate and support rectangular and round ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, reinforcing, and sealing for operating pressures corresponding to the ESP (external static pressure) of the fan system. i.e. Ductwork for a fan with an ESP of 0.75" w.g. should be constructed per SMACNA 1" w.g. pressure standard.
- B. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.
- C. Indicated dimensions on drawings are net inside. Allow for thickness of duct lining where indicated.

- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

2.8 CLOTHES DRYER EXHAUST DUCTWORK

- A. Rigid galvanized sheet metal of minimum 26 gauge with smooth interior finish.

2.9 KITCHEN HOOD EXHAUST DUCTWORK FABRICATION

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and NFPA 96.
- B. Exposed Kitchen Hood Exhaust Ducts: Construct of stainless-steel ASTM A167, type 304 using continuous external welded joints.
- C. Concealed Kitchen Hood Exhaust Ducts: Construct of 16 gage carbon steel or 18 gage stainless steel ASTM A167, type 304 using continuous external welded joints.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

- A. Make field measurements to establish locations of hangers and supports where installation will not damage building construction.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Where ducts pass through partitions, ceilings or floors. Provide 1" clearance and insulate from structure with insulation material. Provide flanged sheet metal closure.
- D. Where ducts pass through rated walls or assemblies without fire dampers, provide ¼" to 1" annular space and fill with firestop sealant. Ductwork shall be minimum 26 gauge metal.
- E. Isolate joints between dissimilar metals with fiber gasket.
- F. Drawings do not attempt to show all offsets in ductwork. Make such offsets as necessary for installation of work without additional cost to Owner. 15 degree maximum angle of offset.

- G. Exposed ductwork shall be Appearance Grade. Ductwork located in crawl spaces, shafts, and suspended ceiling spaces are not considered exposed.
 - 1. All round ductwork shall be spiral seam (no snap-lock joints).
 - 2. All joints clean and workmanlike.
 - 3. Ductwork entirely free of dents.
 - 4. Ductwork subject to denting due to space function construct one gauge heavier than SMACNA standard for size indicated.
 - 5. All hangers trimmed of excess metal.
 - 6. Plumb, level, parallel or perpendicular to building structure.
 - 7. Sealed with transparent, paintable sealant to avoid streaking.
- H. Flexible Duct:
 - 1. Install insulated flexible duct in full extended condition free of sags and kinks.
 - 2. Use minimum length required to make connection.
 - 3. Length shall not exceed 10 feet.
 - 4. Supported on 36" centers with minimum 1-1/2" wide strap. Do not crush.
 - 5. Connect flexible ducts to metal ducts with draw bands.
- I. Install duct hangers and supports in accordance with Section 23 05 00.
- J. Use double nuts and lock washers on threaded rod supports.

3.3 SEISMIC BRACING

- A. See 23 05 00.

3.4 DUCT SEALING

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Ductwork shall be sealed using welds, gaskets, or mastic. Duct tape is not permitted as a sealant on any ducts with the exception of that on fiberglass ducts specifically made for such use.
- B. For all ductwork seal all transverse joints and longitudinal seams. For 2" w.g. and higher pressure class ductwork also seal all duct wall penetrations (i.e. screw, fastener, rod or wire).
- C. Low pressure ductwork (less than 3" w.g.) shall be sealed to a leakage rate not to exceed 6 percent of the system airflow. All deficient ductwork shall be re-sealed until compliant.

3.5 PRESSURE (DUCT LEAKAGE) TESTING

- A. Perform duct leakage rate testing in accordance with SMACNA Duct Leakage Test Procedures for the following.
 - 1. All ductwork regardless of pressure class located exterior of the building or in an unconditioned space shall have a leakage rate of less than 6%.
 - 2. At least 25% of all ductwork with a pressure class of 3" w.g. or more. The maximum duct leakage (CL) shall be 4.0 per Energy Code C403.2.8.3.3.
- B. All ductwork found deficient by testing shall be resealed and retested until leakage compliance is reached.
- C. Provide written documentation of testing to be included with the Test and Balance report, see 23 05 93. Include drawing(s) indicating where test measurements were taken.

3.6 CLOTHES DRYER DUCT INSTALLATION

- A. Ducts shall terminate outside the building and be equipped with a backdraft damper. No screens shall be used at termination.
- B. Ducts shall not be constructed with sheet metal screws or other fasteners that enter the airstream. Ductwork shall be metal with smooth interior finish. The male end of duct joints shall extend in the direction of airflow.
- C. Dryer ducts which penetrate a wall or ceiling membrane shall be fire caulked.
- D. Dryer ducts shall be supported at minimum 4 foot intervals and secured in place.
- E. Provide protective shield plates where duct is in concealed locations within framing. Plates shall be 16 gage steel and cover the duct area plus 2". Shields may be omitted if duct is more than 1-1/2" from nearest edge of structural member.

3.7 KITCHEN HOOD EXHAUST DUCT INSTALLATION

- A. Install kitchen range hoods and ductwork in accordance with NFPA 96.
- B. Kitchen hood exhaust ducts: Use stainless steel for ductwork exposed to view and stainless steel or black carbon steel where ducts are concealed indoors. All exterior ductwork shall be stainless steel.
- C. Prior to duct concealment perform light leakage test on entire duct and duct to hood connection per requirements of IMC 506.3.2.5. Each weld and joint shall be inspected. If any leaks are detected, repair and retest section. Tests shall be witnessed and documented by the Commissioning Agent.

3.8 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal cap with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers or light troffer boots to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.
- C. Connect air outlets and inlets to supply ducts with five foot maximum length of flexible duct. Do not use flexible duct to change direction.

3.9 CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.10 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Supply, Return, Exhaust, Relief	Galvanized Steel, Aluminum
Buried Supply or Return	Glass Fiber Reinforced Plastic
Kitchen Hood Exhaust	Black Carbon Steel, Stainless Steel
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel

B. Ductwork Pressure Class Schedule: Install higher pressure class than indicated where corresponding fan system ESP (external static pressure) is higher.

AIR SYSTEM	PRESSURE CLASS
Constant Volume Low Pressure Supply	Minimum 1 inch wg.
Return, Exhaust	Minimum 1 inch wg

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dampers
 - 2. Dryer Box
 - 3. Duct access doors
 - 4. Flexible duct connections

1.2 COORDINATION

- A. Verify locations for access panels with Architect.
- B. Coordinate damper power, control and fire alarm interface with other trades.
- C. See 23 09 00 for Electric Damper Actuators.

1.3 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

PART 2 PRODUCTS

2.1 MANUAL BALANCING DAMPERS

- A. Manufacturers: Ruskin, Greenheck or approved equal
- B. Frames: Galvanized steel, minimum 20 gage.
- C. Blades: Galvanized steel, minimum 20 gage, attached to minimum 3/8 inch shafts with locking handle quadrant. Provide 2" standoff for insulated ductwork applications.
- D. Maximum Velocity: 1500 fpm.
- E. Rectangular: 24" and under on a side Ruskin MD25; over 24" on a side Ruskin MD35 or equal.
- F. Round: Ruskin MDRS25 or equal.

2.2 CONTROL DAMPERS

- A. Manufacturers: Tamco, Ruskin, Greenheck or approved equal
- B. Frame: Extruded aluminum (6063T5) channel of minimum 0.080" thickness with mounting flanges on both sides.
- C. Blades: Extruded aluminum (6063T5) airfoil. Maximum blade size 6 inches wide, 48 inches long, attached to minimum 7/16 inch hex shafts.

- D. Bearings: Celcon inner bearing fixed to blade pin, rotating within a polycarbonate outer bearing inserted in the frame.
- E. Seals: EPDM blade seals and silicone frame seals.
- F. Damper Leakage: AMCA Pressure Class 1A, maximum leakage rate of 3.0 cfm/ft² at 1.0 inch w.g. pressure differential.
- G. Maximum Pressure Differential: 6 inches w.g.
- H. Rectangular: Tamco 1000, Ruskin CD50, Greenheck VCD-43 or equal.
- I. Round: Ruskin CDRS25, Greenheck VCDR-53 or equal up to 12" diameter, for larger sizes use rectangular damper with manufacturer's square-to-round transitions.
- J. Options:
 - 1. For dampers with a dimension over 48" provide multiple sections with jack shafts.
 - 2. Provide parallel blade action for two position (open/closed) applications.
 - 3. Provide opposed blade action for modulation or control applications.

2.3 INSULATED CONTROL DAMPERS

- A. Manufacturers: Tamco, Ruskin, Greenheck or approved equal
- B. Frame: Insulated extruded aluminum (6063T5) channel of minimum 0.080" thickness with mounting flanges on both sides.
- C. Blades: Extruded aluminum (6063T5) airfoil internally insulated with expanded polyurethane foam and thermally broken. Maximum blade size 6 inches wide, 48 inches long, attached to minimum 7/16 inch hex shafts.
- D. Bearings: Celcon inner bearing fixed to blade pin, rotating within a polycarbonate outer bearing inserted in the frame.
- E. Seals: EPDM blade seals and silicone frame seals.
- F. Damper Leakage: AMCA Pressure Class 1A, maximum leakage rate of 3.0 cfm/ft² at 1.0 inch w.g. pressure differential.
- G. Maximum Pressure Differential: 6 inches w.g.
- H. Rectangular Insulated: Tamco 9000, Ruskin CDTI-50, Greenheck ICD-44 or equal.
- I. Round: Provide rectangular damper with manufacturer's square-to-round transitions.
- J. Options:
 - 1. For dampers with a dimension over 48" provide multiple sections with jack shafts.
 - 2. Provide parallel blade action for two position (open/closed) applications.
 - 3. Provide opposed blade action for modulation or control applications.

2.4 REMOTE OPERATED BALANCING DAMPERS (MANUAL)

- A. Manufacturers: Young, MAT or approved equal.
- B. Damper:

1. Round butterfly or radial damper with external control hardware, 5020-CC, RT-250.
2. Round butterfly or radial damper with internal control hardware, 5020-CC-2, RT-150.
3. Rectangular opposed blade damper with external control hardware, 830A-CC, RT-200.
4. Rectangular opposed blade damper with internal control hardware, 830A-CC-2, RT-100.

- C. Remote Damper Operator:
1. External cable control, 3" cover plate, 270-301
 2. Internal cable control, 270-275
 3. Remote cable wall control, 700 (where indicated).

2.5 REMOTE OPERATED BALANCING DAMPERS (ACTUATED)

- A. Manufacturers: United Enertech, MAT or approved equal.
- B. Damper:
1. Round butterfly or radial damper.
 2. Rectangular opposed blade damper.
- C. Actuator:
1. Low voltage actuator.
 2. Plenum rated low voltage wiring.
 3. Hand held controller/power source with damper position indicator.
- D. Accessories:
1. Ceiling cover plate
 2. Furnish (1) one hand held controller to owner.

2.6 PRESSURE INDEPENDENT VOLUME CONTROLLER (MANUAL CONTROL)

- A. Manufacturer: Trox VFC
- B. Circular adjustable volume flow controller for constant flow independent of duct system pressure. Galvanized steel casing with high-quality plastic damper blade, low-friction bearings, polyurethane bellows, stainless steel leaf spring and external rotary volume flow rate setpoint knob.
- C. Features:
1. Mechanical self-powered, without external power supply.
 2. Volume set from external scale; no tools required.
- D. Technical data:
1. Nominal sizes: 4 – 10 in
 2. Volume flow rate range: 13-784 cfm
 3. Volume flow rate control range: 10 to 100 % of the nominal volume flow rate
 4. Volume flow rate accuracy: approx. ± 10 % of the nominal volume flow rate
 5. Minimum differential pressure: 0.12 in. w.g.
 6. Maximum acceptable differential pressure: 2.0 in. w.g.

2.7 PRESSURE INDEPENDENT VOLUME CONTROLLER (2-POSITION MOTORIZED CONTROL)

- A. Manufacturer: Trox VFC M01

- B. Circular volume flow controller for constant flow independent of duct system pressure with 2-position motorized control actuator. Galvanized steel casing with high-quality plastic damper blade, low-friction bearings, polyurethane bellows, stainless steel leaf spring and actuator.
 - C. Features:
 - 1. Mechanical stops for minimum and maximum volume flow rates.
 - 2. 24 volt supply power voltage.
 - 3. Damper actuator drives from min position to max position on 24 volt control signal.
 - D. Technical data:
 - 1. Nominal sizes: 4 – 10 in
 - 2. Volume flow rate range: 13-784 cfm
 - 3. Volume flow rate control range: 10 to 100 % of the nominal volume flow rate
 - 4. Volume flow rate accuracy: approx. \pm 10 % of the nominal volume flow rate
 - 5. Minimum differential pressure: 0.12 in. w.g.
 - 6. Maximum acceptable differential pressure: 2.0 in. w.g.
 - E. Accessories:
 - 1. Provide 24 volt control transformer.
- 2.8 COMBINATION FIRE AND SMOKE DAMPERS (INLINE)
- A. Manufacturers: Ruskin FSD60/FSD60LP, FSDR60, equal by Greenheck, or approved equal.
 - B. Application: Provide FSD60LP (low pressure) model for dampers 14" in height and smaller. Provide FSDR60 for round ducts. All others provide standard FSD60.
 - C. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S.
 - D. Fire Resistance: 1-1/2 hours or 3 hours depending on rating of wall.
 - E. Leakage Rating: Class I, maximum of 8 cfm at 4 inches w.g. differential pressure.
 - F. Damper Temperature Rating: 350 degrees F.
 - G. Frame: 16 gage, galvanized steel.
 - H. Blades:
 - 1. Style: Airfoil-shaped, single piece, double skin.
 - 2. Action: Opposed.
 - 3. Orientation: Horizontal.
 - 4. Material: Minimum 16 gage equivalent thickness, galvanized steel.
 - 5. Width: Maximum 7 inches.
 - I. Bearings: Stainless steel or bronze.
 - J. Seals: Silicone blade edge seals and flexible stainless steel jamb seals.
 - K. Linkage: Concealed in frame.
 - L. Provide with duct transition connection.

- M. Release Device: Close in controlled manner and allow damper to be reset.
- N. Actuator: Belimo, electric 120 volt, 60 hertz, two-position, fail close.
- O. Resettable Link Release Temperature: 165 degrees F.
- P. Factory installed sleeve and mounting angles. Furnish silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.
- Q. Accessories:
 - 1. Damper Test Switch

2.9 DRYER BOX

- A. Manufacturers: Guy Gray, In-O-Vate Technologies or approved equal.
- B. 22 gauge aluminized steel manufactured wall recessed dryer vent hose receptacle with opening for 4" dia. duct and gas line. UL Classified for a one hour wall. Installation per manufacturer's instructions.

2.10 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.11 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers: Duro-Dyne or approved equal
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- C. Double fold "Grip-Loc" metal-to-fabric connection.
- D. Indoor Connector: "Metal-Fab", 24 ga, 3"metal - 3" fabric - 3" metal.
 - 1. Fabric: UL listed fire-retardant Neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd, 500 lbs tensile strength.
- E. Exterior Connector: "Metal-Fab", 24 ga, 3"metal - 3" fabric - 3" metal.
 - 1. Fabric: UL listed fire-retardant Hypalon coated woven galas fiber fabric conforming to NFPA 90A, minimum density 24 oz per sq yd, 250 lbs tensile strength.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify rated walls are ready for fire damper installation.
- B. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. See Section 23 34 00, paragraph 1.4 for damper installation.
- C. Provide motorized in lieu of gravity back-draft dampers per Energy Code.
- D. Provide control dampers where not furnished with packaged equipment.
- E. Provide insulated control dampers where:
 - 1. The damper is installed behind a louver.
 - 2. The damper is installed in a roof penthouse or gravity ventilator.
 - 3. The damper is unducted and open to a conditioned space.
- F. Provide shroud (matching duct material) over flexible duct connections when installed outside.
- G. Install remote operated dampers for balancing where damper is located in an inaccessible location.
- H. Access Doors: Install access doors at the following locations and as indicated on Drawings:
 - 1. Before and after each fire damper, smoke damper and combination fire and smoke damper.
 - 2. Where access is required for a valve or damper.
 - 3. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96.
- I. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Review locations prior to fabrication.
- J. Install temporary duct test holes as required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- K. Install fire dampers, combination fire and smoke dampers and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
 - 1. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.
 - 2. Install dampers square and free from racking with blades running horizontally.
 - 3. Do not compress or stretch damper frame into duct or opening.

4. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
5. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
6. Coordinate fire/smoke damper and smoke damper with Fire Alarm Contractor for smoke detector activation and fire alarm system integration. Install any duct smoke detectors furnished by Fire Alarm Contractor.

3.3 INSTALLATION – PRESSURE INDEPENDENT VOLUME DAMPERS (PIVD)

- A. Select device volume setpoint closest to scheduled volume.
- B. Provide device dimension the same size as ductwork.
- C. Trox VFC: Mark setpoint on scale and indicate cfm.

3.4 INSTALLATION - FLEXIBLE DUCT CONNECTIONS

- A. Provide flexible duct connection on supply outlet and return/exhaust inlet of all ducted fan powered equipment.
- B. Support and align ductwork to avoid strain on flexible connection.

3.5 DEMONSTRATION

- A. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fans.

1.2 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- D. Balance Quality: Conform to AMCA 204.

1.3 DRIVES AND BELTS

- A. For pressurization or life safety applications provide 1.5 times the required number of sheaves and belts for that duty with a minimum of two sheaves and belts.

1.4 DAMPERS

- A. A gravity backdraft or motorized control damper is required on every exhaust fan.
- B. Fans which are noted to operate continuously or have a capacity of 300 cfm or less shall have a gravity backdraft damper unless noted otherwise. All other fans shall have a motorized control damper.
- C. See 23 33 00 for motorized control dampers.
- D. Provide insulated control dampers where scheduled or where required by 23 33 00.

PART 2 PRODUCTS

2.1 CENTRIFUGAL ROOF EXHAUST FANS

- A. Manufacturers: Greenheck, Cook or approved equal.
- B. Construction: Spun aluminum with rigid internal support and aluminum birdscreen. Backward inclined aluminum (composite) wheel and inlet, statically and dynamically balanced.
- C. Belt Drive:
 - 1. Motor: Premium efficiency, heavy duty ball bearing type with steel frame mounted on vibration isolators out of the air stream. Selected operating horsepower to be a maximum of 80% of rated motor horsepower without using safety factor.
 - 2. Bearings: Pillow block type, self-aligning, permanently sealed, lubricated ball bearings, with L-10 life at 100,000 hours.

3. Shafts: Hot rolled steel, ground and polished, with key way.
 4. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves selected so required rpm is obtained with sheaves set at mid-position. Matched belts, and drive rated minimum 1.5 times nameplate rating of motor.
 5. Accessories:
 - a. Gravity backdraft \ Motorized Control damper. (See Part I, Dampers)
 - b. Insulated roof curb with liner; matched to roof slope.
 - c. Curb seal.
 - d. Aluminum birdscreen.
 - e. NEMA disconnect switch.
- D. Direct Drive:
1. Motor: Electronic Commutation DC brushless motor with internal solid state AC/DC converter circuitry and heavy duty ball bearings. Speed controllable down to 20% of full speed. Minimum 85% efficient at all speeds.
 - a. Motor mounted potentiometer speed control dial.
 2. Accessories:
 - a. Gravity backdraft \ Motorized Control damper. (See Part I, Dampers)
 - b. Insulated roof curb with liner; matched to roof slope.
 - c. Curb seal.
 - d. Aluminum birdscreen.
 - e. NEMA disconnect switch.
 - f. Speed Control

2.2 UP-BLAST CENTRIFUGAL EXHAUST FANS

- A. Manufacturers: Greenheck, Cook or approved equal.
- B. Construction: Spun aluminum with rigid internal support and welded construction. Backward inclined aluminum wheel and inlet, statically and dynamically balanced. Motor cooling tube and heat baffle insulation.
- C. Direct Drive:
 1. Motor: Electronic Commutation DC brushless motor with internal solid state AC/DC converter circuitry and heavy duty ball bearings. Speed controllable down to 20% of full speed. Minimum 85% efficient at all speeds.
 - a. Motor mounted potentiometer speed control dial.
- D. Accessories:
 1. Insulated roof curb with liner; matched to roof slope.
 2. Heat baffle
 3. High temp curb seal.
 4. NEMA disconnect switch.
 5. Hinged curb kit with cables.
 6. Teflon non-stick wheel coating.
 7. Clean out port on windband.
 8. Grease trap with drain and absorbent material.

2.3 CENTRIFUGAL INLINE FANS

- A. Manufacturers: Greenheck, Cook or approved equal.

- B. Construction: Square galvanized steel with duct collars, two removable access panels. Backward inclined aluminum (composite) wheel and inlet, statically and dynamically balanced.
- C. Direct Drive:
 - 1. Motor: Electronic Commutation DC brushless motor with internal solid state AC/DC converter circuitry and heavy duty ball bearings. Speed controllable down to 20% of full speed. Minimum 85% efficient at all speeds.
 - a. Motor mounted potentiometer speed control dial.
 - 2. Accessories:
 - a. Gravity backdraft \ Motorized Control damper. (See Part I, Dampers)
 - b. Nema rated disconnect switch.
 - c. Insulated housing with 1" liner.
 - d. Speed Control.
 - e. Neoprene isolators

2.4 HVLS (HIGH-VOLUME LOW-SPEED) FAN

- A. Manufacturers: MacroAir, Entrematic, Greenheck or approved equal.
- B. Commercial duty, multi blade, rotary airfoil design. High tensile steel support and blade safety system, extruded aluminum blades. Multi-speed with reverse, gearless direct drive motor. Wired touch screen controller. Powder coat or anodized finish, color as specified. 10-year warranty. UL 507 listed.

PART 3 EXECUTION

3.1 ROOF CURBS

- A. Verify roof curbs are installed and dimensions are as instructed by manufacturer.
- B. Provide sound attenuation material in curb where so indicated on drawings.

3.2 INSTALLATION

- A. Secure roof fans with cadmium plated steel lag screws to roof curb.
- B. Suspended Fans: Install flexible connections between inlet and outlet of fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- C. Install safety screen where inlet or outlet is exposed.
- D. Install gravity backdraft or motorized control dampers on discharge of exhaust fans and as indicated on Drawings.
- E. Provide sheaves required for final air balance.

3.3 CLEANING

- A. Vacuum clean inside of fan cabinet.

3.4 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.5 PROTECTION OF FINISHED WORK

- A. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The scope of work in this section is bidder design and install in conformance with the drawings and specifications.
- B. Provide a complete emergency vehicle auto-disconnect, auto-start engine exhaust system comprised of overhead exhaust rails with balancer, nozzle, exhaust fan, ductwork, structural supports and controls.
- C. Provide shop drawings that include: vehicle type and position, duct routing, support locations, dimensions, sizes, weights, performance data, and also location and size of field connections.
- D. Coordinate electrical connections, supports, ductwork routing and wall penetration.
- E. Product Data: Provide manufacturers literature and data sheets (see Section 23 00 00). Include fan curve and sound level data with operating point clearly indicated.
- F. Provide manufacturer's Installation, Operation and Maintenance Manual (see Section 23 00 00).
- G. Provide all required low voltage wiring, conduit and controls.

1.2 QUALIFICATIONS

- A. Contractor shall have been engaged in work of this section for a period of at least two years and have installed at least five such systems of comparable size.
- B. Contractor must supply names, addresses and phone numbers of three (3) active or completed projects within the State of similar or equal scope as outlined within this specification.

1.3 PROJECT REQUIREMENTS

- A. Provide three (3) Magna Rail Green, in the drive through bays, with one (1) trolley and extraction assembly per rail.
- B. Provide one (1) Magna Track Green in the shorter back-in bay, with one (1) trolley and extraction assembly.
- C. Provide two (2) Magna Track Green in the first two drive through bays in a reverse back-in configuration, with one (1) trolley and extraction assembly on each track.
- D. Provide exhaust fan sized for the six (6) vehicle exhaust connections. Provide exhaust fan with variable frequency drive and control for capacity adjustment and electrical soft start. Program soft start time duration for a maximum of 3 seconds.
- E. Provide fan VFD with NEMA exterior rated enclosure.
- F. Provide a minimum 36" long duct silencer on the discharge of the exhaust fan.

- G. Provide extraction nozzles which match fire apparatus exhaust pipes, coordinate with Owner for type and quantity.
- H. Provide exhaust duct connections to rails from a minimum of two top outlets per rail. Size ductwork for two vehicle connections per rails to accommodate future additional vehicle connections. Each vehicle connection shall provide a minimum of 700 cfm of exhaust
- I. Provide magnetic anchor plates and auto-start vehicle ignition transmitters for three (3) vehicles.
- J. Provide a radio receiver for auto-start vehicle transmitters.

PART 2 PRODUCTS

2.1 DUCT SYSTEM

- A. Ducts, unless otherwise specified or approved, shall be round. Ducts shall be straight and smooth on the inside with airtight joints. Ducts shall be constructed of galvanized steel and sealed in accordance with standard SMACNA methods, for the system designed negative pressure of 6 inches w.g. All duct joints to be sealed and air tight.
- B. Reducing fittings shall have a minimum of 1" graduating increase in diameter per 8' in length. Elbows up to 12" in diameter shall have a centerline radius of not less than 1.5 times the diameter. Elbows beyond 12" in diameter shall have a centerline radius of not less than 2.5 times the diameter. Branches shall enter the mains at a specified angle of not less than 30 degrees with the centerline of the main duct in the direction of airflow, unless otherwise indicated or approved. Flexible connections to the main or branch duct shall be braced with approved metal straps or members.
- C. Where duct of dissimilar metals are connected, or where sheet metal connections are made to fan inlet and outlet, only an approved fireproof flexible connection shall be used. The connection shall be installed and securely fastened by zinc coated steel clinch type draw bands for round ducts.
- D. Duct sleeves shall be provided for all round ducts less than or equal to 15" in diameter that pass through floors, walls, ceilings, or roofs. Sleeves in non-load bearing walls shall be fabricated of 20-gauge steel conforming to ASTM A 525. Sleeves in load bearing walls shall be fabricated of standard weight galvanized steel pipe conforming to ASTM A 53. Collars for round ducts less than or equal to 15" shall be fabricated from 20 gauge galvanized steel. Round ducts >15" in diameter passing through floors, walls, ceilings, or roofs shall be installed through framed openings. Structural steel members for framed openings shall conform to ASTM A 36. Framed openings shall provide a 1" clearance between the duct and the opening. A closure collar of galvanized steel greater than or equal to 4" wide shall be provided on each side of the walls or floors where sleeves or framed openings are provided.
- E. The exhaust discharge stackhead will be a no loss type as recommended by ACGIH or as otherwise specified. The stackhead design will protect against weather elements or introduction of debris. The stackhead shall extend a minimum of 24" above apparatus bay roof.

2.2 EXHAUST FANS

- A. Centrifugal fans shall be fully enclosed, single-width, single-inlet steel construction as required. Impeller wheels shall have backward inclined or backward curved blades of the non-overloading type. The bearings shall be self-aligned ball bearing type permanently sealed and lubricated. Fan shafts shall be steel and rotate in a non-sparking aluminum rubbing ring. Fans shall be accurately finished, and shall be provided with key and key seats for impeller hubs and fan pulleys. The fans shall be furnished with factory finish protective weather coating and a drain kit. The motor shall be totally enclosed fan cooled (TEFC) and rated for use with a VFD. Motor shall be provided with a variable frequency drive. The fan shall be structurally supported and provided with vibration isolators as specified to ensure quiet and smooth operation. All fans are tested in accordance with AMCA Standards in an AMCA approved test facility.
- B. Performance: Fan capacity shall be sized as such as to deliver a minimum of 700 cfm (or as otherwise specified) at each hose drop to the vehicle being served. Total fan capacity shall be variable between 3 hose drops (2100 cfm) and 5 hose drops (3500 cfm). The delivered volume shall take into account all lengths of duct work, elbows, branches, shut off, wyes, etc., which accumulate the static pressure at the fan inlet. Manufacturer provided fans shall be performance guaranteed.

2.3 EQUIPMENT

- A. **Manufacturer: Nederman**
- B. The Suction Rail shall be a polished aluminum extrusion that is formed in a configuration such that the extrusion serves not only as a suction duct, but also as the guide rail that the extraction trolley travels in. The overall length shall be as specified and indicated on the drawings. Each open end of the suction rail shall be covered with an end cap that can also be used as a round duct outlet for 6" diameter exhaust duct. As an alternate outlet, one or more rectangular-to-round transitions can be mounted on the topside of the suction rail after the cutout has been made per the manufacturers specified size.
- C. A pair of rubber seals shall be installed at the bottom of the extrusion opening. The rubber seals have a Teflon strip on the inside surface which enables the trolley to travel smoothly and unhindered. The rubber seals close tightly during fan operation for an airtight seal, but open evenly around the trolley during trolley travel. The suction rail shall be supplied with internal rubber bumpers installed at both ends that serve as secondary stops to the trolley. The suction rail shall be supplied with suspension attachments that are specifically designed for fastening to the configuration of the suction rail. Spacing of the suspension attachments shall not exceed 15 feet center-to-center.
- D. The Extraction Trolley body shall be made of thick cast aluminum with a low friction strip on each side to enable the trolley to travel smoothly through the rubber seal. Also, on a formed bracket mounted to the cast aluminum body, shall be a Disconnection box, acting as a circuit breaker for the Magnet.
- E. The Balancer shall be of a cone shape drum design with reverse spring characteristics to ensure that the cord is wound onto the drum at a constant speed with constant torque. The reverse spring characteristic shall permit full spring power to the Balancer when the cord is wound onto the drum.

- F. The upper Vertical Suction Hose shall be 6" in diameter, and of suitable flexibility to have a compression ratio of 6:1. The hose shall be fire resistant according to DIN 4102 B1. The hose shall be capable of withstanding temperatures of 340 degrees Fahrenheit continuously, up to 370 degrees Fahrenheit on an intermittent usage basis. The helix shall be external and made of galvanized steel or aluminum. The helix shall have high flexibility and be able to withstand oil, chemical, ozone and weather resistance.
- G. The inlet boot of the Nozzle is to be made of EPDM rubber, and bonded to a sturdy 24 gauge steel conical reducer. The design of the nozzle shall allow for maximum flexibility to accept a variety of tail pipe configurations, which typically terminate at 90 degrees to the side of the vehicle. Tail pipe adapters are not permitted nor required. No positive locking devices or a concept of a positive locking device, pneumatics, internal or external air hoses, wires, airbags, valves or precautionary devices for pneumatic bursting pressure is permitted or allowed.
- H. A magnet shall be used as the means of keeping the nozzle and hose assembly attached to the vehicle, whether at rest or as it moves to the point of exit. The electromagnet shall be 24 volts, DC with power supplied via an insulated conductor encapsulated within the helix of the upper hose. The electromagnet assembly shall consist of an electromagnet disc, a manual override switch, and an anchor plate. The formed collar shall be of a smooth and rounded configuration to prevent hooking or catching on external devices of the vehicle.

A manual override switch shall be easily accessible to disconnect the hose assembly while accessing storage compartments or performing vehicle maintenance. The 24-volt UL switch shall be surrounded and mounted in a closed cell water resistant neoprene jacket.

The Anchor Plate shall be mounted on the vehicle to allow the operator, in an upright position, to connect the electromagnet. The Anchor Plate shall have an outer circular holder made of hard resilient plastic. Recessed in the center of the holder shall be a finished steel disc to receive the electromagnet.

- I. Affixed to the Rail near the exit door, shall be a permanent magnet, which in conjunction with the disconnection box causes a 24 volt electromagnet to disconnect the hose assembly from the vehicle. The disconnection switch shall be adjustable to create a nozzle release point at a specified distance as the vehicle exits the building. If a proper disconnect does not occur, the electromagnet shall have a built-in safety disconnection feature, which releases it with a 50-pound shear force.
- J. The Rail shall be equipped with an End Stop, one for each Trolley which is designed to stop the travel of the entire hose, nozzle, and balancer assembly. The stopping action itself must be spring cushioned to prevent the assembly from coming to an abrupt and immediate halt. The End Stop shall consist of a coiled spring hydraulic oil damper, located at the end of the Rail nearest to the exit door and safety bolted in place.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Provide factory startup, testing and commissioning.
- B. The exhaust removal system shall be installed as indicated and recommended by the manufacturer. Welding and brazing shall conform to ASME-17. Slip joints shall be

sealed. Riser duct shall be supported to the structure as indicated on the drawings. Main duct shall be attached to building structural members.

- C. Installation height of Guide Track shall be between 10' to 16' range or as otherwise indicated on the drawings. The Guide Track shall be installed approximately 14" from the side of the vehicle and greater than or equal to 12" away from the side edge of the exit door. The Guide Track for the exhaust system shall include corrosion resistant brackets for ease of mounting to structural channel, trusses, or angle iron. Brackets shall be a minimum of 0.125" thickness. Mounting bolts to be no less than 0.375" diameter (structural grade 8) for connection to steel frame. Bolts required for masonry installation shall be 0.5" x 3.5" expansion bolts, or 0.375" x 4" sleeve anchors for wall mount masonry connection.

3.2 TRAINING

- A. See section 23 00 00.

PART 4 SEQUENCE OF OPERATION

4.1 SEQUENCE OF OPERATION

- A. The Fan Auto-Start shall be by a transmitter connected to the emergency vehicle ignition system to ensure the exhaust system is always running whenever a vehicle is in operation. Upon engine start, the exhaust fan VFD shall automatically start and run at full design rpm. The fan stays on as long as the vehicle is in operation. Upon vehicle exit or shut down, a variable timer then activates and the fan automatically turns off after a variable timed cycle. Upon vehicle return, the fan shall automatically activate prior to the vehicle entering the building. The fan remains in operation until the vehicle is turned off and the timer then activates.
- B. The auto-disconnect exhaust system shall be magnetic release type. Upon vehicle exit, the hose assembly remains connected to the tail pipe and automatically disconnects at a specified distance outside the door by de-energizing the electromagnet. The nozzle and hose assembly shall smoothly separate from the vehicle and safely retract to the stored position ready to connect to the vehicle upon reentry. Upon disconnection, the hose assembly shall not be permitted to swing wide or touch the floor. The hose shall remain at the door, ready for reconnection.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diffusers, Registers & Grilles
 - 2. Louvers
 - 3. Louvered penthouses
 - 4. Goosenecks

1.2 QUALITY ASSURANCE

- A. Diffuser, register, and grille performance shall be tested and rated in accordance with ASHRAE 70.
- B. Louver performance shall be tested and rated in accordance with AMCA 500.

PART 2 PRODUCTS

2.1 RECTANGULAR CEILING DIFFUSER

- A. Manufacturers: Titus, Price, Krueger or approved equal.
- B. Type: Square, stamped, multi-core, adjustable pattern diffuser.
- C. Frame: Surface mount with flat frame or T-bar lay-in.
- D. Fabrication: Steel with baked enamel white finish.
- E. Accessories:
 - 1. Field fabricated steel plenum, internal baffle and round side duct inlet assembly.

2.2 LOW-FLOW RECTANGULAR CEILING DIFFUSER (Outside Air)

- A. Manufacturers: Titus TJD or approved equal.
- B. Type: Square plaque, induction nozzles, removable face panel.
- C. Frame: 24"x24" module for lay-in T-bar ceilings or plaster frame for surface mount GWB ceiling.
- D. Fabrication: Steel with baked enamel white finish.
- E. Accessories:
 - 1. Field fabricated steel plenum, internal baffle and round side duct inlet assembly.

2.3 RADIAL TWIST INDUCTION CEILING DIFFUSER (Outside Air)

- A. Manufacturers: Price RTD or approved equal.
- B. Type: Radial twist diffuser with high induction vortex pattern, square face.
Frame: 24"x24" module for lay-in T-bar ceilings.

- C. Fabrication: Galvanized steel with white powder-coated finish.
- D. Accessories:
 - 1. Field fabricated steel plenum, internal baffle and round side duct inlet assembly.

2.4 CEILING SLOT DIFFUSER

- A. Manufacturers: Titus, Price, Krueger or approved equal.
- B. Type: Continuous one inch wide slot, multiple slots wide as indicated, with adjustable vanes for left, right or vertical discharge.
- C. Frame: To match ceiling installation type.
- D. Fabrication: Aluminum extrusions with white border and black pattern controllers.
- E. Plenum: Integral, galvanized steel, insulated, round duct connection.

2.5 EXHAUST/ RETURN GRILLE

- A. Manufacturers: Titus, Price, Krueger or approved equal.
- B. Type: Fixed blades, 1/2 inch blade spacing, with blades set at 35 degrees.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting, welded corners.
- D. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, with factory white enamel finish.
- E. Accessories:
 - 1. Opposed blade damper.
 - 2. Field fabricated steel plenum, internal baffle and round side duct inlet assembly.

2.6 INDUCTION SUPPLY REGISTER (Outside Air)

- A. Manufacturers: Thermal Core HCRH or approved equal.
- B. Type: High capacity, high induction horizontal register with induction ratio greater than 10:1.
- C. Frame: Extruded aluminum surface mount or direct duct mount.
- D. Fabrication: Fire retardant material which meets UL 25/50.

2.7 EGGCRATE EXHAUST / RETURN GRILLE

- A. Manufacturers: Titus, Price, Krueger or approved equal.
- B. Type: Fixed grilles of 1/2 x 1/2 x 1/2 inch aluminum core.
- C. Frame: 1-1/4 inch margin with countersunk screw mounting or channel lay-in frame for suspended grid ceilings.
- D. Fabrication: Aluminum with factory white enamel finish.

2.8 SIDEWALL SUPPLY NOZZLE

- A. Manufacturers: Air Concepts, Price ANF/ANR or approved equal.
- B. Type: High velocity task air outlet. ANR with 30 deg deflection adjustable air pattern controller.
- C. Fabrication: Aluminum Cone, Steel Core.

2.9 LOUVERS

- A. Manufacturers: Greenheck ESD-403, Ruskin, Wonder Metal or approved equal.
- B. Product Description: Stationary, drainable blade. AMCA certified.
- C. Type: 4 inch deep with blades on 45 degree slope, heavy channel frame. Minimum initial point of water penetration of 900 fpm.
- D. Fabrication: 12 gage thick extruded aluminum, welded assembly, with factory 2-coat 70% Kynar finish, color to be selected.
- E. Mounting: Furnish with flanges, mullions, and hardware for installation.
- F. Bird Screen: Aluminum 3/4" x 0.051" flattened expanded metal.
- G. Inset Screen: Aluminum 16x18 mesh, aluminum frame.

2.10 LOUVERED PENTHOUSE

- A. Manufacturers: Greenheck, Cook, Price or approved equal.
- B. Product Description: Square Louvered type, with aluminum constructed housing; aluminum wire bird screen and insect screen; square base to suit roof curb with continuous curb gaskets.
- C. Roof Curb: Galvanized steel or aluminum construction with continuously welded seams, built-in cant strips, 1 inch insulation with liner, damper tray, curb seal and factory installed nailer strip. Matched to roof pitch.
- D. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
- E. Motor Operated Damper: Aluminum multiple blade construction, sealed edged with offset hinge pin, nylon bearings, blades linked and motor drive, power open, spring return.

2.11 GOOSENECKS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, of minimum 18 gage aluminum. Provide termination insect screen.

2.12 CAPS

- A. Wall Cap (round connection): Aluminum construction, aluminum finish, built in birdscreen with damper. Greenheck WC or approved equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify inlet and outlet locations with Architectural Plans.
- B. Verify ceiling/wall type before ordering.
- C. Verify diffuser air patterns are as indicated before starting air balance.

3.2 LOUVERS

- A. Provide louvers with insect screen when louver is un-ducted or when scheduled.

3.3 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black

3.4 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Kitchen Hood

1.2 REQUIREMENTS

- A. The equipment of this section shall be provided by a single vendor.

PART 2 PRODUCTS

2.1 KITCHEN HOOD

- A. Manufacturers: Accurex, Greenheck or approved equal.
- B. Kitchen Ventilation hood shall be of the wall canopy type. The hood shall be UL 710 Listed without fire damper for 400°F rated cooking appliances.
- C. The hood exterior shall be constructed of a minimum of 18 gauge stainless steel with an embossed finish 430 SS. The hood(s) shall be constructed using the standing seam method for optimum strength. An integral 3 inch air space is provided to meet NFPA 96 clearance requirements against limited combustible walls. All seams, joints and penetrations of the hood enclosure shall be welded and/or liquid tight. All unexposed interior surfaces shall be constructed of a minimum 18 gauge corrosion resistant steel including, but not limited to ducts, plenum, and brackets.
- D. The hood shall include a filter housing constructed of the same material as the hood. The filters shall be baffle type stainless, UL 1046. The filter housing shall terminate in a pitched, full length grease trough which shall drain into a removable grease container.
- E. The hood shall include a Performance Enhancing Lip (PEL) to improve capture efficiency by turning air back into the hood.
- F. Vapor proof, U. L. Listed incandescent or LED light fixtures shall be pre-wired to a junction box situated at the top of the hood for field connection. Provide quantity of lights necessary to obtain 40 foot-candles on working surface.
- G. Hood shall be built in accordance with National Fire Protection Association (NFPA) Bulletin #96, International Mechanical Code (IMC), and bear the National Sanitation Foundation (NSF) Seal of Approval.

2.2 CONTROL

- A. Provide by hood manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 96.

- B. Provide 100W equivalent LED bulbs for incandescent fixtures.

3.2 TESTING

- A. Review exhaust and make-up air test and balance for compliance with scheduled equipment, UL tested minimum airflows and code minimum air flows.
- B. Perform smoke capture and containment test with appliances installed under hood per IMC 507.6.1. Test shall simulate cooking by producing smoke or steam. Provide written report of visual observations.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Disposable, pleated filters.
 2. Filter frames and housings.

1.2 PERFORMANCE REQUIREMENTS

- A. Conform to ARI 850 Section 7.4.
- B. Dust Spot Efficiency: Plus or minus 5 percent.

PART 2 PRODUCTS

2.1 DISPOSABLE, PLEATED FILTERS

- A. Manufacturers: Camfil, Flanders, Airguard, Viledon or approved equal.
- B. MERV 8: UL 900 Class 2, pleated, cotton and polyester blend, radial pleat with welded wire grid, cardboard frame. 1", 2" & 4". (Camfil 30/30)
- C. MERV 13 (85%): UL 900 Class 2, pleated synthetic media with three layers, spunbond polyester prefilter, electrostatically spun polycarbonate microfiber middle layer and spunbond polyester downstream layer. 2" & 4" (Viledon Mini 85)

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install filters with felt, rubber, or neoprene gaskets to prevent passage of unfiltered air around filters.
- B. Install filter gage static pressure taps upstream and downstream of filters. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level.
- C. Do not operate fan system until filters are in place. Replace filters used during construction before testing, with clean set. Provide owner with replacement set of filters.

END OF SECTION

PART 1 GENERAL

1.1 DEFINITIONS

- A. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- B. Smoke Pipe: Round, single wall vent connector.
- C. Vent: Portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- D. Vent Connector: Part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.2 SCOPE

- A. Provide plastic or metal venting for equipment in this Division.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate general construction, dimensions, weights, support and layout of breeching. Submit layout drawings indicating plan view and elevations where factory built unit is used.
- B. Product Data: Submit data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.
- C. Product Data: Submit data on fans and accessories including fan curves with specified operating point plotted, power, RPM, and electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

1.4 COORDINATION

- A. Coordinate metal venting material and location for Division 22 equipment.

1.5 QUALITY ASSURANCE

- A. Provide factory built vents and chimneys used for venting natural draft appliances complying with NFPA 211 and UL listed and labeled.

PART 2 PRODUCTS

2.1 CATEGORY 3 SINGLE WALL

- A. Manufacturers: Selkirk Model G, Ampco or approved equal.
- B. Factory-built system, liquid tight, single wall, type 316 stainless steel, 0.035" minimum thickness. Pipe joints shall be sealed by factory bands and sealant.

- C. Provide fittings and accessories including: adjustable length sections for thermal expansion, roof penetration thimble, tall flashing, storm collar and chimney round top cap.

2.2 SINGLE WALL METAL (COMBUSTION AIR INTAKE)

- A. Single wall spiral ductwork per 23 31 00.
- B. Accessories: Complete stack system with fittings, storm collar, roof flashing and cap.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install flue and vent piping per manufacturer's installation instructions. Note maximum allowable venting length.
- B. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- C. Sleeve pipe passing through partitions, walls and floors.
- D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- F. Provide factory vent and combustion air terminations. Flash and seal piping penetrating building exterior to maintain integrity of assembly.
- G. Install flue / breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.
- H. Support flue / breeching from building structure, rigidly with suitable ties, braces, hangers and anchors to hold to shape and prevent buckling. Support vertical breeching, chimneys, and stacks at 12 foot spacing, to adjacent structural surfaces, or at floor penetrations. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for equivalent duct support configuration and size.
- I. For gas vents, maintain UL listed minimum clearances from combustibles. Provide thimble at roof penetrations.
- J. Clean flue / breeching, chimneys, and stacks during installation, removing dust and debris.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Tubular infrared heaters.

1.2 QUALITY ASSURANCE

- A. Gas-Fired Unit Heater Performance Requirements: Conform to minimum efficiency prescribed when tested in accordance with ANSI Z83.8.

1.3 WARRANTY

- A. Furnish five year manufacturer warranty for heat exchanger.

PART 2 PRODUCTS

2.1 TUBULAR INFRARED HEATERS (MODULATING)

- A. Manufacturers: Roberts Gordon or approved equal.
- B. Packaged, factory assembled burner, pre-wired unit consisting of cabinet, burner, heat exchanger, radiant tube, reflector and controls for natural gas.
- C. Performance: Rated in accordance with AHRI Standard 1330. Minimum Infrared factor (IF) of 15.
- D. Heat Exchanger: Aluminized tubular steel combustion chamber with aluminized steel tube with aluminum reflector.
- E. Gas Burner:
1. Gas Burner: Modulating forced draft type with adjustable combustion air supply.
 2. Gas valve provides 100 percent safety gas shut-off; 24-volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration and automatic electric valve.
 3. Electronic pilot ignition, with hot surface igniter.
 4. Non-corrosive burner air blower with permanently lubricated motor.
- F. Gas Burner Safety Controls: Thermo-couple sensor prevents opening of solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure.
- G. Reflectors: High radiant reflective aluminum continuously over entire length of system with end caps. Parabolic design with lower edge of reflector extending below the bottom of the tube.
- H. Controls: Low voltage electronic room thermostat modulates burner to maintain room temperature setting. Provide transform relay for multiple burner control.
- I. Accessories:
1. Vented metal enclosure for thermostat.
 2. Provide additional reflectors for use as heat shields where indicated on drawings.

3. Provide aluminum side shield reflectors when mounted within 5 feet of vertical surface. Do not mount heater reflectors at 45 deg angle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify space is ready for installation of units and openings are as indicated on shop drawings.

3.2 INSTALLATION

- A. Install units in accordance with NFPA 90A.
- B. Installation – Tubular Heaters:
 1. Support system to allow for free expansion of the tube and reflectors.
 2. Enable suspension of the system so that the reflectors shields can be oriented at a fixed angle between 0 to 35 degrees.
 3. The entire system shall be suspended from structure as indicated in the manufacturer’s installation manual.
 4. Slope tubing per manufacturer’s installation instructions. (Typically downward away from burner.)
 5. Seal seams of tubing and vent pipe with high temperature silicone.
 6. Provide seismic restraint.
- C. Installation - Natural Gas Piping:
 1. Connect natural gas piping in accordance with NFPA 54.
 2. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
 3. Install the following piping accessories on natural gas piping connections.
 - a. Strainer.
 - b. Pressure gage.
 - c. Shutoff valve.
 - d. Pressure reducing valve.
- D. Install vent connections in accordance with NFPA 211. Install vents and stacks.
- E. Provide hangers and supports for suspended units.
- F. Provide operating controls.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Package ERV with heat wheel.

1.2 QUALITY ASSURANCE

- A. Entire unit shall be ETL Certified per U.L. 1995 and bear an ETL sticker.
- B. Blowers shall be AMCA Certified for airflow.
- C. Energy Wheel shall be AHRI Certified per Standard 1060.

1.3 COORDINATION

- A. Coordinate size and location of all building penetrations required for installation of each unit and associated hydronic, gas and electrical systems.
- B. Contractor shall coordinate with roofing contractor to ensure curb unit is properly flashed.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Filters: 3 sets of disposable filters for each unit.
 2. One set of fan and energy wheel belts

1.5 ELECTRICAL

- A. Short-Circuit Current Rating (SCCR): All HVAC and refrigeration equipment with multi-motor or combination electrical loads shall comply with NEC 110.10 & 440.4 and must include a SCCR greater than the Available Interrupting Current (AIC) of the electrical circuit serving the equipment. See electrical drawings for required AIC kA rating. Equipment SCCR may be presented in writing from the manufacturer or shown on the unit nameplate. Refrigeration or air-conditioning equipment over 60 Amps MOCP must list the SCCR on the unit nameplate. If the AIC rating is unavailable or cannot be determined provide equipment with a minimum SCCR of 10kA.

PART 2 PRODUCTS

2.1 WHEEL AIR TO AIR HEAT RECOVERY UNIT (ROOF-TOP) (ERV)

- A. Manufacturers: Greenheck ERCH, Aeon or approved equal
- B. General: Unit shall be fully assembled at the factory and consist of an insulated metal cabinet, weatherhood outdoor air intake with metal mesh filters, energy wheel, electric post-heater, motorized insulated low-leak dampers, sensors, curb assembly, frost control, filter assembly for intake air and exhaust air, supply air blower assembly, exhaust air blower, outdoor airflow monitoring and an electrical microprocessor control center. All

specified components and internal accessories factory installed and tested and prepared for single-point high voltage connection.

- C. Cabinet: Formed double wall insulated metal cabinet. Outside casing: 18-gauge galvanized steel, factory pre-painted with polyester urethane paint (permatector). Internal assemblies: 18-gauge, galvanized steel except for motor supports which shall be minimum 14 gauge galvanized steel. Inner wall of double wall construction shall be minimum 24-gauge galvanized steel.
1. Cabinet Insulation: 1" Fiberglass insulation. Full coverage of entire cabinet exterior to include walls, roof and floor of unit. Insulation shall be of semi-rigid type and installed between inner and outer shells of all cabinet exterior components.
 2. Access panels / doors: Unit shall be equipped with insulated, hinged doors. Doors shall be fabricated of 18-gauge galvanized steel.
- D. Energy wheel: Energy wheel shall be of the total enthalpy, rotary air-to-air type and shall be an element of a removable energy wheel cassette. The cassette shall consist of a galvanized steel framework, an energy wheel as specified and a motor and drive assembly. The cassette shall incorporate a pre-tensioned urethane drive belt with a five year warranty. The wheel media shall be a polymer film matrix in a stainless steel framework and be comprised of individual segments that are removable for servicing. Non-segmented energy wheels are not acceptable. Silica gel desiccant shall be permanently bonded to the polymer film. The energy wheel is to have a five year warranty.
- E. Blowers: Belt drive motor and blower shall be assembled onto a 14-gauge galvanized steel platform and must have neoprene vibration isolation devices.
1. Shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
 2. Centrifugal blower housing: Formed and reinforced steel panels to make curved scroll housing with shaped cutoff.
 3. Forward curved blower (fan) wheels: Galvanized or aluminum construction with inlet flange and shallow blades curved forward in direction of airflow. Mechanically attached to shaft with set screws.
- F. Motors: Blower motors greater than $\frac{3}{4}$ horsepower shall be "NEMA Premium™" efficiency. Motors shall be heavy-duty, permanently lubricated type to match the fan load and furnished at the specified voltage, phase and enclosure. Drives shall be sized for a minimum of 150% of driven horsepower and pulleys shall be fully machined cast-type, keyed and fully secured to the fan wheel and motor shafts. Electric motors of ten horsepower or less shall be supplied with an adjustable drive pulley.
- G. Wheel Frost Control: Modulating Wheel – control system shall include an energy wheel VFD, outdoor air thermostat and pressure sensor on the wheel assembly to initiate frost control sequence.
- H. Economizer: Controls will dictate when economizer operation is possible based on temperature and dew point. Controls will then modulate the wheel motor to maintain a leaving air temperature. Factory VFD provided.
- I. Electric Post-heater: Post-heater shall be SCR control and shall include a temperature sensor with field adjustable set point, located in the supply air stream. Heat output of the post-heater shall be infinitely variable.

- J. Motorized dampers: Exhaust Air and Intake Air AMCA Class 1A motorized dampers of insulated low leakage type shall be factory installed.
- K. Filter Section: Permanent 2" aluminum filters located in the outdoor air intake and shall be accessible from the exterior of the unit. Combination of MERV 8 and MERV 13 pleated filters shall be provided in the intake air stream and MERV 8 filters in the exhaust air stream.
- L. Sensors which are part of various optional operational modes or device controllers and are to be factory supplied and installed.
- M. Curb Assembly: 14-gauge galvanized steel factory curb shall provide perimeter support of the entire unit. Curb assembly shall enclose the underside of the unit and shall be sized to fit into a recess in the bottom of the unit. Contractor shall be responsible for coordinating with roofing contractor to ensure curb unit is properly flashed to provide protection against weather/moisture penetration. Contractor shall provide and install appropriate insulation for the curb assembly.
- N. Outdoor airflow monitoring station: Provide digital readout of outdoor air delivery cfm.
- O. Control panel: Unit shall have an electrical control center where all high and low voltage connections are made. Control center shall be constructed to permit single-point high voltage power supply connection including electric post heater.
 - 1. The unit shall be constructed so that it can function as a stand-alone heating system controlled by factory-supplied microprocessor programmable controller, thermostats and sensors.
 - 2. Variable Frequency Drive (VFD): Unit shall have factory installed variable frequency drives for modulation of the blower motors. The VFDs shall be factory-programmed for unit-specific requirements and shall not require additional field programming to operate.
 - 3. Remote Interface: Contractor shall provide and install a Remote Interface that functions as a remote indicator of owner-selected operating parameters and also permits remote inputting of new operating parameters. Each remote panel shall have a large LCD user interface screen.
 - 4. Sensors:
 - a. Dirty Filter Sensors
 - b. Temperature Sensors- OA, SA, RA, EA
 - c. Pressure Sensor- SA, RA
 - d. Rotation Sensor
- P. Accessories:
 - 1. Seismic vibration isolation curb
 - 2. Modulating energy wheel economizer control with temp/enthalpy sensors

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify roof curbs are installed and dimensions are as instructed by manufacturer.

3.2 PREPARATION

- A. Furnish roof curbs for installation.

3.3 INSTALLATION

- A. Secure unit with cadmium plated steel lag screws to roof curb.
- B. Install flexible connections between unit and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- C. Provide sheaves required for final air balance.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Furnish services of factory trained representative for minimum of one day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.5 CLEANING

- A. Vacuum clean coils and inside of fan cabinet.
- B. Install clean filters.

3.6 DEMONSTRATION

- A. Demonstrate fan operation and maintenance procedures.

3.7 PROTECTION OF FINISHED WORK

- A. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. System Description
 - 2. Outdoor unit
 - 3. Indoor units
 - 4. Refrigerant controller
 - 5. Digital Controls
 - 6. Condensate Overflow Switch

1.2 MAINTENANCE SERVICE

- A. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.
- B. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.

1.3 QUALITY ASSURANCE

- A. Capacity rating in accordance with ARI.
- B. Sound rating is accordance with ARI 270.
- C. Insulation and adhesives: Meet requirements of NFPA 90A.

1.4 ELECTRICAL

- A. Short-Circuit Current Rating (SCCR): All HVAC and refrigeration equipment with multi-motor or combination electrical loads shall comply with NEC 110.10 & 440.4 and must include a SCCR greater than the Available Interrupting Current (AIC) of the electrical circuit serving the equipment. See electrical drawings for required AIC kA rating. Equipment SCCR may be presented in writing from the manufacturer or shown on the unit nameplate. Refrigeration or air-conditioning equipment over 60 Amps MOCP must list the SCCR on the unit nameplate. If the AIC rating is unavailable or cannot be determined provide equipment with a minimum SCCR of 10kA.

1.5 QUALIFICATIONS

- A. The system shall be installed by a Trane-Mitsubishi authorized CITY MULTI Diamond Dealer. The contractor service and install training should be performed by the manufacturer.

1.6 WARRANTY

- A. System shall obtain Diamond ten (10) year extended warranty.
- B. Warranties periods shall be from date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Trane-Mitsubishi CITY MULTI or approved equal.

2.2 VARIABLE REFRIGERANT FLOW ZONING SYSTEM

- A. General: Variable capacity, split heat pump heat recovery air conditioning system with Variable Refrigerant Flow Zoning (VRFZ) and simultaneous heating/cooling. The system consists of an outdoor unit, BC (Branch Circuit) Controller, multiple indoor fan coil units, interconnecting refrigerant piping and product specific DDC (Direct Digital Controls). All components factory assembled, internally piped and wired, tested and ready for field assembly.
- B. Quality Assurance:
1. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.
 2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
 3. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
 4. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.
 5. Warranty:
 - a. The units shall be covered by the manufacturer's limited warranty for a period of one (1) year.
 - b. Systems designed by a certified CITY MULTI Diamond Designer, installed by a certified CITY MULTI Diamond Dealer, and verified with a completed commissioning report submitted to Mitsubishi Electric Service Department, shall be covered by an extended manufacturer's limited warranty for a period of five (5) years.
 - c. In addition the compressor shall have a manufacturer's limited warranty for a period of six (6) years.

2.3 OUTDOOR CONDENSING UNIT (6 TONS AND LARGER):

- A. General: Units shall be equipped with multiple circuit boards that interface to the control system and shall perform all functions necessary for operation, be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
1. Sound rating no higher than 60 dB(A).
 2. Both refrigerant lines from the outdoor unit to the BC (Branch Circuit) Controller shall be insulated.
 3. Accumulator with refrigerant level sensors and controls.
 4. High pressure safety switch, over-current protection and DC bus protection.
 5. Capable of operating in heating down to -4°F ambient temperature without additional low ambient controls.
 6. High efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
- B. Unit Cabinet: The casing shall be fabricated of galvanized steel, bonderized and finished with powder coated baked enamel.

- C. Fan: Direct drive, variable speed propeller type fan with inherent protection, permanently lubricated bearings, mounted for quiet operation, raised guard and vertical discharge airflow.
- D. Refrigerant: R410A refrigerant is required.
- E. Coil: Nonferrous construction with lanced or corrugated plate fins on copper tubing with an integral metal guard. 4 circuits with two position valves for each circuit, except for the last stage.
- F. Compressor: High performance, inverter driven, modulating capacity scroll compressor with a factory mounted crankcase heater, an inverter to modulate capacity variable down to 16%, internal thermal overload, mounted to avoid the transmission of vibration.
- G. Electrical: The unit shall be controlled by integral microprocessors with the control circuit between the indoor units, BC Controller and the outdoor unit being 12VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.4 BRANCH CIRCUIT (BC) CONTROLLER:

- A. General: These units shall be equipped with a circuit board that interfaces to the M-NET controls system and shall perform all functions necessary for operation. The unit shall have a galvanized steel finish. The BC Controller shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory. This unit shall be mounted indoors.
- B. BC Unit Cabinet: Fabricated of galvanized steel with a liquid-gas separator, multiple refrigeration control valves and two tube-in-tube heat exchangers.
- C. Refrigerant valves: Each circuit shall have one (54,000 Btu/h or smaller indoor unit section) two-position liquid line valve and a two-position suction line valve. When connecting a 54,000 Btu/h or larger indoor unit section, two branch circuits shall be joined together at the branch controller to deliver an appropriate amount of refrigerant. The two refrigerant valves shall operate simultaneously. Linear electronic expansion valves shall be used to control the variable refrigerant flow.
- D. Service shut-off ball valves with Schrader port shall be field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
- E. An integral condensate pan and drain shall be provided.
- F. Accessories:
 - 1. Provide with BlueDiamond MaxiBlue condensation pump complete with reservoir and accessories. Provide power from unit.

2.5 TPKFY INDOOR UNIT (wall-mounted)

- A. General: Wall mounted indoor unit section with a slim silhouette and a modulating linear expansion device.
- B. Indoor Unit: Factory assembled, wired and run tested with all factory wiring, piping, electronic modulating linear expansion device, control circuit board, fan motor, self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test

run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

- C. Unit Cabinet: White finish, same for all model sizes. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining. Separate back plate which secures the unit firmly to the wall.
- D. Fan: An assembly with one or two line-flow fan(s) direct driven by a single motor. Statically and dynamically balanced to run on a motor with permanently lubricated bearings. Multi-speed fan with two speeds selected by the room controller. Manual adjustable guide vane with the ability to change the airflow from side to side (left to right). Motorized air sweep louver with automatic change in airflow by directing the air up and down to provide uniform air distribution.
- E. Filter: Factory installed MERV 4.
- F. Coil: Nonferrous construction with smooth plate fins on copper tubing, inner grooves for high efficiency heat exchange, phos-copper or silver alloy brazed joints, pressure tested at the factory. A condensate pan and drain shall be provided under the coil. Both refrigerant lines to the PKFY indoor units shall be insulated.
- G. Controls: Unit controls to be provided with unit as part of VFRZ system to perform functions necessary to operate the system. The unit shall be able to control external backup heat.
- H. Accessories:
 - 1. Provide with BlueDiamond condensation pump complete with reservoir and accessories. Provide model MicroBlue for units up to 15 MBH and MaxiBlue for units 18 MBH and larger. Provide power from fan coil unit.

2.6 TPLFY INDOOR UNIT (4-way Cassette)

- A. General: A cassette style indoor unit that recesses into the ceiling with a ceiling grille and a modulating linear expansion device.
- B. Indoor Unit: Factory assembled, wired and run tested with all factory wiring, piping, electronic modulating linear expansion device, control circuit board, fan motor, self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet: Ceiling-recessed cassette with provisions for a field installed filtered outside air intake. Branch ducting shall be allowed from cabinet. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow. Grille vane angles shall be individually adjustable from the controller to customize the airflow pattern for the conditioned space.
- D. Fan: An assembly with a turbo fan direct driven by a single motor. Statically and dynamically balanced to run on a motor with permanently lubricated bearings. Four (4) fan speeds, two of which may be selected by the room controller. Adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow. Auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.
- E. Filter: Factory installed MERV 4.

- F. Coil: Nonferrous construction with smooth plate fins on copper tubing, inner grooves for high efficiency heat exchange, phos-copper or silver alloy brazed joints, pressure tested at the factory. A condensate pan and drain shall be provided under the coil. Both refrigerant lines to the PLFY indoor units shall be insulated.
- G. Controls: Unit controls to be provided with unit as part of VFRZ system to perform functions necessary to operate the system.
- H. Accessories:
 - 1. Factory installed condensate lift pump.

2.7 TPEFY-MA INDOOR UNIT (Ceiling-Concealed Ducted)

- A. General: A ceiling concealed ducted indoor fan coil design that mounts above the ceiling with a 2-position, field adjustable return and a fixed horizontal discharge supply and a modulating linear expansion device.
- B. Indoor Unit: Factory assembled, wired and run tested with all factory wiring, piping, electronic modulating linear expansion device, control circuit board, fan motor, self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.
- C. Unit Cabinet: Ceiling concealed, ducted with provisions for a field installed filtered outside air intake. Unit shall have a ducted air outlet system and ducted return air system.
- D. Fan: An assembly with one or two Sirocco fan(s) direct driven by a single motor. Statically and dynamically balanced and run on a motor with permanently lubricated bearings. Three (3) fan speeds, plus Auto-Fan function.
- E. Filter: MERV 8 (minimum) installed in field rack or mixing box.
- F. Coil: Nonferrous construction with smooth plate fins on copper tubing, inner grooves for high efficiency heat exchange, phos-copper or silver alloy brazed joints, pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The condensate shall be gravity drained from the fan coil. Both refrigerant lines to the PEFY indoor units shall be insulated.
- G. Controls: Unit controls to be provided with unit as part of VFRZ system to perform functions necessary to operate the system. The unit shall be able to control external backup heat.
- H. Accessories:
 - 1. Factory installed condensate lift pump.

2.8 TPEFY-MH Indoor Unit (High Static Option, ceiling-concealed ducted)

- A. General: A high-performance ceiling concealed ducted indoor fan coil that mounts above the ceiling with a 2-position, a field adjustable return and a fixed horizontal discharge supply, and a modulating linear expansion device.
- B. Indoor Unit: Factory assembled, wired and run tested with all factory wiring, piping, electronic modulating linear expansion device, control circuit board, fan motor, self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor

unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

- C. Unit Cabinet: Low profile, ceiling concealed, ducted with provisions for a field installed filtered outside air intake. Unit shall have a ducted air outlet system and ducted return air system
- D. Fan: An assembly with one or two Sirocco fan(s) direct driven by a single motor. Statically and dynamically balanced to run on a motor with permanently lubricated bearings. Two (2) fan speeds, which are selectable on the room controller.
- E. Filter: MERV 8 (minimum) installed in field rack or mixing box.
- F. Coil: Nonferrous construction with smooth plate fins on copper tubing, inner grooves for high efficiency heat exchange, phos-copper or silver alloy brazed joints, pressure tested at the factory. A condensate pan and drain shall be provided under the coil. The condensate shall be gravity drained from the fan coil. Both refrigerant lines to the PEFY indoor units shall be insulated.
- G. Controls: Unit controls to be provided with unit as part of VFRZ system to perform functions necessary to operate the system. The unit shall be able to control external backup heat.
- H. Accessories:
 - 1. Provide with BlueDiamond MaxiBlue condensation pump complete with reservoir and accessories. Provide power from fan coil unit.

2.9 FILTER BOX

- A. Manufacturer: Mitsubishi or approved equal.
- B. Manufactured and constructed specifically to match fan coil and fasten directly to return inlet of unit. Box shall be 20 ga GSM construction.
- C. Filter rack shall be angled and shall accept 1", 2" or 4" filters. Access door shall be hinged and fastened with knurled nobs such that tools are not required to open. Rack and door shall have foam gasket.

2.10 TRIM PANEL

- A. Manufacturer: Trane-Mitsubishi PLFY-ITP1, PLFY-ITP2 or PMFY-ITP1
- B. Ceiling cassette trim panel to adapt with t-bar ceilings. High performance ABS impact resistant polymer with a smooth white finish. Black finish optional.

2.11 CONTROLS

- A. General: The physical controllers shall be plastic material with a neutral color. Each remote controller, at a minimum, shall have a LCD (Liquid Crystal Display) that shows room temperature, set point, and fan speed.
- B. Electrical:
 - 1. The electrical voltage from each circuit board to the controls shall be 12 volts DC.

2. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit then to the BC controller and outdoor unit. Control wiring shall run from the indoor unit terminal block to the controller associated with that unit.
3. Wiring shall be 2-conductor 16 AWG or 18 AWG stranded wire with a shield, as defined by control drawing.

2.12 REMOTE CONTROLLERS

- A. Remote controllers shall operate indoor units. The wiring for the remote controllers shall be simple, non-polar, two-wire connections. All remote controllers shall be wall-mounted with an LCD display and contain a microprocessor that constantly monitors operation to maintain smooth indoor unit operation. Set temperature shall be adjusted in increments of 1°F or 2°F, depending on the systems and controllers. In the event of an abnormality, the remote controller shall display a four-digit error code and the indoor unit address.
- B. TAR-40MAA: Deluxe MA Remote Controller
 1. Backlit display
 2. Capable of controlling up to 16 indoor units (defined as 1 group).
 3. Displays: Room temperature, relative humidity, operation status, setpoint.
 4. Control the following operations: On/Off, Operation Mode (cool, heat, auto, dry, and fan), temperature setting, fan speed setting, setback, hold and airflow direction setting.
 5. Timer settings of on/off/temperature up to 8 times in a day in 5-minute increments with an Auto Off timer and able to limit the set temperature range.
 6. Room temperature shall be sensed at the Controller.

2.13 CMCN: System Controllers

- A. TE-200 Centralized Controller
 1. Standalone controller shall be capable of controlling up to 50 indoor units across multiple outdoor units. Controller shall be capable of controlling up to 200 indoor units across multiple outdoor unit with expansion of up to three AE-50A controllers.
 2. Power shall be provided by integrated power supply.
 3. Controller shall support operation superseding that of the remote controllers, system configuration, daily/weekly scheduling, monitoring of operation status, night setback setting, free contact interlock configuration and malfunction monitoring.
 4. Controller shall have five basic operation controls which can be applied to an individual indoor unit, a group of indoor units, or all indoor units. These controls shall include on/off, operation mode selection (cool, heat, auto, dry, setback and fan), temperature setting, fan speed setting, and airflow direction setting.
 5. Ability to enable or disable operation of local remote controllers.
 6. Allow both daily and weekly schedules with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed and permit/prohibit of remote controllers.
 7. Controller shall be equipped with a RJ-45 Ethernet port to support interconnection with a network PC via a closed/direct Local Area Network (LAN), via an Ethernet Hub on a LAN.
 8. 9" high resolution, back lit, color touch panel interface for direct graphical interface and control of system.
 9. Memory back up via USB port.

10. Software functions shall be available so that the building manager can securely log into each AE-200 via the PC's web browser to support operation monitoring, scheduling, error e-mail, personal browser, and maintenance diagnostics.
- B. Digital Input Digital Output (DIDO) Control Board
 1. 2 digital inputs (DI) and 2 digital outputs (DO)
 2. (DI) Provide status or fault monitoring.
 3. (DO) Provide on/off, start/stop, enable/disable control to external equipment.
 4. Interlock M-NET devices or output contacts according to input status.
 5. Provide 24 VDC power.
- 2.14 CONDENSATE PUMPS
- A. See Section 230500.
- PART 3 EXECUTION
- 3.1 EXAMINATION
- A. Coordinate size and location of roof support rails for condensing unit. Provide inserts for mounting.
 - B. Coordinate size and location of sleeves or block-outs needs for refrigerant piping.
 - C. Determine refrigerant pipe routing to efficiently minimum run length and avoid interference.
- 3.2 INSTALLATION
- A. Install condensate piping with trap and determine route from drain pan to nearest waste with 1/4" slope. Provide condensate pump where drain is not available or slope cannot be made.
 - B. Install components furnished loose for field mounting.
 - C. Install condensing unit at roof on fabricated rails or curb with cap. Secure unit to support and seal.
 - D. Install refrigerant piping from condensing unit(s) to branch controller(s) and from branch controller(s) to indoor units. Install refrigerant specialties furnished with unit.
 - E. Insulate both liquid and vapor refrigerant piping on all runs.
 - F. Evacuate refrigerant piping and install initial charge of refrigerant.
 - G. Install electrical devices furnished loose for field mounting.
 - H. Install control wiring between air handling unit, condensing unit, and field installed accessories.
- 3.3 INSTALLATION – CONTROLS
- A. Set control of equipment based on room controller space temperature rather than default return air temperature.

- B. Setup Ethernet access via local area network. Coordinate setup for remote access with IT.
- C. Setup output of error message notification via email, coordinate with owner for address.
- D. Designate Fan Coils with unit tag and room/space name.
- E. Setup occupied and unoccupied space temperature schedules with 2 hour interval occupied sweep and second unoccupied temperature sweep. Coordinate schedules with Owner.
- F. Provide graphical floor plans for central controller display. Show locations of fan coils on plan with equipment tag.

3.4 INSTALLATION - CONDENSATE PUMPS

- A. See Section 230500.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Furnish initial start-up and commissioning. During first year of operation, including routine servicing and checkout.

3.6 CLEANING

- A. Vacuum clean coils and inside of unit cabinet.
- B. Install new filters in indoor units at Substantial Completion.

3.7 DEMONSTRATION

- A. Demonstrate system operation and maintenance.
- B. Furnish services of manufacturer's technical representative for one day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days' notice to Architect/Engineer of training date.

3.8 PROTECTION OF FINISHED WORK

- A. Do not operate indoor units during construction for temporary heat.
- B. Do not operate indoor units until ductwork and room is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electric duct coils.

PART 2 PRODUCTS

2.1 ELECTRIC COILS

- A. Manufacturers: Brasch, Indeeco, Neptronic, Greenheck or approved equal.
- B. Assembly: UL listed and labeled, with terminal control box and hinged cover, splice box, coil, casing, and controls.
- C. Coil: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings and stainless steel terminals.
- D. Casing: Channel frame of galvanized steel with brackets, stiffening ribs and gussets welded to frame. Flange duct connection unless noted otherwise.
- E. Controls: Automatic reset thermal cut-out, built-in magnetic disconnecting contactors (3-poles), control circuit transformer and fuse, secondary replaceable thermal cut-out, air flow proving device, fused disconnect.
- F. Accessories:
 - 1. Insulated terminal box
 - 2. SCR control
 - 3. Door interlock switch
 - 4. Pilot lights

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify ductwork is ready for installation.
- B. Verify concealed blocking and supports are in place and connections are correctly located.

3.2 INSTALLATION

- A. Install air coils in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- B. Protect coils to prevent damage to elements.
- C. Install coils level.

- D. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electric radiant heaters.
 - 2. Electric wall heaters.

PART 2 PRODUCTS

2.1 ELECTRIC RADIANT PANEL

- A. Manufacturers: Markel, Aztec or approved equal.
- B. Assembly: Electric resistance graphite element imbedded between two layers of insulation, steel shell. T-bar mount, surface mount with aluminum frame, suspended with aluminum frame or recessed mount with aluminum frame based on ceiling installation type. UL listed and labeled.
- C. Ceiling Panels: 24x24 or 24x48 inch with baked enamel white finish.

2.2 FORCED AIR WALL HEATER (Tamperproof)

- A. Manufacturers: Markel, Cadet, Brasch or approved equal.
- B. Heavy gauge housing and frame with sealed tubular heating element, thermal overload cut-off, fan delay switch, built-in tamperproof thermostat, vane axial blower. UL listed.

2.3 FORCED AIR WALL HEATER

- A. Manufacturers: Markel, Cadet, Brasch or approved equal.
- B. 18-gauge powder coated housing and frame, white. Sealed tubular heating element, thermal overload cut-off, fan delay switch, built-in double pole adjustable thermostat, vane axial blower. Without summer fan switch. UL listed.

2.4 FORCED AIR WALL HEATER (Freeze Protection)

- A. Manufacturers: Markel, Cadet, Brasch or approved equal.
- B. Heavy gauge housing and frame with sealed tubular heating element, thermal overload cut-off, fan delay switch, built-in tamperproof thermostat set to 45F for freeze protection, vane axial blower. UL listed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. For recessed units, verify recess dimensions are correct size.
- B. Verify wall construction is ready for installation.

- C. Verify concealed blocking and supports are in place.

3.2 INSTALLATION

- A. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.
- B. Protection: Install finished cabinet units with protective covers during remainder of construction.
- C. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals.

3.3 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units.
- B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide all labor, materials, tools, equipment, supervision, and services required for the construction, installation, connection, testing and operation of electrical work described herein and shown on the drawings. This section applies to all Division 26, 27 and 28 sections.
- B. General Requirements: The provisions and intent of the General Conditions, Special Conditions, and Division 01 apply to Work in this section.

1.2 PERMITS

- A. Purchase the necessary permits, including State of Washington Labor and Industries and Snohomish County permit fees, licenses and approvals required for execution of this work and include all costs in the bid.

1.3 CODES AND STANDARDS

- A. Execute electrical work in strict accordance with the 2017 National Electrical Code, and the current Washington State Electrical Rules and Regulations; and local ordinances and regulations.
- B. Conform to applicable industry standards, UL standards, NEMA standards, and other standards as noted.
 - 1. Notify the A/E of deviations in Contract Documents to applicable codes and ordinances prior to installation of the Work. Perform changes in the Work after initial installation due to requirements of code enforcing agencies at no additional cost to the Owner.
 - 2. If conflict occurs between legally adopted codes and the Contract Documents, the codes prevail, except that this shall not be construed as relieving the Contractor from complying with requirements of the Contract Documents which may exceed code requirements and not contrary to same.

1.4 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.5 SUBMITTALS

- A. Comply with requirements in Division 01 and with additional requirements indicated in this article.
- B. Product Data:

1. Submit prior to fabrication of assemblies and delivery of purchased items.
 2. Submit complete at one time. Partial product submittals not acceptable and will be returned not reviewed.
 3. Clearly mark catalog pages, equipment, and model number to be used. Note required accessories.
 4. Confirm with A/E whether product data may be submitted electronically in lieu of physical submittal. Format organization and requirements shall follow that of a physical submittal. See Item 5. below.
 5. Format:
 - a. Assemble submittals in 3-ring binders. Use multiple binders if pages in a single binder would exceed 2-1/2 inch thickness. Separate binders for each category, such as Electrical, Communications, and Fire Alarm and Security. Where one subject matter encompasses more than one binder, differentiate by volume numbers. Include indexed tabs for each binder.
 - b. Include overall table of contents of items submitted, organized by specification section.
 - c. Include heavy, tabbed divider sheet for each specification section, with specification section number and title on tab. Include table of contents for each specification section, including catalog numbers or drawing numbers if appropriate.
 - d. Fold drawings to 8-1/2 inch size and bind as above (with reinforcing at punched holes) or place in clear plastic holder designed for 3 ring binders.
 - e. Include contractor and manufacturer's representative contact information for each product.
 6. Identify on cover and spine for each binder with printed title "ELECTRICAL SUBMITTALS", names of project, Owner, general contractor, electrical subcontractor, Architect, and electrical engineer, and year of project completion.
- C. Sustainable Design Submittals:
1. Comply with requirements of Section 26 31 00
 2. Comply with requirements of Section 01 81 13
 3. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- D. Shop Drawings:
1. Confirm with A/E whether shop drawings may be submitted electronically in lieu of physical drawings. Format organization and requirements shall follow that of physical shop drawings.
 2. Submit as specified in the individual specification sections. Submit minimum 30 days prior to starting fabrication on installation work. Do not fabricate or install until reviewed by the A/E. Include complete location dimensions, and hanger and support sizes and dimensions.
 3. "Typical" drawings and wiring diagrams not accepted unless they specifically apply to this project.
 4. Drawings shall be drawn at sufficient scale to show details clearly on same size sheets as Drawings.
 5. Show required coordination with work of other trades.
 6. Identify details and show their locations in Project.

7. Include description of configuration and operation of proposed systems.
 8. Include outline drawings of proposed equipment in plan and elevation views including overall dimensions, weights, and clearance required.
 9. Include one-line electrical diagrams required for control and sensing.
 10. CAD Drawings: AutoCAD floor plan backgrounds are available in electric format and shall be requested from the A/E.
 11. Direct use of the Drawings as the basis of Contractor's prepared Shop Drawings not acceptable.
- E. Approval: Approval of a manufacturer's name or product by the A/E does not relieve the Contractor of the responsibility for providing materials and equipment which comply in detail with requirements of the Contract Documents.
- F. Re-Submittals: Clearly identify re-submittals. Provide revised tabs, indexes, page renumbering, and other formats to interface with original submittal. Identify changes and include date for project tracking.
- G. Test reports and Certificates: Submit as a package prior to Substantial Completion.
- H. Certifications: Submit written certifications from the governing building authorities stating that work has been inspected and accepted, and complies with applicable codes and ordinances.
- I. Record Drawings: Comply with Article "Record Drawings" in this section.
- J. Schedule of Values:
1. Comply with the requirements in Division 1 with additional requirements as indicated in this paragraph.
 2. Include costs in Schedule of Values as follows:
 - a. Mobilization.
 - b. Submittals.
 - c. Electrical Permit.
 - d. Electrical Site – Utility Provisions, Material.
 - e. Electrical Site – Utility Provisions, Labor.
 - f. Electrical Site – Lighting Rough In & Wiring, Material.
 - g. Electrical Site – Lighting Rough In & Wiring, Labor.
 - h. Electrical Site – Power Rough-in & Wiring, Material.
 - i. Electrical Site – Power Rough-in & Wiring, Labor.
 - j. Generator - Material
 - k. Generator - Labor
 - l. Lighting Systems – Fixtures & Lamps Material.
 - m. Lighting Systems – Fixtures & Lamps Labor.
 - n. Lighting Systems – Branch Circuit Rough-in & Wiring, Material.
 - o. Lighting Systems – Branch Circuit Rough-in & Wiring, Labor.
 - p. Lighting Systems – Devices & Trim, Material.
 - q. Lighting Systems – Devices & Trim, Labor.
 - r. Lighting Controls Systems – Lighting Controls, Material
 - s. Lighting Controls Systems – Lighting Controls, Labor
 - t. Power Systems – Switchgear, Disconnects, Material.
 - u. Power Systems – Switchgear, Disconnects, Labor.
 - v. Power Systems – Feeder Rough-in, Material.
 - w. Power Systems – Feeder Rough-in, Labor.
 - x. Power Systems – Equipment Connections.

- y. Power Systems – Branch Circuit Rough-in & Wiring, Material.
- z. Power Systems – Branch Circuit Rough-in & Wiring, Labor.
- aa. Power Systems – Devices & Trim, Material.
- bb. Power Systems – Devices & Trim, Labor.
- cc. Low Voltage – Fire Alarm Rough-in & Wiring, Material.
- dd. Low Voltage – Fire Alarm Rough-in & Wiring, Labor.
- ee. Low Voltage – Fire Alarm Trim, Material.
- ff. Low Voltage – Fire Alarm Trim, Labor.
- gg. Punch List and Close Out.
- hh. Commissioning, Testing and Training

1.6 DEFINITIONS AND ABBREVIATIONS

- A. Refer to Division 1 for definitions and abbreviations. Additional definitions and abbreviations are as follows.
- B. “Approved” or “Approval” means written approval by the owner or “Owner’s agent” (A/E).
- C. “Codes” means AHJ adopted codes, rules, and ordinances and additional codes as specified herein.
- D. “Concealed” means spaces out of sight. For example, above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.
- E. The word “Contractor”, as used in Division 26 sections, means the electrical subcontractor.
- F. “Coordination”, “Coordinating”, and “Coordinate” means to bring, or the bringing, into a common action, movement, or combination so as to act together in a smooth concerted way.
- G. “Directed”, “Requested”, “Accepted”, and Similar Terms means these terms imply “by the A/E” unless otherwise indicated.
- H. “Exposed” means open to view. For example, raceways installed in a tunnel or raceways installed in a room and not covered by other construction.
- I. “Furnish” means supply and deliver to the project site ready for unloading, unpacking, assembly, installation, and similar activities.
- J. “Indicated” and “Indicated on the Drawings” means shown on Drawings by notes, graphics or schedules, or written into other portions of Contract Documents. Terms such as “shown”, “noted”, “scheduled” and “specified” have same meanings as “indicated”, and are used to assist the reader in locating particular information.
- K. “Install” means to place in position for service or use. Includes operations at project site, such as unloading, unpacking, assembly, erection, placing, preserving, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar activities.
- L. “Provide” means furnish and install for a complete, finished, and operable system and ready for intended use.
- M. “Shop Drawings” means Document which fully details equipment and intended installation relative to this specific Project.

- N. "Substantial Completion" shall mean that the entire project (or readily definable portion thereof if so designated in the Contract Documents) is acceptable to code enforcement authorities and to extent required by such authorities, has been inspected and approved by such authorities, and is suitable for occupancy by the Owner or occupant for the purpose intended. Refer to Division 0 and 1 for additional requirements.
- O. "Work" or "Project" means entire scope of work required by the Contract Documents.
- P. Abbreviations:
- | | | |
|------|--|--------------------|
| A/E | Architect | |
| AHJ | Authorities Having Jurisdiction | |
| ANSI | American National Standards Institute | |
| ASTM | American Society for Testing and Materials | |
| C | | Degrees Celsius |
| ETL | Environmental Technology Laboratory | |
| F | | Degrees Fahrenheit |
| FM | Factory Mutual Engineering Corporation | |
| IBC | International Building Code | |
| NEC | National Electrical Code, NFPA 70 (latest adopted edition with Amendments) | |
| NEMA | National Electrical Manufacturer's Association | |
| NFPA | National Fire Protection Association | |
| OSHA | Occupational Safety and Health Administration | |
| UL | Underwriters Laboratories Inc. | |
| RMS | Root Mean Square | |
| THD | Total Harmonic Distortion | |
| V | | Volts |

1.7 MATERIALS

- A. Where 2 or more manufacturers are listed, select for use any of those listed. The first mentioned, in general, was used as the basis of design. Bids on any manufacturer named acceptable as long as that manufacturer meets every aspect of the Contract Documents. Note that equipment layout is based on equipment listed in equipment schedules.
- B. Where other than the first named manufacturer is selected, include cost of resulting work and redesign of associated services and structure. Include redesign drawings with Shop Drawings.
- C. Ensure that equipment will fit within available space, including manufacturer's recommended clearances.

1.8 STANDARDS OF QUALITY

- A. Materials and Equipment: UL listed and labeled or other AHJ approved testing laboratory and in compliance with other industry standards as specified.
- B. Equipment shall be manufacturer's regularly catalogued items and shall be supplied as a complete unit in accordance with manufacturer's standard specifications and any optional items required for proper installation for equipment unless otherwise noted. Equipment and materials shall be installed in accordance with the manufacturer's recommendations and best trade practices.
- C. Products shall be new unless indicated otherwise in the Contract Documents.

- D. Fabricator and Manufacturer Qualifications: Specialists with at least 5 years experience and regularly engaged in manufacture of equipment and materials specified.
- E. Furnish products of a single manufacturer for items which are used in quantity. A Product, for the purpose of this paragraph, is an assembly of components such as switchboards, transformers, panelboards, and similar items. Materials such as wire and cable, raceways, outlet boxes, and similar items not requiring maintenance are not included in the single manufacturer requirement of this paragraph.
- F. Installer Qualifications: Specialists with at least 5 years experience and regularly engaged in the installation of the system, equipment, and materials specified. Where required by the AHJ, employ licensed trades persons.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, and handle products in accordance with manufacturer's recommendations, using means and methods to prevent damage, deterioration, and loss, including theft.
- B. Deliver products to site in manufacturer's original containers, complete with labels.
- C. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
- D. Store products subject to damage by weather conditions above ground, under cover in weathertight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

1.10 SUBSTITUTIONS

- A. Comply with requirements in Division 1 with additional requirements indicated in this article.
- B. Substitutions will be considered following bid award only when a product becomes unavailable through no fault of the Contractor.
- C. Where "Manufacturer" paragraphs include the words "or approved", prior approval of the proposed substitution is required. The A/E is sole judge of quality of proposed substitution.
- D. When the A/E approves a substitution request, the approval is given with the understanding that the Bidder:
 - 1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - 2. Will provide the same warranty for the Substitution as for the specified Product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
- E. Whenever a Product is described by detail, specification, trade name, manufacturer's name or catalog reference, use only such Product, unless written approval is given for substitution prior to bid. Submit written requests on substitution request form included in Division 1. Approved substituted manufacturers will be listed by Addendum.

- F. Provide as specified certain products, materials, and systems where “manufacturer” paragraphs are followed by the words “no substitutions”.
- G. Substitutions will not be considered when they are indicated or implied on Shop Drawings or product data submittals, without separate written prior approval, or when approval will require revision to the Contract Documents.

1.11 DRAWINGS AND SPECIFICATIONS

- A. General: The electrical drawings are diagrammatic. Complete details of building features which affect electrical installation may not be shown. For additional details, refer to other Contract Documents. Report any discrepancies to the A/E along with suggested revisions. Obtain written response from the A/E before proceeding with changes.
- B. Depiction of Work: Drawings do not show the exact characteristics of the work including, physical arrangement of equipment, lengths of wiring or conduit runs. Base work on actual field measurements and conditions. Provide work required to complete the installation.
- C. Dimensions: Do not scale drawings. Dimensional accuracy is not guaranteed, and field verification of dimensions, locations, and levels to suit field conditions is required.
- D. Since the Drawings of floor, wall, and ceiling installation, are made at small scale, outlets, devices, equipment, and similar items are indicated only in their approximate location. Locate outlets and apparatus symmetrically on floors, walls, and ceilings where not dimensioned and coordinate such locations with work of other trades to prevent interferences.
- E. Discrepancies: Field verify dimensions and existing conditions prior to performing work. Bring to the A/E's attention any discrepancies within the Contract Documents and between the Contract Documents and field conditions. Also for any design and layout changes required due to specific equipment selection, prior to the Contractor's work (equipment and material purchasing and installation). Any corrective work required by the Contractor after his discovery of such discrepancies, inconsistencies, or ambiguities shall be at no additional cost to the Owner.
- F. Specifications: These specifications are written in imperative mood and streamlined form. The imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases.

1.12 RECORD DRAWINGS

- A. Comply with requirements in Division 1, with additional requirements as indicated in this article.
- B. Prepare Record Drawings. Record Drawings shall be new blue line prints (pencil and black pen not acceptable) and shall show the measured locations of portions of the Work and changes the Contractor has made.
- C. Record corrections and changes made during the progress of the work, showing work as actually installed. In general, tolerance plus or minus 1'-0" from actual location. Indicate installed locations for underground raceways. Neatly hand-draft on daily basis. Keep readily

available at project site. Use latest revisions and keep neat and clean. Do not use Contractor's working drawings.

- D. Record Drawings are subject to review by the A/E on a regular basis throughout construction. At end of construction, check drawings for completeness and accuracy.
- E. Drawings shall show addendum items, change orders, clarifications, supplemental instructions, and deviations from the Drawings.
- F. Per project closeout procedures, submit in AutoCAD format along with corrected blue line drawings. Each sheet shall be noted as "RECORD DRAWING".

1.13 COORDINATION

- A. Coordinate Division 26 and 28 work with other trades.
- B. Be aware of restricted space for installation of electrical systems. Include offsets and perform rerouting and coordination to fit elements in available space. Include provisions for such requirements in bid.
- C. Electrical equipment and systems shown are based on existing drawings as available and on limited project site observations to the extent possible under current conditions. Field verify existing conditions prior to commencement of work. Obtain specific locations of structural and architectural features or equipment items from referenced drawings, field measurements, or trade providing material or equipment.
- D. Coordinate raceway installations to clear light fixtures and electrical cable trays. Include clearance over light fixtures to allow removal and replacement. Include minimum 6 inch clearance above and to sides of cable trays.
- E. Be responsible for beam penetrations as they relate to the electrical work. Submit sizes and locations to the structural engineer for review and determination of structural details.
- F. Coordinate attachments to structure to verify that attachment points on equipment and structure can accept seismic, weight, and other loads imposed.
- G. Refer to architectural and structural drawings for location of expansion and seismic joints. Provide flexible loops for raceways and cable trays crossing expansion and seismic joints.

1.14 WORKMANSHIP

- A. Work shall be in accordance with best trade practices. Remove substandard workmanship and provide new material at no extra cost to the Owner.

1.15 SITE VISIT

- A. The Contractor shall visit site during bidding period to note conditions affecting installation of Work. No additional charges allowed due to failure to adequately review conditions.
- B. Investigate each space through which equipment must be moved. Where necessary, arrange with equipment manufacturers to ship equipment in sections with suitable dimensions for moving through restricted spaces. For movement through occupied spaces,

ascertain from the Owner as acceptable times of day or night that movement could occur. Include costs in bid for off hours labor, reassembly, and field testing.

1.16 CERTIFICATION

- A. By submitting a bid for the electrical systems, the Contractor and his subcontractors acknowledge and certify the following:
1. That they have carefully examined and fully understand the Drawings and Specifications (including but not limited to architectural, site, utility, mechanical, structural and electrical drawings and specifications. In addition, they have determined that the Drawings and Specifications are adequate to complete the electrical systems and that they can provide a complete finished and operable system in accordance with the Contract Documents.
 2. That they have had a reasonable opportunity to discover any ambiguities in the Contract Documents and such ambiguities have been brought to the attention of the A/E in writing prior to submitting the bid.
 3. That they have reviewed the project progress schedule with the general contractor, fully understand the schedule, and they have verified, prior to submitting a bid, availability of necessary labor and materials, including supervision and office backup, and can comply with the schedule requirements.
 4. That there may be changes to the scope of work and that they understand that any proposal submitted for performance of additional work shall include costs associated with such change including but not limited to labor, materials, subcontracts, equipment, taxes, fees, schedule impact, loss of efficiency, supervision, overhead and profit.
 5. That the Contract requires them to coordinate their work with that of other trades and that responsibility for coordination includes rerouting, offsets, and similar provisions, to fit Work and address manufacturer's recommended clearances for service access, maintenance, and replacement of equipment in a manner that is compatible with work of other trades in the same area.
 6. That routing of elements of electrical systems shown on the Drawings is schematic only and that offsets and rerouting probably will be required in installation and that labor and materials have been included for such in their bids.
 7. That they have consulted with affected utilities and included in their bids labor and materials to meet requirements which may be imposed by each utility and have included in their bids costs and fees to be paid to such utilities, including temporary services and temporary and permanent connections unless specifically excluded in the Contract Documents.
 8. That they understand submittals of material and equipment to the A/E is for the purpose of establishing what they are providing for the project. Any review undertaken by the A/E does not relieve them of their responsibilities to furnish and install materials and equipment required for work in the project nor does such review relieve them of their responsibilities for coordination with other trades and designers to ensure that such materials and equipment will fit and be suitable for purpose intended.
 9. That they agree to receive payment for bid amounts as full compensation for furnishing materials and labor which may be required in prosecution and completion of work required under the Contract Documents, and in respects to complete the contract work to the satisfaction of the A/E.
 10. That they include in their bids costs to furnish bonds as specified in the Contract Documents.

1.17 WARRANTY

- A. Conform to requirements in General Conditions, Supplementary Conditions, and Division 1. Where not so prescribed or defined, the period shall be 1 year. Warranty periods within Division 26 and 28 shall not commence until Substantial Completion. Contractor shall extend longer warranties specified in other sections.

1.18 EQUIPMENT FURNISHED BY OWNER INSTALLED BY CONTRACTOR (OFCI)

- A. Material Handling and Delivery: Coordinate delivery of OFCI equipment. Receive, off load, transport, store, hoist, unpack, dispose of packing, same as for other project equipment arriving at job site. Requirements of the Contract Documents apply to OFCI equipment.
- B. Operation and Maintenance Data: Obtain from the Owner operation and maintenance data for the OFCI equipment and incorporate them into the Operations and Maintenance Manuals.
- C. Start-up and Warranty:
 - 1. OFCI equipment suppliers will pass on to the Contractor start-up information, maintenance and parts information, and warranty provisions of their products in accordance with the equipment suppliers contract requirements. Organize and coordinate start-up and warranty requirements for the OFCI equipment.
 - 2. Include one year warranty on OFCI equipment starting at Substantial Completion regardless of shorter time limits by OFCI suppliers.

1.19 DEMONSTRATION

- A. Comply with requirements in Division 1 with additional requirements indicated in this article.
- B. Following installation of electrical work and prior to final acceptance, demonstrate that equipment and systems operate as indicated in the Contract Documents and in accordance with manufacturer's recommendations.
- C. Perform in presence of the A/E and Owner's representative, unless otherwise directed by the A/E. Give minimum 1 week notice prior to demonstrations.
- D. Provide instruments and personnel required to conduct demonstrations.

1.20 SUBSTANTIAL COMPLETION

- A. Comply with requirements in Division 1.
- B. Prepare list of items that are not complete prior to asking for a substantial completion review by the A/E.

1.21 ALTERNATES

- A. General: See Bid Form and Alternates described in Division 1 for possible effect on work of Division 26.

1.22 OPERATION AND MAINTENANCE MANUALS

- A. Prepare Operation and Maintenance Manuals for equipment and materials furnished under Division 26.
- B. Comply with requirements in Division 1 with additional requirements indicated in this article.
- C. Submit 4 copies of Operation and Maintenance Manuals for review at least 4 weeks prior to Substantial Completion date. Assemble Operation and Maintenance Manual in 3-ring binder(s). Use multiple binders if pages in a single binder would exceed 2-1/2 inch thickness. Separate binders for each category, such as Electrical, Communications, and Fire Alarm and Security. Where one subject matter encompasses more than one binder, differentiate by volume numbers. Include indexed tabs for each binder. Engrave cover with the project title in 1/2 inch high letters and name and address of the Contractor in 1/4 inch high letters. Provide same information in 1/8 inch high letters on spine.
- D. Include complete cleaning and servicing data compiled in clearly and easily form. Include serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, and similar information. Each item of equipment shall have its own individual sheet. (Example: If 2 items of equipment A and D appear on the same sheet, individual sheet shall be included for each unit specified).
- E. Include the Following Information:
 - 1. Identifying name and mark number.
 - 2. Certified outline drawings and Shop Drawings.
 - 3. Parts list.
 - 4. Performance curves and data.
 - 5. Wiring diagrams.
 - 6. Manufacturer's recommended operating and maintenance instructions.
 - 7. Vendor's name, address and telephone number for all parts and equipment.
 - 8. Name, address and telephone number of Contractor performing the work.
 - 9. Test reports.
 - 10. Product data and Record Drawings.

1.23 MISCELLANEOUS

- A. Allowance: The electrical contractor shall include in the bid an allowance of two thousand five hundred dollars (\$2,500) to be used to defray the costs of any extra electrical work arising during the period of construction. Charges against this sum shall be accounted for, itemized, and approved by the Architect. Extra work shall include only work not called for or implied by the plans and specifications.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish specified items acceptable to AHJ as suitable for intended use.
- B. Furnish new materials, unless otherwise indicated, free from defects and the standard products of reputable manufacturers regularly engaged in production of such equipment.

- C. Furnish materials of the same type or classification and used for the same purpose by the same manufacturer.
- D. Materials and Equipment: Shall be UL listed and labeled or other AHJ approved testing laboratory, approved by inspection authorities, and rated by the manufacturer as suitable for the intended use.
- E. Remove rejected or damaged material from site.
- F. Samples may be required for non-standard or substituted items before installation. Submit samples as required in specific specification sections.
- G. Furnish required items necessary for installation and testing procedures.

2.2 POSTED INSTRUCTIONS

- A. Posted Operating Instructions: Furnish simplified, consolidated equipment control and power diagrams. Graphically represent entire system and actual equipment installed. Include concise written instructions on how to start and stop systems. Show settings and conditions to be observed. Indicate what control adjustments are to be made or maintained by the operator.
 - 1. Include control diagrams and specific operating instructions.
 - 2. Indicate understandable how to energize each major component of systems. Show what action must be taken in an emergency, how to restore power following an outage, and what precautions to be taken when maintenance is required.
 - 3. Include photographic or comparable non-fading reproductions, either framed under glass or encased in non-discoloring plastic.
 - 4. Include one-line diagrams of electric power distribution riser.
- B. Copies of operating instructions shall be used with Operation and Maintenance Manuals as basis in training Owner's employees in the operation and maintenance of systems and related installed equipment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of the various sections. Do not install until unsatisfactory conditions are corrected.

3.2 INSPECTIONS

- A. Confirm that installations have been inspected before enclosure within building features, buried, or otherwise hidden from view. Pay costs associated with uncovering or exposing installations and features not previously inspected and for repair to exposed surfaces.

3.3 PREPARATION

- A. Protect surrounding areas and surfaces to prevent damage as work is installed.

- B. Obtain equipment roughing-in dimensions from approved Shop Drawings or actual measurements.
- C. Be familiar with the location of other trade's equipment. Eliminate conflicts. Check door swings before installing switches. Locate switches on strike side of doors unless noted otherwise.
- D. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, and similar activities. Where such cutting, drilling, channeling and similar activities become necessary for proper installation, perform with care using skilled mechanics of trades involved. Repair damage to building and equipment at no additional cost to the Owner.
- E. Provide all openings required for the electrical work. Perform cutting work of other trades only with consent of that trade. Cutting structural members not permitted without consent of the A/E.

3.4 INSTALLATION

- A. Install Work as specified and in accordance with the Drawings and manufacturer's instructions. Where these conflict, manufacturer's instructions govern.
- B. Review Architectural, Mechanical and other applicable drawings and applicable Shop Drawings to prevent switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, and similar items, or from being located in whiteboards, tackboards, glass panels, and similar items. Relocate electrical devices and connections as directed by the A/E at no additional cost to the Owner if the work is not properly coordinated.
- C. Where conduit, outlets, and apparatus are encased in concrete, locate and secure at point of installation. Check locations of electrical items before and after concrete and masonry installation and relocate displaced items.
- D. Provide block-outs, sleeves, demolition work, and similar items required for installation of Work specified in this division.

3.5 WORKMANSHIP

- A. Work and materials will be subject to observation at any time by the Owner and the A/E.
- B. Install equipment and material in a neat and workmanlike manner and align, level and adjust for satisfactory operation. Install equipment so that all parts are easily accessible for inspection, operation, maintenance and repair. Install material and equipment in accordance with manufacturer's instructions. Provide calibrated torque wrenches and screwdrivers as required.
- C. Cutting and Patching: Do not weld to, cut, or notch structural members or building surfaces without approval of the A/E. Restore surfaces neatly to original condition after cutting, channeling, chasing, and drilling of walls, partitions, ceilings, paving, and anchorage of conduit, raceways, and other electrical equipment.

3.6 WELDING, CUTTING, AND DRILLING

- A. Perform in accordance with American Welding Society Standards.

3.7 EXCAVATION FOR ELECTRICAL WORK

- A. Perform earthwork required for installation of electrical work below grade. Coordinate with requirements in Division 2.
- B. Locate and protect existing utilities and other underground work in manner which will ensure that no damage or service interruption will result from excavating and backfilling. Perform excavation in a manner which protects walls, footings, and other structural members from being disturbed or damaged in any way.
- C. Protect persons from injury at excavations by barricades, warnings, and illumination.
- D. Coordinate excavations with weather conditions to minimize possibility of washouts, settlements and other damages and hazards.
- E. Do not excavate until Work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimum. Refer to other sections for additional requirements for excavating.
- F. Store excavated material (temporarily) near excavation in manner which will not interfere with or damage excavation, other work or excavated material.
- G. Retain excavated material which complies with requirements for backfill material. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material. Remove unused material from project site and dispose of in lawful manner.

3.8 BACKFILL

- A. For Buried Conduit or Cable (Other than Concrete Encased): Two inch thickness of sand or pea gravel below, on sides of, and over conduit or cable.
- B. For Trench Backfill to within 6 Inches of Final Grade: Soil material suitable for compacting to required densities.
- C. For Top 6 Inches of Excavation: Top soil except where excavations occur below paved or gravel area.
- D. Backfill excavations in 8 inch high courses of backfill material, uniformly compacted to densities of 90 percent in unpaved areas and 95 percent in building and under paved areas (percent of maximum density, ASTM D 1557), using power-driven compaction equipment.
- E. Subsidence: Where subsidence is measurable or observable at electrical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work to eliminate evidence of restoration.

3.9 CONCRETE BASES

- A. Unless noted otherwise, provide 4 inch high reinforced concrete bases for floor mounted and floor standing electrical equipment, including generators, transformers, switchgear, battery racks, motor control centers, and similar equipment. Extend bases 4 inches beyond equipment or mounting rails in each direction unless noted otherwise on the Drawings.
- B. Concrete bases shall be provided under Division 26. Coordinate size and location of bases and provide required anchor bolts, sleeves, and templates required to obtain proper installation.
- C. Provide concrete lids and vaults for power company furnished pad mounted transformers in accordance with power company clearance requirements.

3.10 CLEANING

- A. Clean equipment, conduit, and fittings and remove packing cartons and other debris created by Division 26 Work.
- B. Before Substantial Completion, carefully clean equipment, fixtures, exposed raceways and similar items. Remove construction labels, dirt, cuttings, paint, plaster, mortar, concrete, and similar items. Clean fixtures, interiors and exteriors of equipment and raceways.
- C. The premises must be kept free of accumulated materials, rubbish and debris at all times. Surplus material and equipment must not be stored at the job site.

3.11 IDENTIFICATION

- A. Provide nameplates and decals required to identify equipment and components, comply with requirements in Section 26 05 53.
- B. Mount operating instructions and diagrams near equipment or elsewhere as otherwise designated by the Owner.

3.12 PROTECTION

- A. Protect equipment during and after electrical hookup, painting, and final testing.

3.13 TESTING

- A. Comply with requirements in Section 26 08 00 and 26 08 10.

3.14 PROJECT TRAINING

- A. Upon completion and testing of equipment and system installation, assemble equipment factory representatives and subcontractors for system training with Owner's representatives as required in specific specification sections.
- B. Each representative and subcontractor shall assist in start-up, check out, and training for their respective system and remain on-site until the total system operation is thoroughly reviewed by the Owner's representatives and are thoroughly trained. Return for additional training sessions as required to completely train Owner's Representatives.

- C. Factory representative and system subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and operation personnel. To certify acceptance of operation and instruction by the Owner's representative, prepare a written statement.
- D. Provide video of training sessions per Division 01.
- E. Submit copy of acceptance to A/E.

3.15 PUNCHLIST AND FINAL REVIEWS

- A. At the time of punchlist and final reviews, the project electrical foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested to allow review of entire electrical system.

3.16 PROJECT CLOSEOUT

- A. Engineering services required beyond the final completion date shall be paid by the Contractor at a rate of \$150 per hour.
- B. Punchlists will be done at Substantial Completion and final completion dates. Submit Record Drawings and final Operation and Maintenance Manuals prior to Substantial Completion date. Subsequent reviews shall be paid by the Contractor at a rate of \$125 per hour.

3.17 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 01 91 13 – General Commissioning Requirements, Section 26 08 00 – Commissioning of Electrical Systems and 26 08 10 Electrical Testing. The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes final electrical connection to equipment having electrical requirements. Contractor shall make final connections for Owner furnished equipment including switches, receptacles, and similar items. See other applicable specification sections for building temperature control wiring requirements specified in Divisions 22, and 23.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Section 26 05 00 apply to Work in this section.
- C. Connection to Equipment Specified in Divisions 22, and 23 as Follows unless Specified Otherwise in Divisions 22, and 23:
 - 1. For motorized only equipment with built-in controllers (packaged equipment), Connect power and provide an external disconnect mounted independently at equipment. Division 23 will provide control wiring.
 - 2. For motorized only equipment with external controller (non-packaged equipment), provide external motor controller, disconnect switch, and make power wiring complete to equipment. Division 23 will provide control wiring.
 - 3. For electric duct heaters with built-in controllers (packaged type equipment), connect power complete and provide external disconnect switch at equipment. Division 23 will provide control wiring.
 - 4. For electric duct heaters with remote controllers (non-packaged type equipment), provide external controller, disconnect switch, and make power wiring to equipment. Division 23 will provide control wiring.
 - 5. For combination motorized and electric heating packaged units specified with built in controllers and specified with "single point electrical connection" under Division 23, connect power and provide external disconnect switch. Division 23 will provide control wiring.
 - 6. For equipment requiring a full voltage non-reversing starter, include as a combination disconnect unit.
 - 7. Provide a fused disconnect switch at all equipment whose nameplate indicates "Maximum Fuse Size".
- D. Refer to Division 23 sections for control system wiring.
- E. Refer to sections of other divisions for specific individual equipment power requirements.
- F. Make final connection to kitchen equipment.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

- B. NEC Compliance: Comply with applicable portions of NEC as to type of products used and installation of electrical power connections.
- C. Comply with applicable NEMA standards and refer to NEMA standards for definitions of terminology herein. Comply with NEC for workmanship and installation requirements and to applicable Division 26 sections.
- D. UL Labels: Provide electrical connection products and materials which have been UL listed and labeled.

PART 2 - PRODUCTS

2.1 ELECTRICAL CONNECTIONS MATERIALS

- A. For each electrical connection indicated, include complete assembly of materials, including but not limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories to complete splices, terminations, and connections.
- B. Comply with requirements in Section 26 05 19 for wires and cables, Section 26 05 33 for raceway systems, and Section 26 27 26 for wiring devices.
- C. Include Final Connections for Equipment Consistent with the Following:
 - 1. Permanently Installed Fixed Equipment: Flexible seal-tite conduit from branch circuit terminal equipment, and raceway to equipment, control cabinet, terminal junction box, and wiring terminals. Totally enclose wiring in raceway.
 - 2. Movable and/or Portable Equipment: Wiring device, cord cap, and multi-conductor cord suitable for equipment and in accordance with NEC requirements.
 - 3. Other methods as required by NEC and as required by special equipment and field conditions.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.
- C. Coordinate installation of electrical connections for equipment with installed equipment.
- D. Verify electrical loads (voltage, phase, full load amperes, number and point of connections, minimum circuit ampacity, and similar characteristics) for equipment furnished under other divisions, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment

electrical characteristics. Report variances from electrical characteristics noted on electrical drawings to the A/E before proceeding with rough-work.

- E. Obtain and review equipment submittals and shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.
- F. Comply with requirements in Section 26 05 53 for identification of electrical power supply conductor terminations.

3.2 STARTERS (CONTROLLERS)

- A. Install non-packaged starters and wiring devices near motors or as indicated on the Drawings. Securely support and anchor in accordance with manufacturer's installation instructions. Locate for proper operational access, including visibility for safety.

3.3 PROVISIONS FOR MECHANICAL CONTROLS

- A. Provide 120 Volt, 20 Amp circuit at locations required and described mechanical drawings. Coordinate exact locations prior to installation.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes wire, cable, splices, and terminations for systems 600 Volts and less and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.
- C. The word "Cable" in this section relates to wire only. It does not infer Metal Clad Cable. See Specification 26 05 21 METAL CLAD CABLES for information on this wiring method, if approved for use on this project. METAL CLAD CABLES ARE NOT APPROVED FOR THIS PROJECT.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county and state codes and ordinances.
- B. Codes and Standards:
 - 1. NFPA 70, National Electrical Code (NEC).
 - 2. UL 83, Thermoplastic-Insulated Wires and Cables.
- C. Comply with NEC as applicable to construction and installation of electrical wire and cable. Electrical wire and cable UL listed and labeled.
- D. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of wire and cable.
- E. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of wire and cable.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Product Data: Submit manufacturer's technical product data for each type of wire, cable, and appurtenance.

- C. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- D. Test Reports: Comply with requirements of 26 08 10.
 - 1. Field test reports.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 POWER AND LIGHTING CIRCUITS

- A. Factory-fabricated conductors of sizes, ratings, materials and types indicated on the Drawings for each service. Where not indicated, select to comply with project's installation requirements and NEC standards. Comply with the following:
 - 1. UL 83.
 - 2. Copper Conductor. Wire and cable stranded for all sizes.
 - 3. Insulation type THHN/ THWN dual rated, 600 Volt for circuits from 115 to 600 Volts.
 - 4. Use only 90° C insulated conductors based on 75° C ampacity tables of the NEC.
- B. Aluminum Conductors: Use of aluminum conductors is not permitted.

2.2 REMOTE CONTROL AND SIGNAL CIRCUITS

- A. Class 1:
 - 1. UL 83.
 - 2. Stranded copper conductor.
 - 3. Insulation type THHN, or THWN, 600 Volt for circuits from 115 to 600 Volts.
- B. Class 2 and 3:
 - 1. Copper conductor, 300 Volt insulation, rated 75° C in dry locations and 60° C in wet locations. Individual conductors twisted together and covered with non-metallic jacket unless otherwise noted on the Drawings.
 - 2. UL listed for use in air handling ducts and hollow spaces used as ducts and plenums.

2.3 PLASTIC CABLE TIES

- A. Teflon or nylon, locking type.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 WIRING AND CABLE INSTALLATION, GENERAL

- A. Install electric conductors and cables as indicated on the Drawings, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation," and in accordance with recognized industry practices.
- B. Coordinate installation work with electrical raceway and equipment installation work for proper interface.
- C. Pull cables by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device made through approved swivel connection. Non-metallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop to which pull wire can be attached. Remove insulation from conductors before forming loop. Larger sizes of cable may be pulled by using basket weave pulling grip, if pulling force does not exceed limits recommended by manufacturer. If pulling more than one cable, bind them together with friction tape before applying grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.
- D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to conductors limited to 0.008 lbs. per circular mil of conductor cross-section area.
- E. Pull in cable from end having the sharpest bend (bend closest to reel). Keep pulling tension to minimum by liberal use of lubricant, turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one in pullhole during this operation.
- F. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.

- G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50 percent greater than specified above for training.
- H. Apply wire and cable pulling compound recommended by specific cable manufacturer.
- I. Seal cable ends unless splicing is done immediately.
- J. Support cables in pullholes, concrete trenches, and similar locations by cable racks. Secure to rack insulators with nylon cord or self-locking nylon cable ties. Place each cable on separate insulator.
- K. Follow manufacturer's instructions for splicing and cable terminations.

3.5 WIRING METHODS, GENERAL

- A. Install all wiring in raceways unless shown otherwise on the Drawings or authorized by the A/E.
- B. Install Wire After:
 - 1. Interior of building is protected from weather.
 - 2. Mechanical work likely to injure conductors is completed.
 - 3. Conduits have been cleaned and moisture removed.
- C. Neatly train and lace wiring inside boxes, equipment, and panel boards.
- D. Clean raceway system before installing conductors.
- E. Use half-lapped synthetic tape if taping is utilized for insulation purposes.
- F. Provide conductor support devices as required by NEC in vertical conduit runs.
- G. Torque conductor connections and terminations to manufacturer's recommended values.
- H. Maintain minimum 12-inch clearance between open cabling and heat sources such as flues, steam pipes, and heating appliances.

3.6 MINIMUM SIZES

- A. Minimum No. 12 AWG for power and lighting circuits.
- B. Minimum No. 14 AWG for control wiring.

3.7 CABLE INSTALLATION

- A. Support cable with bridle rings, drive rings, or Teflon cable ties. Support from conduit not acceptable.
 - 1. Install all exposed low voltage cable in conduit where it is visible.
- B. Protect exposed cables where subject to damage.

- C. Support cables above accessible ceilings. Do not rest on ceiling tiles.
- D. Use suitable cable fitting and connectors.

3.8 WIRING SPLICES AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Use compression-set pressure connectors with insulating covers or screw-on pressure (wire nuts) for wire splices and taps sizes No. 10 AWG and smaller.
- C. Use compression-set pressure connectors with insulating covers for wire splices and taps sizes No. 8 AWG and larger. Split bolt splices and connectors not acceptable.
- D. Except where equipment is furnished with bolted or screw type lug, use compression set pressure connectors with insulating covers for wire terminations.
- E. Tape un-insulated portions of conductor and connectors with electrical tape to 150 percent of conductor insulation value.
- F. Clean wires before installing lugs and connectors.
- G. Make splices, taps, and terminations to carry full capacity of conductors without perceptible temperature rise.
- H. Leave minimum 8 inches of pigtail at outlet boxes for connection to fixtures and devices. Where wiring is continued to other outlets, splice connection wire in a tap. In no case will continuity through double terminal of device be allowed for either hot or neutral leg of circuit.
- I. Insulate ends of spare conductors with electrical tape or wire nut.
- J. Terminate control circuit conductors at terminal blocks only.
- K. Utilize eye or forked tongue type compression set terminator for conductors No. 12 AWG and smaller when termination is to a bolted or screw set type terminal block or terminal cabinet.
- L. Make below grade splices in manholes watertight with epoxy resin type splicing kits similar to Scotchcast.

3.9 FIELD QUALITY CONTROL

- A. Test for Cables 600 Volts and Less: Comply with requirements in Section 26 08 00.
 - 1. After installation and prior to energization, test cable and wire for continuity of circuitry and for short circuits. Megger circuits of 100 Amp and greater rating. Correct malfunctions. Submit record of megohmmeter readings to A/E.
 - 2. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements of the Contract Documents.
 - 3. Inspect wire and cable for physical damage and proper connection.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes grounding requirements for underground metal water piping, gas piping, grounding electrodes, rods, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 0 1, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. IEEE C2, National Electrical Safety Code (NESC).
 - 2. IEEE 81, Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System Part 2: Normal Measurements.
 - 3. NFPA 70, National Electrical Code (NEC).
 - 4. UL 467, Standard for Grounding and Bonding Equipment.
- C. Comply with NEC and IEEE requirements as applicable to electrical grounding and ground fault protection systems.
- D. Products UL listed and labeled.
- E. Testing Agency Qualifications: Comply with requirements of 26 08 10 ELECTRICAL TESTING
 - 1. Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the International Electrical Testing Association and that is acceptable to the AHJ.
 - 2. Ground system resistance tests performed by an independent testing agency.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 1 and Section 26 05 00.

- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Submit manufacturer's technical product data for each item and appurtenance.
- D. Shop Drawings: Indicate layout of ground ring, location of system grounding electrode connections, and routing of grounding electrode conductor.
- E. Test Reports: Comply with requirements of 26 08 10.
 - 1. Field test reports.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Ground Rods: Sectional copper clad steel, conical points, threaded joints or couplings, 3/4 inch diameter by 10 foot long sections. Ground rods minimum 20 feet long (2 sections) at each location. Copper-Weld or approved.
- B. Ground Conductors: Soft drawn bare copper.
- C. Ground Conductor in Non-Metallic Conduits: Bare, stranded, annealed, copper.
- D. Ground Connections:
 - 1. Conductor to Conductors, Conductor to Steel, and Conductor to Ground Rod: Exothermic-welded type connectors. Cadweld, Thermoweld, or approved.
 - 2. Conductor to Water Service, Conductor to Bars, and Conductor to Grounding Lugs of Electrical Equipment: UL listed grounding terminal compression set on grounding conductor.
 - 3. When making bolted connection to aluminum and galvanized structures, apply corrosion-inhibitor to contact surfaces between cable, connector, and surface of structure. Penetrox A or approved.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.
- C. Preparation of Surfaces: Clean contacting surfaces of ground connections to bright metal before connecting.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 GROUNDING INSTALLATION

- A. Ground each separately-derived system neutral to nearest building steel.
- B. Bond together system neutrals, service equipment enclosures, exposed noncurrent carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, underground metal water piping systems, and gas piping systems.
- C. Install separate, insulated equipment grounding conductor in all feeders and branch circuits. Terminate each end on grounding lug, bus, and bushing and to intermediate metallic enclosures.
- D. Connect grounding conductors to motors in accordance with NEC. Remove paint, dirt, and other surface coverings at grounding conductor connection points so that good metal-to-metal contact is made.
- E. Bare Grounding Conductors Below Grade:
 - 1. Minimum 30 inches below top of soil.
 - 2. Not in contact with gravel fill and concrete unless making transition from connections above slab to conductors below grade.
 - 3. Neatly trained around foundations and footings.

- F. Ground shields of shielded power and control cable at each splice and termination as recommended by manufacturer.
- G. Ground metal sheathing and exposed vertical metal structural elements of building. Ground metal fences enclosing electrical equipment. Bond metal equipment platforms which support electrical equipment to equipment ground. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, instrument cabinets, raceways, and similar items carrying circuits to these devices.
- H. Grounding Connections:
 - 1. Provide full weld between coupling and ground rod at joint.
 - 2. Connect grounding conductors to ground rods at upper end of rod with end of rod and connection point below finished grade.
 - 3. When making Thermite welds, wire brush or file point of contact to bare metal surface. Use Thermite welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from the weld area and clean joint. Use connectors of specified size for conductors and ground rods. Notify A/E before backfilling ground connections.
 - 4. Where conditions are not suitable for exothermic welding, provide permanent, non-reversing mechanical connections.
- I. System ground not to exceed maximum 5 ohms meggered resistance.
- J. Size main grounding system per NEC. Provide conduit to protect ground wire from damage to an area 6 feet above floor.
- K. Install ground conductor in all non-metallic conduits.

3.5 FIELD QUALITY CONTROL

- A. Comply with requirements in Section 26 08 00 and 26 08 10.
- B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- C. Testing agency, approved by the Owner and the A/E, shall perform ground resistance testing of system. Perform test by means of fall-of-potential method. Maximum acceptable value 5 ohms.
 - 1. Testing Instrument: Battery-powered or hand-cranked AC tester.
 - a. Indicates ground resistance in ohms from digital decade switches when unit's self-contained meter indicates null condition.
 - b. Range: 0.01 to 9990 ohms in 4 overlapping ranges.
 - c. Null condition occurs when no current flows through potential electrodes.
 - d. Instrument accuracy: Plus 2 percent or greater.
 - 2. Fall-of-Potential Test:
 - a. Connect instrument according to manufacturer's instruction.
 - b. Place rod P2 at various locations in line between tested electrode and probe C2 and plot results on graph (distance vs. resistance). Take sufficient readings to

yield portion of plotted curve as being constant (rate of resistance change becomes so small with respect to distance as to be insignificant).

3. Conduct 2 separate tests on opposite sides of grounding grid.
 4. Report failure to obtain specified ground resistance to the A/E.
- D. Include field test reports of grounding system in the Operation and Maintenance Manual.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes conduit and equipment supports, fastening hardware, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Sections 26 05 00, and 26 05 48 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Submit manufacturer's technical product data for each item and appurtenance.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. General: Built-up framing for electrical raceway and equipment supporting systems, including but not limited to channel, rod, clamps, and hardware. Comply with requirements in Section 24 05 48 for seismic restraints. Unless design is shown on the Drawings, size for 400 percent of calculated load.

1. Channel: 12 gage galvanized formed metal with or without pre-drilled holes, epoxy coated. Cooper B-Line Dura Green, Unistrut, Powerstrut, or approved.
 2. Beam Clamps, in Pairs, at each Supporting (Structural) Beam: B-line B441-22 and B441-22A; Superstrut U-501 and U-502; Unistrut P2785, P2786, and P1379S, or approved. Submit other manufacturers for approval with evidence proving clamp complies with IBC and ASCE 7-05 for seismic requirements. Submitted proof can consist of letter signed and stamped by a professional engineer licensed in engineering in the state in which the Work is performed.
 3. Beam Clamps for Use with Rods: B-Line B751-J4, B751-J6, B751-J9, and B751-J12; Superstrut U-569; Unistrut P2824-6, P2824-9, and P2824-12, or approved. Submit other manufacturers for approval with evidence proving clamp complies with seismic requirements. Submitted proof can consist of letter signed and stamped by a professional engineer licensed in engineering in the state in which the Work is performed.
 4. Fittings for Attaching Channel-to-Channel for Built-Up Framing: Unistrut P6028, P6033, P6069, P6290, P6291, P6326, P6331, P6332, P6346, P6358A, P6359, P6381, P6382, P6726A, P6917, P6962, or approved.
 5. Connectors for Bracing: Unistrut P6186, P7097, P7098, P7100, P7101, P7108, P7109, P7110, P6546, or approved.
 6. Unless otherwise shown on the Drawings, attach connectors to vertical framing members with 2 bolts.
- B. Hardware, including Nuts (Locking Type), Bolts, and Set Screws: Corrosion resistant, designed for intended use.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 SUPPORTING DEVICES INSTALLATION

- A. Install diagonal bracing for trapeze support systems at 2 right angle planes to brace against:

1. Horizontal and torsional movement lateral seismic forces.
 2. Vertical (uplift) movement caused by vertical seismic forces.
 3. Horizontal distortions in conduit system caused by wire pulling.
- B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or beam clamps. Spring steel clips and clamps not acceptable.
- C. Install toggle bolts or hollow wall fasteners in hollow masonry, plaster, and gypsum board partitions and walls. Install expansion anchors or preset inserts in solid masonry walls, self-drilling anchors, and expansion anchors on concrete surfaces. Comply with requirements in Section 26 05 48 for seismic anchors.
- D. Do not fasten supports to piping, ductwork, mechanical equipment, and conduit.
- E. Powder actuated fasteners not acceptable.
- F. Drilling and welding to structural steel members not acceptable except as indicated on the Drawings.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under nuts.
- H. Free Standing Electrical Equipment: Bolt to concrete base with leveling channels. Comply with requirements in Section 26 05 00 for concrete base and Section 26 05 48 for seismic restraints.
- I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- J. Lighting Fixture Supports: Comply with requirements in Section 26 51 00.
- K. Conduit:
1. Perforated pipe straps, ceiling support wires, fixture support wire, and wires installed primarily to support single runs of conduit not acceptable.
 2. Install trapeze support systems for 2 or more parallel runs of conduit with 25 percent space (6 inches minimum) for future conduit runs.
 3. Welding conduit and conduit fittings to structure not acceptable.
 4. Space conduit so that conduit fittings are accessible to accommodate pulling or splicing.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes outlet, junction, and pull boxes and associated appurtenances required to enclose devices, permit pulling conductors, and for wire splices and branches.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NFPA 70, National Electrical Code (NEC).
 - 3. UL 514A, Metallic Outlet Boxes.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Submit manufacturer's technical product data for each type of outlet box and appurtenance.

PART 2 - PRODUCTS

2.1 OUTLET BOXES FOR INTERIOR WIRING

- A. General: Outlet and pull boxes pressed steel, zinc coated with plaster ring where applicable, minimum 4 inch size.
- B. Surface Metal Raceway: Boxes of same manufacturer and to match raceway. Boxes shall accommodate standard devices and device plates.
- C. Concrete and Masonry: Boxes for casting in concrete and mounting in masonry walls of type specifically designed for that purpose.
- D. Ceiling Outlet Boxes: Galvanized octagonal 4 inch, 1-1/2 inches deep (without fixture stud) and 2-1/8 inch deep (with fixture stud).
- E. Sheet Metal Boxes Larger than 12 Inches in any Dimension: Include hinged enclosure.

2.2 OUTLET BOXES FOR EXTERIOR WIRING

- A. General: Weather resistant and rain tight, with appropriate covers, gaskets, and screws.
- B. Above Grade: Outlet and junction boxes cast or malleable iron or cast of corrosion resistant alloy compatible with raceway to which they are connected. Pull boxes fabricated of hot dipped galvanized heavy gage steel. Boxes with gasketed covers.
- C. Below Grade: Where exposed to earth, boxes (handholes) constructed of precast concrete with size, configuration, cover, grates and reinforcing as required by particular installation. Utility Vault Co. or approved.

2.3 OUTLET BOXES CONTAINING MULTIPLE DEVICES

- A. Outlet Boxes Containing Emergency and Normal Devices: Permitted only with steel barriers manufactured especially for purpose of dividing outlet box into 2 completely separate compartments.
- B. Outlet Boxes Containing Multiple Devices and Wiring Rated over 150 Volts to Ground and Over 300 Volts between Conductors: Permitted only with steel barrier manufactured especially for purpose of dividing outlet box into separate compartments for each device having exposed live parts.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 COORDINATION OF OUTLET BOX LOCATIONS

- A. Locate as shown on the Drawings and as required to facilitate pulling. Limit number of bends per NEC.
- B. Coordinate spacing requirements, both on same side of wall and on back to back wall situations with Sound Consultant prior to rough-in and comply.
- C. Electrical box locations shown on the Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets before roughing in.
- D. Locate outlet boxes to allow access. If inaccessible, furnish, arrange, and pay for installation of access doors.
- E. Coordinate Work of this section with the Work of other sections and trades to avoid conflicts. Check and verify door swings and locations of built-in cabinets, plumbing, heating, and ventilating equipment.
- F. Install outlet boxes of sizes and at locations necessary to serve equipment furnished under this or other divisions of the specifications. Make final connections thereto. Outlet boxes required if equipment is furnished with pigtail for external connection, does not have space to accommodate branch circuit wiring, or requires wire with insulation rating different from branch circuit wiring. Review equipment Shop Drawings for required outlet locations.
- G. Where more than one outlet box is shown on the Drawings, and indicated to be at same elevation or one above the other, align them exactly on center lines horizontally or vertically. Relocate outlet boxes which are not so installed (including lighting, receptacle, power, signal, and temperature control outlets) at no additional cost to the Owner.
- H. Centered on Built-In Work: In the case of doors, cabinets, recessed or similar features, or where outlet boxes are centered between such features, such as between door jamb and cabinet, make these outlet box locations exact. Relocate outlet boxes which are not centered.
- I. Flush mount boxes with front edge of box or plaster ring even with finished surface of wall and ceiling, except those mounted above accessible ceilings and where surface mounting is permitted.
- J. Locate to maintain headroom and to present a neat appearance.

- K. Route conduit from switch and receptacle boxes in walls vertically to space above ceiling. Install junction box before horizontal run.
- L. Offset outlet boxes minimum of 24" horizontal separation between flush boxes mounted on opposite sides of acoustic rated common wall. Seal all recessed sides of outlet boxes with firestop putty pads.
- M. Install outlet boxes with minimum 6 inch horizontal separation between closest edges of flush boxes mounted on opposite sides of common wall.
- N. Ceiling Locations: Locate outlet either at corner joint or in center of a panel, whichever is closer to normal spacing. Locate outlet boxes in same room in same panel locations.
- O. Conceal outlet boxes for electric water coolers behind cooler unit housing.

3.5 OUTLET BOX INSTALLATION

- A. Anchor boxes so they will not shift or rock when devices are operated (including insertion and removal of cord caps).
- B. Firmly anchor flush outlet boxes directly or with concealed bracing to studs and joists.
- C. Close unused openings.
- D. Support boxes independently of conduit except for cast outlet boxes that are connected to 2 rigid metal conduits, both supported within 12 inches of outlet box.
- E. Use multiple-gang outlet boxes where 2 or more devices are mounted together. Do not use sectional boxes.
- F. Install blank covers or plates over outlet boxes that do not contain devices.
- G. In inaccessible ceiling areas, install outlet and junction boxes within 6 inches of recessed luminaire to be accessible through luminaire ceiling openings.
- H. Install recessed outlet boxes in finished areas. Secure outlet boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall and adjustable steel channel fasteners for flush ceiling outlet boxes.
- I. Install outlet boxes in walls without damaging wall insulation.
- J. Seal conduit boxes, telephone boxes, and similar items airtight with acoustical caulk where located in acoustical rated walls that are not fire rated.
- K. Install outlet boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for outlet boxes. Use outlet boxes with sufficient depth to permit conduit hubs to be located in masonry void space.
- L. Install pull boxes to be accessible after completion of building construction.

3.6 ELECTRICAL WORK IN COUNTERBACKS, MILLWORK, AND CASEWORK

- A. Install as shown on the Drawings. Furnish templates to other trades for drilling and cutting to ensure accurate location of electrical fixtures (outlets and devices) as verified with the A/E. Install wiring, devices, plates, and connections required by said fixtures.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes conduit, electrical metallic tubing, wireway, surface metal raceway, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. UL 1, Standard for Flexible Metal Conduit.
 - 2. UL 5, Standard for Surface Metal Raceways and Fittings.
 - 3. UL 6, Standard for Rigid Metal Conduit.
 - 4. UL 360, Standard for Liquid-Tight Flexible Steel Conduit.
 - 5. UL 514B, Standard for Conduit, Tubing, and Cable Fittings.
 - 6. UL 651, Standard for Schedule 40 and 80 Rigid PVC Conduit.
 - 7. UL 651A, Standard for Type EB and A Rigid PVC Conduit and HDPE Conduit.
 - 8. UL 797, Standard for Metallic Tubing – Steel.
 - 9. UL 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
 - 10. UL 1242, Standard for Intermediate Metal Conduit – Steel.
- C. NEC Compliance: Comply with applicable portions of NEC as to type of products used and installation of electrical power connections.
- D. Comply with applicable NEMA standards and refer to NEMA standards for definitions of terminology herein. Comply with NEC for workmanship and installation requirements of raceway systems.
- E. Manufacturers: Firms regularly engaged in manufacture of raceway systems of types and sizes specified and whose products have been in satisfactory use in similar service for not less than 3 years.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

A. Comply with requirements in Division 1 and Section 26 05 00.

B. Sustainable Design Submittals:

1. Comply with requirements of Section 01 81 13
2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

a. Include statement indicating costs for each product having recycled content.

C. Product Data: Submit manufacturer's technical product data for each type of raceway system and appurtenance.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (RMC) AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 6, hot-dip galvanized.

B. Fittings and Conduit Bodies: UL 514B, threaded galvanized.

2.2 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 1242, hot-dip galvanized.

B. Fittings and Conduit Bodies: UL 514B, threaded galvanized.

2.3 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 797, hot-dip galvanized.

B. Fittings: UL 514B, galvanized steel, insulated throat, raintight compression ring type through 1-1/4 inch, set screw type for 1-1/2 inch and larger. Drive-on type and cast fittings not acceptable.

C. Use of aluminum EMT not permitted.

2.4 FLEXIBLE METAL CONDUIT AND FITTINGS

A. Ferrous Metal Conduit: Steel, UL 1, galvanized. UL listed for grounding as available. Aluminum and flexible metallic tubing not acceptable.

B. Fittings: Insulated throat, UL 514B, galvanized steel, UL listed for grounding as available.

C. Use of aluminum Flexible Metal Conduit not permitted.

2.5 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Ferrous Metal Conduit: Galvanized with PVC weatherproof cover, UL 360 listed for grounding as available.
- B. Fittings: Insulated throat, UL 514B, galvanized steel, UL listed for grounding as available.

2.6 RIGID NON-METALLIC CONDUIT

- A. PVC Conduit: Schedule 40, UL 651, rigid type unless noted otherwise. UL 651A Type A permitted for underground concrete duct banks.
- B. Fittings: UL 651 and UL 651A.
 - 1. For electric (power) duct, 90 degree elbows factory manufactured PVC coated rigid steel with minimum 48 inch radius.
 - 2. For telephone and cable television duct, 90 degree elbows factory manufactured PVC coated rigid steel with minimum 60 inch radius.

2.7 SURFACE METAL RACEWAY

- A. UL 5, sheet metal channel with fitted cover. Type and size as shown on the Drawings.
- B. Finish: Enamel. Field paint to match wall color.
- C. Fittings, Boxes, and Extension Rings: Designed for use with raceway systems.
- D. All raceway and fittings to be supplied by one manufacturer.
- E. Manufacturers: Wiremold, or approved.

2.8 CONDUIT BODIES

- A. Conduit bodies cast malleable iron, zinc or cadmium plated with threaded connections. Covers gasketed, blank steel, or cast malleable iron, zinc or cadmium plated, and of same manufacturer as conduit body. Where conduit bodies are used as junction or splice boxes, comply with NEC.

2.9 WIREWAY AND AUXILIARY GUTTER

- A. UL 870, lay-in type, with hinged cover but without knockouts.
- B. Size: As shown on the Drawings, 4 by 4 inch minimum.
- C. Finish: Rust-inhibiting primer coat with manufacturer's standard enamel finish.

2.10 EXPANSION FITTINGS

- A. Malleable iron, hot-dip galvanized allowing 4 inches (plus or minus 2 inches) conduit movement. OZ/Gedney Type AX Series or approved.

2.11 SEALING FITTINGS

- A. Wall Sealing Fittings: At each wall sealing fitting, include conduit seal fitting, OZ/Gedney FSK Series, Crouse Hinds EYS Series, or approved.
- B. Raceway Stubups and Stubouts: Conduit seals together with wall sealing fittings. OZ/Gedney CSB Series or approved.
- C. For Exterior Wall Penetrations below Grade: Include sealing bushing at interior end of penetrating raceway. Only threaded fittings are permitted in entering raceways ahead of sealing bushing. OZ/Gedney Type CSB or approved.

2.12 CONDUIT SUPPORTS

- A. Conduit Clamps, Straps, and Supports: Steel or malleable iron. Comply with requirements in Section 26 05 29.

2.13 FIRE RATED SEALING COMPOUND

- A. Dow Corning 3-6548 Silicone RTV Foam or approved.
- B. 3M Fire Barrier Moldable Putty Stix MP+ or approved.
- C. 3M Fire Barrier Moldable Putty Pads MPP+ or approved.
- D. 3M Fire Barrier Pillows and Self-Locking Pillows or approved.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 RACEWAY SIZING, ARRANGEMENT, AND SUPPORT

- A. Unless otherwise shown on the Drawings, size conduit for conductor type installed. Minimum size 3/4 inch.
- B. Install conduit to maintain headroom and present neat appearance in unfinished spaces. Install a minimum of 9'-6" above finished floor in spaces unless otherwise indicated on the Contract Drawings.
- C. Install conduit concealed in walls, below floors, and above ceiling in spaces, except conduit may be exposed in mechanical rooms, electrical rooms, and similar unfinished spaces.
- D. Horizontal conduit installation is not allowed in floor slab unless specifically noted on electrical and structural Contract Drawings.
- E. Route conduit parallel and perpendicular to building planes.
- F. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, heating and hot water pipes, and heating appliances.
- G. Brace conduit or conduit supports to prevent distortion of alignment by wire-pulling operations.
- H. Where conduit is run in parallel, group on formed channel supports. Comply with requirements in Section 26 05 29.
- I. Do not fasten or support with wire or perforated pipe straps. Remove temporary conduit supports used during construction before conductors are pulled.
- J. Do not cut structural members for passage of raceway.

3.5 RACEWAY INSTALLATION

- A. Cut conduit square using a saw or pipe cutter. Deburr cut ends.
- B. Bring conduit to shoulder of fittings and couplings and tighten securely.
- C. Use conduit hubs for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.
- D. Do not use conduit bodies to make sharp changes in direction unless shown on the Drawings.
- E. Use hydraulic one-shot conduit bender or factory elbows for bends in 2 inch conduit and larger.
- F. Provide plastic bushings on conduit stubs used for transition from conduit to open cable runs.
- G. During construction, use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- H. Distance Between Supports:

1. Threaded Rigid Metal Raceways: Maximum 8 foot centers and within 18 inches of each outlet, junction box, and bend.
 2. Electrical Metallic Tubing: Maximum 8 foot centers at each bend and within 12 inches of each outlet, junction box, and coupling.
 3. Surface Metal Raceway, Auxiliary Gutter, and Wireway: Maximum 5 foot centers or in accordance with manufacturer's instruction, whichever is less, unless otherwise shown on the Drawings.
- I. Install nylon pull string with printed footage indicators secured at each end of each empty conduit, except sleeves and nipples. Identify with tags at each end origin and destination of each empty conduit.
- J. Route conduit through roof inside openings for ductwork where possible. Otherwise, install through roof jack and seal weather tight.
- K. Install no more than equivalent or four 90 degree bends between boxes.
- L. Avoid moisture traps where possible. Where unavoidable, install junction box with drain fitting at conduit low point.
- M. Raceway Installation below Slab on Grade and underground:
1. Install marker tape over underground raceway as specified in Section 26 05 53.
 2. Arrange and slope raceway entering building to drain away from building.
 3. Install insulated grounding bushings at conduits stubbed up or out from underground unless capped for future (spare).
 4. Wipe PVC conduit clean and dry before jointing. Apply full even coat of cement to entire area to be inserted into fitting. Let joint cure for minimum 20 minutes.
 5. Install conduit that stub up through floor at such depth that exposed conduit is vertical and no curved section of elbow is visible.
- N. Sealing of Conduit Penetrations:
1. Exterior Wall Surfaces above Grade: Seal around penetrations with caulking approved by the A/E. For concrete construction above ground level, cast conduit in wall or core drill wall and hard pack with mixture of equal parts of sand and cement.
 2. Exterior Wall Surfaces below Grade: Cast conduit into wall (and floor) or use manufactured seal assembly cast in place.
 3. Roofs: Install mopped and flashing roof jack and where conduit penetrates roof membrane.
 4. Fire Rated Construction: Seal penetrations with fire rated sealing compound to maintain fire rating of construction penetrated.
- O. Sealing of Raceways: Seal interior of raceways that pass through building roof and through outside walls of building, above or below grade. Seal on end inside building. Use raceway sealing fittings manufactured for purpose sealed with non-hardening, compound-type mastic, specially designed for such service. Pack around wires in raceways.
- P. Do not install conduit on exterior surface of building, except as shown on the Drawings and as approved by the A/E.
- Q. Where flexible metal or liquid tight flexible metal conduit is installed, install bonding conductor to insure electrical continuity of raceway. Route bonding jumper inside conduit and terminate at grounding bushing or grounding locknut installed on inside of junction boxes at each side of flexible section. In instances where this method is not feasible (such

as when cast boxes with hubs are used or where required by the NEC, route bonding jumper on outside of flexible conduit and terminate in accordance with methods acceptable to the AHJ.

- R. Raceway shall not penetrate sheet metal ducts unless approved by the A/E. Install sleeves for raceway installation.
- S. Install 6 spare 3/4 inch conduits (capped) from each recessed/flush mounted branch panelboard into ceiling space or mechanical platform if one exists. Extend conduits required distance necessary to reach accessible ceiling space.
- T. In finished areas with exposed structure, subject to the approval of the A/E, raceways may be installed exposed. Install raceways as high as possible, tight to the ceiling deck, and neatly arranged. Submit shop drawing indicating routing of proposed surface raceways and boxes in finished areas.
- U. At locations above first floor slab, conduit runs are not permitted within concrete slab. Route conduits in walls, above ceiling, and below floor. Install additional knockouts in floor boxes to serve them from below.

3.6 SURFACE METAL RACEWAY INSTALLATION

- A. Use flat-head screws to fasten channel to surfaces. Mount plumb and level.
- B. Install insulating bushings and inserts at connections to outlets and corner fittings.
- C. Maintain grounding continuity between raceway components for continuous grounding path.
- D. Fastener Option: Use manufacturer's standard clips and straps for installed purpose.

3.7 AUXILIARY GUTTER INSTALLATION

- A. Bolt auxiliary gutter to steel channels fastened to wall or in self-supporting structure. Install level.
- B. Gasket each joint in oil-tight gutter.
- C. Mount raintight gutter in horizontal position only.

3.8 UNDERGROUND DUCTBANK INSTALLATION

- A. Install top of duct bank at depth shown on the Drawings or minimum 24 inches below finished grade, whichever depth is deeper.
- B. Install conduit with minimum slope of 4 inches per 100 feet.
- C. Terminate conduit in end bell at manhole entries.
- D. Stagger conduit joints in concrete encasement minimum 6 inches.
- E. Use suitable separators and chairs installed not greater than 4 foot on center. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement.

- F. Provide minimum 3 inch concrete cover at bottom, top, and sides of duct bank.
- G. Do not use union-type fittings without approval of the A/E.
- H. Construction:
 - 1. When termination of duct is not detailed on the Drawings, extend duct 1'-0" beyond concrete encasement and end cap.
 - 2. Plug and cap ends of ducts to protect from damage during construction and at end of each day's concrete pour. Protect ends of conduits not used for long periods from dirt and rodents with wooden or manufactured plugs. Non-setting mastic may be used on plug to adhere to conduit end. Drill 1/4 inch hole in lower portion of plug for drainage of conduit.
 - 3. Swab ducts immediately upon completion of concrete pour. After cement has set, but before backfilling, pull mandrel having diameter equal to nominal conduit inside diameter, minus 1/2 inch, and not less than 12 inches long, through each duct. Mandrel lead-covered or painted white to indicate protrusion inside conduit which might injure cable sheath. Attach wire to rear end of swab mandrel to replace wire being pulled out. When not in use, fasten this wire securely at both ends of duct.
- I. Observation: Ducts will be reviewed by the Owner's Representative before pouring concrete. The Owner's Representative will review for backfill compaction, drainage slope, spacers, floatation ties, conduit condition, and joints. Concrete shall not be poured until the observation is complete.

3.9 RACEWAY SCHEDULE

- A. Rigid Metal Conduit:
 - 1. Acceptable in all locations except as modified in this section.
 - 2. Where in contact with earth or concrete, install protective coating consisting of spirally wrapped 20 mil PVC tape with 1/2 inch minimum overlap – 3M Scotchrap Tape 51 or approved - or utilize PVC Coated Rigid Metal Conduit. Completely wrap and tape field joints.
 - 3. Required for exposed raceways in areas subject to physical damage.
- B. PVC Coated Rigid Metal Conduit:
 - 1. Required in corrosive environments or where indicated on the Contract Drawings.
- C. Intermediate Metal Conduit:
 - 1. May be used in lieu of rigid metal conduit unless otherwise prohibited by code or indicated on the Contract Drawings.
 - 2. Not acceptable for circuits over 600 Volts.
- D. Electrical Metallic Tubing:
 - 1. Acceptable for dry interior locations where not exposed to moisture or physical damage.
 - 2. Not acceptable for circuits over 600 Volts.
- E. Rigid Non-Metallic Conduit:

1. Acceptable underground with minimum 24 inches of cover.
 2. Acceptable below concrete slab on grade installed a minimum of 2 inches below bottom of slab.
 3. Acceptable within masonry walls subject to approval by structural engineer.
 4. Not acceptable for raceways extending through concrete; utilize Rigid Metal Conduit.
 5. Not acceptable for bends 45 degrees and greater unless concrete encased; utilize Rigid Metal Conduit as specified herein or PVC Coated Rigid Metal Conduit. Field bends not acceptable.
 6. Concrete encased were indicated on Contract Drawings or where required by Code or Utility.
- F. Flexible Steel Conduit:
1. For connections to recessed light fixtures and devices installed in suspended ceilings, maximum six foot length.
 2. For connections to motors, transformers and other equipment subject to vibration. Minimum of three foot and maximum of six foot length with 90 degree loop.
- G. Liquid-Tight Flexible Metal Conduit.
1. For pump motors and equipment subject to vibration in damp and wet locations, in areas subject to being washed down, and for machinery where cutting oil is used. Minimum of three foot and maximum of six foot length with 90 degree loop.
- H. Surface Metal and Multi-Outlet Raceway: Install where indicated on the Contract Drawings.
- I. Auxiliary Gutters and Wireways: Install where indicated on the Contract Drawings and as required in unfinished spaces. Elsewhere as approved by the A/E.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes isolation pads, spring isolators, restrained spring isolators, restraint cables, hanger rod stiffeners, anchorage bushings and washers, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards: NFPA 70, National Electrical Code (NEC).
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 010.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation and seismic restraint device.

2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to the AHJ.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- D. Delegated-Design Submittal: For vibration isolation and seismic restraint details indicate to comply with performance requirements and design criteria, including analysis data signed and sealed by professional engineer responsible for their preparation.
1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors.
 - b. Comply with requirements in other Division 26 sections for equipment mounted outdoors.
 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 3. Field fabricated supports.
 4. Seismic Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to structure during seismic events. Indicate association with vibration isolation devices.
 - c. Preapproval and Evaluation Documentation: By agency acceptable to AHJ, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
- E. Welding certificates.
- F. Test Reports:
1. Field test reports.
 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.5 PERFORMANCE REQUIREMENTS

- A. General: A single supplier shall furnish isolation mounts, pads, seismic restraints, sway braces, related hardware, and fabricate isolation bases for the project unless otherwise specified.
- B. Responsibility: This supplier shall be responsible for selection and installation supervision of vibration isolators. Prepare engineering drawings and details and submit to the A/E. Perform installation supervision and provide adjustment instructions.
- C. Seismic Restraints:
 - 1. Design and select restraint devices for ducts, pipes, and equipment to meet seismic requirements defined in IBC and ASCE 7-05. Prepare calculations based on coefficients included on the structural drawings. Refer to the structural drawings for allowable methods and loads.
 - 2. Shop Drawings, details, and calculations shall be stamped and signed by a professional engineer licensed in engineering in the state in which the Work is performed.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Amber/Booth, California Dynamics Corporation, Kinetics Noise Control, Mason Industries, Vibro-Acoustics, Vibration Mountings & Controls, or approved.
- B. Isolation Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
- C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4 inch thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed. Factory-drilled baseplate bonded to 1/4 inch thick neoprene or rubber isolator pad attached to baseplate underside. Adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit-stop as required for equipment and AHJ.
3. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
4. Minimum Additional Travel: 50 percent of required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC RESTRAINT DEVICES

- A. Manufacturers: Amber/Booth, California Dynamics Corporation, Cooper B-Line, Hilti, Mason Industries, TOLCO, Unistrut, or approved.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements as defined in reports by an agency acceptable to AHJ.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components minimum 4 times maximum seismic forces to which they will be subjected.
- C. Restraint Cables: ASTM A 603 galvanized steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service. Include minimum 2 clamping bolts for cable engagement.
- D. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- E. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchors and studs.
- F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene with a flat washer face.
- H. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of 8 times diameter.
- I. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to the AHJ.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces. Welding stiffeners to rods not acceptable.
- C. Strength of Support and Seismic Restraint Assemblies: Select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.5 SEISMIC RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 3. Install seismic restraint devices using methods approved by agency acceptable to AHJ providing required submittals for component.
- B. Install bushing assemblies for mounting bolts for wall mounted equipment, arranged to provide resilient media where equipment or equipment mounting channels are attached to wall.

- C. Attachment to Structure: If specific attachment is not indicated on the Drawings, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, and at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the A/E if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, and grout has achieved full design strength.
 - 3. Mechanical Anchors: Protect threads from damage during anchor installation. Install sleeve anchors with sleeve fully engaged in structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from bottom of hole and progressing toward surface in such a manner as to avoid introduction of air pockets in adhesive.
 - 5. Set anchors to manufacturer's recommended torque using a torque wrench.

3.6 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections and branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.7 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Obtain the A/E's approval before transmitting test loads to structure. Install temporary load-spreading members.
 - 2. Test at least 4 of each type and size of installed anchors and fasteners selected by the A/E.
 - 3. Test to 90 percent of rated proof load of device.
 - 4. Measure isolator restraint clearance.
 - 5. Measure isolator deflection.
 - 6. Verify snubber minimum clearances.
 - 7. If a device fails test, modify installations of same type and retest until satisfactory results are achieved.
- B. Remove and replace malfunctioning units, provide new, and retest as specified above.
- C. Prepare test and inspection reports. Include copy of reports in the Operation and Maintenance Manual.

3.8 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes nameplates, wire and cable markers, conduit color coding, buried duct marking tape, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards: NFPA 70, National Electrical Code (NEC).

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Nameplate schedule.

PART 2 - PRODUCTS

2.1 IDENTIFICATION MATERIAL

- A. Nameplates:
 - 1. Engraved three-layer laminated plastic.

- a. Normal Power: White letters on black background.
 - b. Emergency Power: White letters on orange background.
2. Panelboards and Switchboards: 1/2 inch high letters to identify equipment designation. 1/4 inch high letters to identify voltage rating and source.
 3. Enclosed Circuit Breakers, Disconnect Switches, Motor Starters: 1/4 inch high letters to identify load served and source.
 4. Transformers: 1/2 inch high letters to identify equipment designation. 1/4 inch high letters to identify primary and secondary voltages, primary source, and secondary load and location.
 5. Automatic Transfer Switches: 1/2 inch high white letters to identify equipment designation, voltage rating, normal source, standby source and load served and location.
 6. Emergency Power Boxes and Enclosures larger than six inches by six inches. 1/2 inch high letters to identify equipment and source designation.
- B. All outlet boxes, junction boxes and pull boxes for emergency system devices and circuits shall be orange in color, both inside and outside.
- C. All outlet boxes, junction boxes and pull boxes for fire alarm system devices and conductors shall be red in color, both inside and outside.
- D. Permanent felt marker for junction and pull box circuit notation.
1. Normal Power: Black letters.
- E. Wire and Cable Markers:
1. Split sleeve or tubing type. Vinyl impregnated cloth, vinyl, and mylar self-adhesive types not acceptable.
 2. Color code wire in accordance with the coding shown in Decal Detail below. Conductors of power systems in this building (plant) are identified as follows:

Conductor	208Y/120 Volt	480/277 Volt
A Phase (Left Bus In Panel):	Black	Brown
B Phase (Center Bus In Panel):	Red	Orange
C Phase (Right Bus In Panel):	Blue	Yellow
Neutral:	White	Gray
Equipment Ground:	Green	Green
 3. Color Code 208Y/120V isolated/insulated ground circuits as follows:

Conductor	Color
Phase A	Black with yellow stripe
Phase B	Red with yellow stripe
Phase C	Blue with yellow stripe
Neutral-Phase A	White with black stripe
Neutral-Phase B	White with red stripe
Neutral-Phase C	White with blue stripe
Isolated Ground	Green with yellow stripe
Equipment Ground	Green
- F. Phase Identification: Vinyl colored electrical tape.
- G. Buried Duct Marking Tape:

1. Electrical (Power) Ducts: Six inch wide red tape with words "CAUTION - ELECTRIC LINE BURIED BELOW".
 2. Telephone Ducts: Six inch wide orange tape with the words "CAUTION- TELEPHONE LINE BURIED BELOW".
 3. Cable Television Ducts: Six inch wide orange tape with words "CAUTION - CABLE TV LINE BURIED BELOW".
- H. Electrical Hazard Marking Tape: Black and yellow striped vinyl 2" wide hazard tape, Identi-Tape #VH2BKY or equal.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. Description: Install, apply, erect, and perform work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, more stringent requirements govern.
- B. Nameplates:
1. Degrease and clean surfaces to receive nameplates .
 2. Install nameplates parallel to equipment lines.
 3. Secure nameplates to equipment fronts using screws or rivets. Adhesives not acceptable.
- C. Wire Identification:
1. Install wire markers on conductors in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.
 2. Install solid colored jackets for wire sizes smaller than number 8 AWG. Wire sizes larger than number 10 AWG may be taped at both ends and at pull and junction boxes with appropriate colored tape. Color coding tape to completely encircle conductor at least 3 inches wide.

- D. Decals: Install decal behind circuit breaker door where it can be easily seen when circuits are added.
- E. Felt Marker Identification: Apply on front of cover in non-finished areas, such as mechanical/electrical rooms, above ceilings, and similar locations, and on back of cover in finished areas.
- F. Provide black and yellow striped vinyl 2" wide hazard tape on floor and stencil "Electrical Hazard-Keep Clear" on floor, spaced as to not exceed 4 feet on center to identify code required clearance in front of electrical equipment including switchboards, panelboards, motor control centers, transformers, transfer switches, etc. in unfinished spaces such as electrical and mechanical rooms.
- G. Conduit Color Coding: Identify conduits containing medium-voltage cable (greater than 600 Volt) by painting exposed conduits with Orange Safety (FSC-12246) paint. Stencil legend "HIGH VOLTAGE" in Gloss Black (FSC-17038) paint at intervals not exceeding 15 feet at visible locations.

3.4 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 01 91 13 – General Commissioning Requirements and Section 26 08 00 – Commissioning of Electrical Systems. The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes preparation of fault (short-circuit) calculations for distribution system and protective device coordination study of distribution system as indicated on the Drawings to ensure that protective devices in system are coordinated. Study shall be based on actual devices installed.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. IEEE C57.109, IEEE Guide for Transformers Through-Fault Current Duration
 - 2. IEEE 141, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (IEEE Red Book).
 - 3. IEEE 241, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (IEEE Gray Book).
 - 4. IEEE 242, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (IEEE Buff Book).
- C. Qualifications: Fault calculations and protective device coordination study shall be prepared by electrical equipment manufacturer who furnishes incoming service equipment to building or an independent electrical engineer. In either case, calculations and study shall be stamped and signed by a professional engineer licensed in the state in which the Work is performed.

1.3 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Submit study outline.
- C. Initial Submittals:
 - 1. One-line diagram with each bus and node having a unique number indicating that fault calculation will be made at that point.
 - 2. Representative one-line diagram of distribution system (with bus numbers as described herein) indicating which devices will be presented in protective device coordination study.

- D. Following review and approval of the initial submittals by the A/E, submit final calculations and study in a common bound report.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The fault calculations and protective device study may be prepared with a network analyzer, digital computer, or by written calculations, but must include complete fault calculations for each proposed and ultimate source combination.
- B. Source combinations may include present and future power company supply circuits, large motors, and generators.
- C. Drawings and specifications indicate general requirements for electrical equipment being provided. Changes and additions may be suggested by results of study. Submit proposed changes and additions as a part of study.
- D. See Specification Section 26 24 13 paragraph 1.3, D., and Section 26 24 16 paragraphs 1.3, C., for Arc Flash Study requirements.

2.2 FAULT (SHORT CIRCUIT) CALCULATIONS

- A. Prepare description of calculation methods, assumptions, and base per unit quantities selected.
- B. Prepare one-line diagram(s) and source impedance data including X/R ratio and power company system characteristics.
- C. Prepare impedance diagrams, typical calculations, tabulations of calculation quantities, and results, conclusions, and recommendations.
- D. Prepare calculations of short circuit interrupting and momentary (when applicable) duties for an assumed 3 phase, bolted, fault at medium voltage switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear or switchboard lineup, motor control center, distribution panelboard, branch circuit panelboard, and other significant locations throughout system.
- E. Prepare ground fault current calculations for the same system areas including associated zero sequence impedance diagram.
- F. Prepare tabulations including fault impedance, X/R ratios, asymmetry factors, motor contributions, short circuit KVA, and symmetrical and asymmetrical fault currents.

2.3 PROTECTIVE DEVICE COORDINATION STUDY

- A. Prepare time-current coordination curves graphically indicating proposed coordination for system centered on 11 by 17 inch log-log forms.

- B. Include with each curve sheet a complete title and one-line diagram with legend identifying specific portions of system covered by that particular curve sheet.
- C. Include detailed description of each protective device identifying its type, function, manufacturer, device tap, time-dial, pick-up, instantaneous, and time-delay settings.
- D. Include on curve sheets power company relay and fuse characteristics, system medium-voltage equipment relay and fuse characteristics, low voltage equipment circuit breaker and fuse characteristics, pertinent transfer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices.
- E. Include, as a minimum, devices down to largest branch circuit and largest feeder circuit breaker in each motor control center.
- F. Include adjustable setting and ground fault protective devices.
- G. Include manufacturing tolerance and damage bands in plotted fuse characteristics.
- H. Show transformer full load, 150, 400, and 600 percent current, transformer magnetizing inrush, transformer withstand parameters according to IEEE C57.109, and significant symmetrical or asymmetrical fault current to which device is exposed.
- I. Select each primary protective device required for transformer winding configuration shown so that its operating band is within transformer characteristics including point equal to 59 percent of IEEE C57.109 to withstand point for secondary line-to-ground fault protection. Where primary device is not within transformer characteristics, show transformer damage curve.
- J. Separate transformer primary protective device characteristic curves by a 16 percent current margin for coordination and protection in event of secondary line-to-line faults. Separate medium voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.
- K. Prepare complete sets of individual protective device time-current coordination characteristics on transparencies.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Devices to be tested using primary current injection at rated ampacity.

3.2 ADJUSTING

- A. After review by the A/E, make revisions to protective device settings to accomplish conformance with approval fault calculations and protective device coordination study.

3.3 DEMONSTRATION

- A. Demonstrate to the A/E that correct device settings and ratings have been made. Include settings and ratings on the Record Drawings.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. System specific commissioning procedures
- B. Related Sections:
 - 1. The following sections specify commissioning activities for this project:
 - a. 01 91 13 – General Commissioning Requirements
 - 2. All sections related to the following commissioned systems may contain start-up, testing and/or commissioning related activities:
 - a. Lighting Control

1.2 DESCRIPTION OF WORK

- A. Work includes the completion and documentation of formal commissioning procedures by the Contractor on selected equipment and systems as listed under 1.1 B. Commissioning is defined as the process of verifying and documenting that the installation and performance of selected building systems meet the specified design criteria and therefore satisfies the design intent and the Owner's operational needs. The Contractor shall be responsible for participation in the commissioning process as outlined herein, and in subsequent sectional references and attachments throughout the project documents. Commissioning procedures shall be designed and conducted under the direction of the Commissioning Authority (CxA) and coordinated by the Contractor Commissioning Coordinator (CCC).
- B. This section contains the system specific commissioning requirements for the systems referenced herein.

PART 2 - PRODUCTS

- 2.1 Documentation requirements for the systems to be commissioned are specified in Section 01 91 13, Part 2 - Products

PART 3 - EXECUTION

- 3.1 Execution of the commissioning process for the systems to be commissioned is specified Section 01 91 13, Part 3 - Execution

SCHEDULE A – Start-up Plan , Contractor Checklists and Document Tracking

A Startup Plan shall be developed as outlined in Section 01 91 13. The Startup Plan shall include manufacturer's startup procedures and Contractor Checklists (CCL) as provided by the CxA.

Sample CCLs are included in this Schedule. The Contractor responsible for delivery of the equipment and appurtenances associated with the systems listed in Table – A shall be responsible for completion of the CCL for each individual piece of equipment in the system group. The CCLs included within this Schedule are sample versions and are representative of what will be included in the final Commissioning Plan.

The Contractor is responsible to demonstrate the proper operation of all installed systems and the final CCLs shall contain the requirements to document these demonstrations. In no case shall the checklists require performance criteria more stringent than specified by the Project Documents.

The CCC is responsible for collecting the completed CCLs and start-up documents and maintaining the Startup Plan during installation and startup activities. The CCC shall review the material for completeness, then sign off on the CCLs as an indication that documents are complete. Once all CCLs and start-up documents are received, they shall be turned over to the CxA.

The following Table - A identifies the CCLs and related documents that will be included in the final Startup Plan. Listed as subcategories below each system are the documents that will be required to be submitted as part of the system startup activities. This documentation includes installation, startup, static tests, certifications and other miscellaneous checklists. This table shall be used as a document tracking mechanism by the CxA, CCC and Contractor for the process of submittal, review and approval of installation and startup documents and CCLs. The table shall be included in the Startup Plan, which is a subset of the Commissioning Plan.

Table-A Key:

- A. System description for each system commissioned. A Contractor Checklist is included for each commissioned system. The subcategories include required documentation to be submitted with the CCL.
- B. Contractor responsible for installation, startup, testing and submittal of documents for commissioned system. To be filled in after contract award.
- C. Date the proposed documents are received by the CxA from the responsible Contractor. NOTE: These documents shall include, but are not limited to, procedures and forms to include such activities as: manufacturer's installation and start-up, pressure testing, TAB, cleaning, flushing and disinfection. The CCL is provided by the CxA.
- D. Indicates that CxA has received and approved proposed installation and start-up documentation.
- E. Date the completed documents are received by the CxA from the responsible Contractor.
- F. Indicates that CxA has received and approved completed documentation.
- G. Notes on status of forms, irregularities and rework needed

TABLE - A: SYSTEM SUMMARY AND DOCUMENTATION TRACKING

A	B	C	D	E	F	G
System Description	Responsible Contractor	Proposed Document Received	O K	Completed Document Received	O K	Notes
Documents Required						
Occupancy Sensors						
Manufacturer Start-up Documenta						
Contractor Checklist		CxA Provided				
Daylight Dimming/Switching Cont						
Manufacturer Start-up Documenta						
Contractor Checklist		CxA Provided				
Lighting Control System						
Manufacturer Start-up Documenta						
Point to Point Verification		CxA Provided				
Contractor Checklist		CxA Provided				

CITY OF KIRKLAND
FIRE STATION 27
Kirkland, washington

SECTION 26 08 00
Commissioning OF Electrical SYSTEMs

Notes:

Sample Contractor Checklist
 Power Monitoring System

Unit No:		Contractor:	
Location:		Serves:	
Manufacturer:		Model:	

Check	RC	CxA	Note
Equipment			
Area is cleaned and clear of construction debris.			
Unit is clean and has no visible physical damage.			
Equipment labels are installed per project documents.			
Unit is accessible for service.			
Mounting is appropriate.			
Meter readout is visible and per project documents.			
Electrical			
Supply power is installed and disconnect is accessible.			
Disconnect is labeled.			
Supply power is sourced per project documents (e-power).			
Current transformers oriented correctly and located per manufacturer's installation instructions.			
Voltage taps located per manufacturer's installation instructions.			
Wires labeled per project documents.			
Start-Up			
Manufacturer's installation and start-up procedures complete.			
Meter calibration complete and documented.			
Communication protocols set up and interface verified working correctly (ModBus, BacNet, LonWorks, IP address, etc.)			
Communication with Building Automation System and/or data acquisition and display system confirmed			
Start-up documentation submitted to CxA.			
Readiness			
System is ready for functional performance testing			
Representative photograph provided			

Sign-Off:

Team Member	Name	Date
Responsible Contractor (RC):		
Commissioning Authority (CxA):		

Notes:

SCHEDULE B – Functional Performance Tests

Functional Performance Tests

- 1 The draft versions of the Functional Performance Test and Verification Outline sheets contained in this Schedule define the individual systems to be tested and Contractor responsibilities based on the specific method of commissioning. These draft Functional Performance Test and Verification Outline sheets represent information available at the time of commissioning specification development. The final versions may be somewhat different and will be included within the Commissioning Plan as presented at the initial commissioning coordination meeting.
- 2 The methods of functional performance test and verification are listed in Table 1 of this Schedule. The Contractor will be responsible for supporting the testing activity as indicated. This may include developing the test plan and functional performance test forms for approval by the Commissioning Authority, performing testing to be witnessed by the CxA or providing support during functional performance testing conducted by the CxA or their sub-Authority.
- 3 Contract documents state that the Contractor is responsible to demonstrate that all systems comply with contract requirements and meet the project design intent. The scope of testing outlined in the following Functional Performance Test and Verification Outline sheets in this Schedule represent the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. If systems fail the initial tests additional testing may be required.
- 4 The following Test Summary Table identifies the functional tests that will be conducted on this project. This table will be used as a document tracking mechanism for the process of submittal and review of contractor provided testing documentation.
- 5 The contractor is responsible for submitting proposed functional test documentation to the Commissioning Authority for review and approval at least one month prior to these activities. It is the Contractor's responsibility to notify the Commissioning Authority in advance of the scheduled activity, testing or startup date. A minimum of 5 working days advance notification is required. If the CxA is not notified in advance of a scheduled start-up or testing activity, the start-up or testing shall be rescheduled and repeated to the satisfaction of the CxA.
- 6 The "Responsible Contractor" column of the table will be completed during the Initial Commissioning Coordination Meeting by assigning an individual Contractor responsible for the activities associated with each system based on what contractor provided that system.

TABLE – B: FUNCTIONAL TEST SUMMARY TABLE

A	B	C	D	E	F	G
System Description	Responsible Contractor	Proposed Test Forms Received	O K	Testing Complete	O K	Notes
Occupancy Sensors						
Daylight Dimming/Switch						
Lighting Control System						
Power Monitoring System						

Summary Table Key:

- A. System description for each system commissioned.
- B. Contractor responsible for providing testing. To be filled in after contract award.
- C. Date the proposed test forms are received by the CxA from the responsible Contractor (if applicable).
- D. Indicates that CxA has received and approved the proposed test forms.
- E. Date(s) testing was performed by contractor.
- F. Indicates that Commissioning Authority has witnessed and approved the testing and received all completed test forms.
- G. Notes on status of forms, irregularities and rework needed.

TABLE 1 – FUNCTIONAL TEST AND VERIFICATION METHODS

The following applies regardless of test method.

The contractor shall support the CxA during testing or verification, including but not limited to: scheduling and sequencing and adequate time for testing, on-site support during testing, testing instruments and equipment, setting up trend logs, providing access to equipment (including lifts), providing access to control systems both on-site and remotely.

The CxA shall do one or a combination of the following to verify contractor testing:

1. The CxA shall witness all or portions of the tests during contractor testing.
2. The CxA shall re-conduct the functional tests on all or portions of the systems using the same test plan and data sheets.
3. The contractor shall be required to duplicate some of the testing by demonstrating a percentage of the system as selected and witnessed by the CxA.

If during the verification process inconsistencies are found that demonstrate that the functional testing conducted by the contractor was not properly executed, the CxA shall suspend verification and the contractor shall be required to correct the problems and re-conduct the entire functional test and verification for the system(s) in question. Excessive test failures shall be subject to the back-charging provisions in Section 01 91 13.

Test Method A – Contractor Written and Conducted with CxA Oversight

The test plan and test data sheets are developed by the contractor responsible for the system and submitted to the CxA for approval. These can be the system manufacturer's stock test forms if appropriate. The CxA shall assist contractor in development of test forms if requested to do so. The contractor shall conduct the tests on 100% of the equipment per the plan, document results and submit completed test forms to the CxA for review and approval.

Test Method B – CxA Written and Conducted, Contractor Supports

The test plan and test data sheets are developed by the CxA. The CxA shall conduct the tests per the plan, document results and notify contractor of any issues found.

Test Method C – CxA Written, Contractor Conducts

The test plan and test data sheets are developed by the CxA. The CxA shall turn over the test plan and test data sheets to the contractor. The contractor shall conduct the tests on 100% of the equipment per the plan, document results and submit completed test forms to the CxA for review and approval.

LIGHTING CONTROL SYSTEM (CONTROLLER W/RELAY PANEL)
Functional Test and Verification Outline

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule-B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Will Sample or Witness
C.3	CxA	Contractor	100%	N/A

Functional Tests:

- 1) Lighting Controls – Demonstrate and document the following:
 - a) All features and functions of control panel
 - b) On/Off control
 - c) Battery operated emergency lighting on power failure
 - d) Dimming control
 - e) Manual overrides
 - f) Scheduling programming
 - g) Exterior photo eye or astrological clock function
 - h) Light zoning and channel verification

DAYLIGHT DIMMING/SWITCHING SENSORS Functional Test and Verification Outline

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule-B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Will Sample or Witness
C.3	CxA	Contractor	100%	N/A

Functional Tests:

- 1) Daylight Dimming – Demonstrate and document the following:
 - a) Operation of all features and functions
 - b) Sensitivity range
 - c) Light level control verification
 - d) On, Off and By-Pass Functions

OCCUPANCY SENSORS Functional Test and Verification Outline

The testing outlined below represents the minimum expected level of testing to be performed during commissioning. The contractor shall be required to conduct and document any tests as necessary to prove all systems comply with the design intent. Table 1 in Schedule-B details the various methods of accomplishing functional testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Will Sample or Witness
C.3	CxA	Contractor	100%	N/A

Functional Tests:

- 1) Occupancy Sensors – Demonstrate and document the following:
 - a) Operation of all features and functions
 - b) Sensitivity range
 - c) Time delay setting
 - d) On, Off and By-Pass Functions

PART 4 – SAMPLE FUNCTIONAL TEST DOCUMENTS

- 4.1 Sample functional test procedures and data forms are provided in this section to demonstrate the rigor of the process, test procedures and documentation that will be required from the contractor. These forms and procedures will be amended, augmented and updated in the final commissioning plan based on the final project documents, addendums and submittal information. **This sample section does not contain all functional test procedures and data forms that are required to be executed by the contractor.** Schedule - B of Part 3 provides a full list of the functional tests that will be required to be executed by the contractor.

Sample Draft Functional Performance Test

Lighting System Control - Time of Day Functions

Procedures:

1. Place the system in the scheduled-on mode.
2. Verify all zones and associated luminaries are on.
3. Place the system into the unscheduled-on mode.
4. Verify all zones and associated luminaries are off.
5. Schedule each zone off then on individually for short period, one after the other.
6. Verify each zone turns off in sequence.
7. Schedule all zones and associated luminaries off into the scheduled-off mode.
8. Program zone over-ride timer for 5 minutes.
9. Select a zone station in each zone and place that zone into the over-ride mode and verify associated zone and luminaries turn on.
10. Allow over-ride timer to time out and verify each zone turns off.

Data Sheet

Zone:	1	2	3	4	5	6	7	8
Zone is in the scheduled-on mode – All ON								
Zone is in the scheduled-off mode – All OFF								
Zone sequences with schedule								
Systems with Override:								
Zone is in the scheduled-off mode - OFF								
Over-ride zone - ON								
Zone OFF after over-ride time out								
Test Pass/Fail								

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Testing Contractor:			
CxA Witness/Verification:			

Comments:

Lighting System Control - Time of Day Functions with Photo Cell

Procedures:

1. Place the system in the scheduled-on mode with photo cell exposed to light.
2. Verify all zones and associated luminaries are off
3. Simulate dark conditions by blacking out photo cell.
4. Verify all zones and associated luminaries turn on.
5. Place the system in the scheduled-off mode with photo cell blacked out
6. Verify all zones and associated luminaries remain off.
7. Remove blackout from photo cell
8. Verify each zone and associated luminaries remain off.

Zone:	1	2	3	4	5	6	7	8
Zone is in the scheduled-on mode lit photo cell – All OFF								
Photo cell is blacked out – All ON								
Zone is in the scheduled-off mode photo cell dark – All OFF								
Photo cell blackout removed – All OFF								
Test Pass/Fail								

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Testing Contractor:			
CxA Witness/Verification:			

Comments:

Sample Functional Performance Test

Occupancy Sensor Control

1. Verify and record occupancy delay time.
2. Verify wall switches (if applicable) are on.
3. Wait till rooms are unoccupied and lights are off.
4. Enter room and verify lights are activated.
5. Leave the room and measure time delay until lights go out.

Room:						
Occupancy delay time setting (minutes)						
Lights off when unoccupied, record time						
Lights come on when room is entered						
Lights off after time delay, record time						
Calculated actual delay time						
Delay time acceptable						

Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 and Section 26 05 00 apply to Work in this section.

1.2 SECTION INCLUDES

- A. Work includes testing requirements for individual components, equipment, systems, and integration to ensure intended facility operation. Test equipment per manufacturer guidelines and industry standards. Test modes of operation and interlocks and alarm functions. This section presents a guideline of system testing. Provide complete, comprehensive testing in addition to minimum requirements specified in individual sections and in this section.
- B. Include comprehensive Owner operation and maintenance training of individual components, equipment, and systems. Training includes normal operation and alternate modes of operations.
 - 1. Provide video of all training sessions per Div. 01.

1.3 SUBMITTALS

- A. Provide submittals in accordance with Division 01 and Section 26 05 00.
- B. Submittal for this section shall be complete with all required information. Partial product submittals are not acceptable and will be returned unreviewed.
- C. Submittal shall be arranged under categories such as test reports, testing agency qualifications, certifications, and similar items. Include index with the submittals.
- D. Pre-construction Submittal:
 - 1. Qualifications:
 - a. Testing agency qualifications.
 - 2. Testing Plan and Schedule:
 - a. Detailed test plan and schedule of testing and training for acceptance by the Owner and the A/E prior to initiation of work.
 - 3. Test Procedures:
 - a. Test procedures and sample test forms.
- E. Test Report Submittal:

1. Submit detailed report of testing functions with associated results. Include date of testing and corresponding line item for system tested and individual components. Include testing checklists for each system and device tested. Include for each line item corrective work taken and retest date and confirmation. Include copy of reports in the Operation and Maintenance Manual.
- F. Certification: Certification that tests have been completed.
- G. Closeout Submittal:
1. Submit closeout documentation to the Owner's Representative and Architect or Engineer under provisions of Division 01, Section 26 05 00 and this section.
 2. Provide all project closeout documentation including but not limited to; test documentation, certification of completed tests and Operation and Maintenance Manuals.

1.4 QUALITY ASSURANCE

- A. Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
1. ANSI/NETA ATS 2009, Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
 2. ANSI/NETA MTS-2011, Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems.
 3. NFPA 70B, Recommended Practice for Electrical Equipment Maintenance.
 4. NFPA 70, National Electrical Code (NEC).
- C. Testing Agency:
1. Testing shall be accomplished by an approved testing agency. Retain services of a NETA certified firm or approved.
 2. Testing agency shall not be associated with manufacturer of equipment or systems under test.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 GENERAL

- A. Perform acceptance tests in accordance with manufacturer's recommendations, NFPA 70 and ANSI/NETA ATS.
- B. Report any system, material, or workmanship which is found defective on basis of electrical inspections and tests to the A/E.
- C. If test reveals a fault or problem, repeat entire test until problem is corrected. Submit additional written test reports.
- D. Maintain written record of tests. Upon completion of project, assemble and certify final test report and include in the Operation and Maintenance Manual. Compile field test reports signed by individuals performing the tests.

3.5 GENERAL COMPONENT AND EQUIPMENT TESTING REQUIREMENTS

- A. Phase Relationship Tests: Check connections to existing and new equipment for proper phase relationship. During such check, disconnect devices which could be damaged by application of voltage or reversed phase rotation.
- B. Grounding:
 - 1. Test each ground electrode system. Comply with requirements in Section 26 05 26.
 - 2. Visual and Continuity Test: Perform for each of the following ground connections:
 - a. Data ground busses.
 - b. Equipment ground connections.
 - c. Cable tray grounding.
- C. Feeders:
 - 1. After installation and prior to energization, test cable and wire for continuity of circuitry and for short circuits, Megger circuits of 100 Amp and greater. Correct malfunctions. Submit record of megohmmeter readings to the A/E.
 - 2. Inspect wire and cable for physical damage and proper connection.

3. Inspect ground conductor's installation to ensure ground terminations, jumpers, and devices have solid, mechanical connection.
 4. For circuits above 80 Amps, perform torque test for each conductor termination. Torque connections per manufacturer's recommendations and tabulate results.
- D. Overcurrent Protective Device Calibration:
1. Perform necessary field settings and adjustments to conform to the coordination study specified in Section 26 05 73.
- E. Overcurrent Protective Device Factory Tests:
1. Submit documentation of factory testing of distribution circuit breakers as specified in Section 26 28 13.
- F. Panelboards:
1. Inspect for physical damage, proper installation, supports, and grounding.
 2. Inspect cabinets for foreign objects. Clean exterior and interior of cabinets from dirt and dust.
 3. Verify neutrals are grounded only at main or separately derived service point.
 4. Check load balance of panelboards for load balance between phases and make adjustments to bring phases within 15 percent of average load.
- G. Receptacles:
1. Test for open ground, reversed polarity, open hot, open neutral, hot and ground reversed, and hot on neutral.

3.6 ELECTRICAL SYSTEM TESTING REQUIREMENTS

- A. Generator Paralleling Main Distribution Panelboard: Test as follows:
1. Test generator operation under building load through generator test initiation and through simulated utility power loss.
- B. Auto Transfer Switches: Test as follows:
1. Inspect equipment for signs of damage.
 2. Verify installation per the Contract Drawings.
 3. Inspect cabinets for foreign objects. Clean exterior and interior of cabinets from dirt and dust.
 4. Check control wiring connections for tightness.
 5. Check power wiring connections for tightness.
 6. Test manual transfer switches for proper switch operation.
 7. Check programmable transfer control settings.
 8. Test automatic switch operation under loss of power condition. Test for loss and restoration of power for each supply source.
 9. Test operation from remote controller input.
 10. Check transfer switch status monitoring at remote data monitoring system.
 11. Perform comprehensive Owner operation and maintenance training sessions.

3.7 SOLAR ENERGY ELECTRICAL POWER GENERATION TESTING

- A. Perform and comply with all field inspection and testing requirements as stated in 26 31 00 paragraph 3.2, A. and B.

3.8 LIGHTING CONTROLS TESTING

- A. Test lighting controls, components and systems in accordance with local codes, manufacturer recommendations.
- B. Test each device to confirm operation per manufacturer recommendations and design requirements.
- C. Document each component, device and system tested and include "as-left" settings for all adjustable settings. Include a matrix which identifies device, type and location at a minimum.

3.9 REPORTS

- A. Prepare test reports for each system, equipment and device tested. Include copy of each test report in the Operation and Maintenance Manual. Utilize test forms for systems and equipment tested. Use manufacturer's standard or other appropriate test forms commensurate with test performed. Test reports shall include the following.
 - 1. Summary of project.
 - 2. Description of equipment tested.
 - 3. Description of test.
 - 4. Test results including retesting results.
 - 5. Test dates.
 - 6. Tester's name.
 - 7. Witnesses (when required).
 - 8. Corrective work.
 - 9. Acceptance criteria.
 - 10. Conclusions and recommendations.
 - 11. Appendix including appropriate test forms.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes switchboards, disconnect switches, transformers, panelboards, and associated appurtenances used for service entrance equipment as specified in applicable Division 26 sections and are included as work of this section. Extent of service entrance work is indicated on the Drawings and schedules.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.
- C. Consult local utility company relative to costs for line extensions, connections, and similar requirements and include those costs for bringing service to facility in base bid. Confirm location of point of service before bidding.
- D. Include labor and materials required to accomplish local utility company metering in accordance with power company standards and requirements.
- E. Include concrete pads of size and type required for service transformers. Verify location, size, openings, reinforcing requirements with local utility company before beginning work. Comply with local utility company clearance requirements.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Comply with NEC and NEMA standards as applicable to construction and installation of service entrance equipment and accessories. Provide service entrance equipment and accessories which are UL listed and labeled, and equipment marked, "Suitable for use as Service Equipment".

1.3 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Product Data: Submit manufacturer's technical product data for service entrance equipment and appurtenances.
- C. Shop Drawings: Submit dimensioned layouts of service entrance equipment and spatial relationships to proximate equipment.
- D. Test Reports:
 - 1. Field test reports.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE EQUIPMENT

- A. General: Include service entrance equipment and accessories, of type, sizes, ratings, and electrical characteristics indicated on the Drawings, which comply with manufacturer's standard materials, design, and construction in accordance with published product information, as required for complete installation, and as specified in this section.

2.2 OVERCURRENT PROTECTIVE DEVICES

- A. Overcurrent Protective Devices: Comply with requirements in Section 26 28 13 and as indicated on the Drawings.
- B. Meter Sockets: Include remote meter sockets which comply with requirements of local utility company supplying electrical power to service entrance equipment of building project. Coordinate exact location of remote meter prior to bid and include costs in base bid.

2.3 RACEWAYS, WIRES, AND CABLES

- A. Raceways: Comply with requirements in Section 26 05 33.
- B. Wires and Cables: Comply with requirements in Section 26 05 19.
- C. Wall and Floor Seals: Comply with requirements in Section 26 05 33.

2.4 SWITCHBOARDS

- A. Comply with requirements in Section 26 24 13.

2.5 DISCONNECT SWITCHES

- A. Comply with requirements in Section 26 28 16.

2.6 PANELBOARDS

- A. Comply with requirements in Section 26 24 16.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 SERVICE ENTRANCE EQUIPMENT INSTALLATION

- A. Install service entrance equipment as indicated on the Drawings, in accordance with manufacturer's written instructions, and with recognized industry practices to ensure that service entrance equipment fulfills requirements. Comply with applicable installation requirements of NEC and NEMA standards.
- B. Coordination with other work, including local utility company wiring necessary to interface installation of service entrance equipment work with other work.
- C. Install floor standing service equipment on 4 inch high concrete pad. Comply with requirements in Section 26 05 00.

3.5 GROUNDING

- A. Install grounding and bonding connections for service entrance equipment and conductors. Comply with requirements in Section 26 05 26.

3.6 ADJUST AND CLEAN

- A. Adjust operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred enclosure surfaces to match original finishes.

3.7 FIELD QUALITY CONTROL

- A. Upon completion of installation of service entrance equipment and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Repair malfunctioning units on site, then retest to demonstrate compliance. If not possible to repair on site, remove and provide new units and retest. Include copy of field test reports in the Operation and Maintenance Manual.

END OF SECTION

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes free standing dead front type low-voltage service entrance, distribution and commercial metering switchboards and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1, and Sections 26 05 00 and 26 28 13 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards: Low voltage switchboards and components shall be designed, manufactured, and tested in accordance with the following standards:
 - 1. NEMA PB 2, Deadfront Distribution Switchboards.
 - 2. NFPA 70, National Electrical Code (NEC).
 - 3. UL 891, Standard for Dead-Front Switchboards.
- C. Manufacturer Qualifications:
 - 1. Manufacturer of assembly shall be manufacturer of circuit breakers within assembly.
 - 2. For equipment specified in this section, manufacturer shall be ISO 9000, 9001, or 9002 certified.
 - 3. Manufacturer of equipment shall have produced similar electrical equipment for minimum period of 5 years. When requested by the A/E, submit list of installations with similar equipment demonstrating compliance with this requirement.

1.3 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Submit AE approved submittal drawings to serving utility for approval prior to ordering. Comply with all serving utility requirements.
- C. Short Circuit Study: Obtain available fault current at point of connection from serving utility. Perform fault current study identifying available fault currents in excess of 14,000 Amps at switchboards, distribution panelboards and branch circuit panelboards. Provide documentation to demonstrate that all submitted equipment and protective devices meet or exceed available fault current at point of application. Study to be performed by licensed professional electrical engineer with at least ten years applicable experience.

- D. Arc-Flash Study: Perform an Arc-Flash Study in accordance with the NEC and Authority Having Jurisdiction to determine the incident energy exposure, the flash protection boundary, shock hazard approach limits and required PPE levels. Study to provide required data for approved arc flash warning labels on all switchboards, panelboards, disconnect switches and transfer switch. Provide and adhere Arc Flash labels to equipment.
- E. Product Data: Submit manufacturer's technical product data for each item and appurtenance as follows:
 - 1. Component list.
 - 2. Master nameplate schedule.
 - 3. Assembly Ratings Including:
 - a. Short circuit rating.
 - b. Voltage.
 - c. Continuous current.
 - 4. Major Component Ratings Including:
 - a. Voltage.
 - b. Continuous current.
 - c. Interrupting ratings.
 - 5. Cable termination sizes and types.
- F. Shop Drawings: Submit for each item as follows:
 - 1. Front view elevation.
 - 2. Plan view.
 - 3. Top view.
 - 4. Section.
 - 5. Shipping splits.
 - 6. Assembly data.
 - 7. Wiring diagrams.
 - 8. Single line schematic diagram.
 - 9. Conduit entry/exit locations.
 - 10. Access requirements if not all front accessible.
- G. Test Reports:
 - 1. Field test reports.
 - 2. Factory test reports.
 - 3. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Switchboards: Square D, Eaton, Siemens, General Electric or prior approved.

2.2 GENERAL:

- A. Disconnecting and overcurrent protective devices as indicated on the Contract Drawings and as specified herein.
- B. Entire assembly front accessible with main lugs or main device as shown on the Drawings. Rear accessible only allowed where space is indicated on Contract Drawings.
- C. Nominal Voltage Rating: As indicated on Contract Drawings
- D. Amperage Rating: As indicated on Contract Drawings.
- E. Short Circuit Withstand Rating: Braced to withstand short circuit rating indicated on Contract Drawings; minimum 100,000 Amps symmetrical.
- F. Short Circuit Interrupting Rating: Fully-rated for available fault current indicated on Contract Drawings; minimum 100,000 Amps symmetrical. Refer to Section 26 28 13 for additional requirements.
- G. Bus Bars: Silver-plated copper. Bus sizing based on NEMA standard temperature rise criteria of 65 C over 40 C ambient (outside enclosure)
 - 1. Horizontal Bus Bars: Fully-rated for switchboard ampacity entire length. Mounted with phases arranged in same vertical plane. Provide for future extensions from both ends.
 - 2. Neutral bus: Full capacity, unless indicated otherwise, installed entire length of switchboard.
 - 3. Ground bus: Minimum ¼ inch by 2 inches installed entire length of switchboard and secured to each vertical section structure.
- H. Enclosure – Indoor: Steel, NEMA 1. Finish: Exterior and interior steel surfaces of switchboard cleaned and furnished with rust-inhibiting phosphatized coating. Color and finish ANSI 61 light gray. Include pullbox on top of switchboard, where indicated on Contract Drawings or where approved. Barriers between adjacent switchboard sections.
- I. Control Accessories and Wiring: Type SIS, bundled and secured with nylon ties. Insulated locking spade terminals for control connections except where saddle type terminals are integral to device.
 - 1. Connect current transformer secondary leads to accessible short circuit terminal blocks before connecting to other devices.
 - 2. Provide terminal blocks with suitable numbering strips for groups of control wires leaving switchboard.
 - 3. Provide wire markers at each end of control wiring.
 - 4. Provide necessary fuse blocks and terminal blocks.
 - 5. Mark control components mounted within assembly, such as fuse blocks, relays, pushbuttons, switches, and similar components for identification corresponding to appropriate designations on manufacturer's wiring diagrams.
- J. Terminations: Compression lugs suitable for copper and aluminum cable rated for 75 C. Size for conductors as indicated on the Contract Drawings.
- K. Nameplates: For each and every instrument, protective device and disconnection device for the entire assembly. Nameplates shall designate item and circuit number and frame amp

size and appropriate trip rating. Submit master nameplate list indicating switchboard designation, voltage and ampere ratings, short circuit rating, manufacturer's name, general order number, and item number. Comply with requirements in Section 26 05 53.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES:

- A. General: Fusible switches or circuit breakers as indicated on Contract Drawings.
- B. Spaces for future disconnecting and overcurrent protective devices as indicated. Spaces shall include bus extensions and ancillary devices to allow for future device without additional modifications.
- C. Short circuit rating: Fully rated.
- D. Circuit breakers: Per Section 26 28 13.
 - 1. Circuit breakers 1200 Amps and larger: Individually-mounted, fixed insulated-case circuit breakers.
 - 2. Circuit breakers smaller than 1200 Amps: Group-mounted, fixed, molded-case circuit breakers.
- E. Bolted Pressure Switches:
 - 1. Main protective devices bolted pressure contact type. UL listed and labeled.
 - 2. Include fusible switches with Class L fuse clips. Switch contact interrupting capacity 12 times continuous rating of switch.
 - 3. Fuse access door mechanically interlocked with operating handle and with provisions for padlocking switch in open position.
 - 4. Switch with stored energy dead front operating mechanism compressed and released by operating handle for quick positive switching action independent of speed of operating handle.
 - 5. Switches manually operated or electrically tripped as indicated on the Contract Drawings. Electrically tripped switches designed to be closed only after opening spring has been charged, ready for electrical opening by solenoid or manual opening by mechanical pushbutton.
 - 6. Include electrically tripped switch(es) with the following accessories where indicated on the Drawings: Ground fault protection including test panel, single phase protection to open switch(es) upon loss of any phase from source, blown fuse protection to open switch upon blowing of one or more of fuses.
- F. Fusible Switches:
 - 1. Quick-make, quick-break.
 - 2. Switches with safety cover interlocks to prevent opening cover with switch in "ON" position or prevent placing switch in "ON" position with cover open. Include defeater for authorized personnel. Handles with provisions for padlocking and labels to indicate "ON" and "OFF" positions. Front cover doors padlockable in closed position. Fusible switches 30 through 600 Amp frames furnished with rejection Class "J" type fuse clips unless otherwise scheduled.
 - 3. Fusible switches 30 through 600 Amp frames furnished with rejection Class "J" type fuse clips unless otherwise scheduled.
 - 4. Fusible switches sized 800 through 1200 Amps furnished with Class L fuse clips. Include fusible switches with Class L fuse clips. Switch contact interrupting capacity 12 times continuous rating of switch.

5. Fusible switches sized 400 through 1200 Amps designed to accommodate UL listed shunt trip. Where shown on the Drawings, furnish the following accessories: UL listed 120 Volt AC shunt trip, zero sequence ground protection system including test panel, ground fault relay with separate time and current pick-up adjustments.
- G. Phase Failure Protection: Square D 8430MPD29 or approved.
 1. Include on bolted pressure switches, fusible switches and where indicated. Include relay with adjustable time delay to operate shunt trip or capacitor operated trip to open switch upon malfunction.
- H. Fuses: Per Section 26 28 13.

2.4 ELECTRONIC POWER MONITORING

- A. General: Integral microprocessor-based digital power monitoring system, wiring and appurtenances.
- B. Power Monitoring at Switchboard Main: Eaton/Cutler Hammer IQ Analyzer or equivalent with local display.
- C. Power Monitoring at Feeders, where indicated: Eaton/Cutler Hammer DP-4000 or equivalent, with local display.
- D. Controls and Networking: Provide with factory-wired CT's, PT's, power supplies, control wiring and ancillary devices. Configure for Mod-Bus interface with mechanical controls system.

2.5 SERVICE ENTRANCE RATED SWITCHBOARDS:

- A. Service-entrance listed and labeled.
- B. Where switchboard is utility-fed, utility metering compartment fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- C. Refer to Section 26 24 10 for additional requirements.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 SWITCHBOARD INSTALLATION

- A. Install on concrete housekeeping pad. Anchor to structure. Comply with requirements in Section 26 05 00 for concrete bases and Section 26 05 48 for seismic restraints.

3.5 FIELD QUALITY CONTROL

- A. Include copy of field test reports in the Operation and Maintenance Manual.

3.6 TRAINING

- A. Comply with requirements in Section 26 05 00.
- B. Perform training session for Owner's representative for 2 hours at jobsite location determined by the Owner.
- C. Conduct training session by a manufacturer's qualified representative. Training program shall consist of instruction on operation and location of assembly, circuit breakers, fused switches, meters, and major components within assembly.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes panelboards for lighting and appliances, distribution circuits, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Sections 26 05 00, and 26 28 13 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. NEMA PB-1, Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
 - 2. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 3. NFPA 70, National Electrical Code (NEC).
- C. Units UL listed and labeled. Comply with NEC as applicable to panelboards and cabinets. Comply with requirements in NEMA 1 and NEMA 250.

1.3 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Short Circuit Study: Obtain available fault current at point of connection from serving utility. Perform fault current study identifying available fault currents in excess of 14,000Amps at distribution panelboards and branch circuit panelboards. Provide documentation to demonstrate that all submitted equipment and protective devices meet or exceed available fault current at point of application. Study to be performed by licensed professional electrical engineer with at least ten years applicable experience.
- C. Arc-Flash Study: Perform an Arc-Flash Study in accordance with the NEC and Authority Having Jurisdiction to determine the incident energy exposure, the flash protection boundary, shock hazard approach limits and required PPE levels. Study to provide required data for approved arc flash warning labels on all switchboards, panelboards, disconnect switches and transfer switch. Provide and adhere Arc Flash labels to equipment.
- D. Product Data:
 - 1. Submit manufacturer's technical product data, installation instructions, maintenance data, and general recommendations for each type of panelboard and appurtenance.
 - 2. Include dimensioned drawings of panelboards and enclosures showing scaled layouts of enclosures and required individual panelboard devices, including circuit breakers,

fusible switches, fuses, ground-fault circuit interrupters, accessories, and similar items.

- E. Test Reports: Comply with requirements of 26 08 10.
 - 1. Field test reports.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.4 SPARE MATERIALS

- A. Deliver 6 keys for panelboard enclosures to the Owner.

PART 2 - PRODUCTS

2.1 PANELBOARDS

- A. Manufacturers: Square D or prior approved.
- B. General:
 - 1. Except as otherwise indicated on the Drawings, panelboards, enclosures and ancillary components of types, sizes, and ratings indicated. Include number of unit panelboard devices for complete installation. Include "spaces" with hardware to receive breaker or switch of size indicated. Include CU/AL rated lugs of size to accommodate conductors shown on the Drawings and specified in Section 26 05 19.
 - 2. Include separate ground busbar for panels supplying isolated ground circuits.
 - 3. Include feed through or double lugs with amperage equal to incoming feeder amperage unless indicated larger on the Drawings.
- C. Lighting and Appliance Panelboards: Dead-front safety type with switching and protective devices in quantities, ratings, types, and arrangement indicated on the Drawings. Include bolt-on thermal magnetic type branch breakers. For multiple breakers, include common trip handle. Include copper bus bars, full-sized neutral bus, ground bus, and isolated ground bus as required.
 - 1. Provide panelboards suitable for the available fault current. Provide fully rated.
- D. Service and Power Distribution Panelboards: Dead-front safety I-Line type with switching and protective devices in quantities, ratings, types and with arrangement indicated on the Drawings. Include copper bus bars, full-sized neutral bus, and ground bus. Include fusible or circuit breaker branch and main devices indicated on the Drawings. Comply with requirements in Section 26 28 13 for overcurrent protective devices.
- E. Load Centers: Not permitted.
- F. Panelboard Enclosures:
 - 1. Flush or surface as indicated on the Drawings. Tight closing doors without play when latched. Where 2 cabinets are located adjacent to each other in finished areas, include matching trim of same height.

2. Include lock for each cabinet door. Electrical distribution equipment locks common keyed.
 3. Door within door – Fasten panelboard front with machine screws. Provide continuous piano hinge on right side of outer door with door latches/locks on left side. Provide second door over dead front with continuous piano hinge on right side with door latches/locks on left side.
 4. Factory prime coat finish for cabinets located in finished areas. Where cabinets are located in unfinished areas, standard lacquer or enamel finish, gray or blue-gray color acceptable for factory finish coat.
- G. Identification: Comply with requirements in Section 26 05 53.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 PANELBOARD INSTALLATION

- A. Install panelboards and enclosures where indicated on the Drawings in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure products fulfill requirements.
- B. Secure in place with top of cabinet at 6'-0", unless otherwise noted on the Drawings. Top of cabinet and trim level. Anchor cabinets directly or with concealed bracing to building structure. When panels are not located in or directly on a wall, provide support frame of formed steel channel anchored to floor and ceiling structure. Interior components not installed until structure is totally enclosed. Where panels are mounted adjacent to each other, top edges at same height.

- C. Bolt floor standing distribution panelboards to concrete base. Comply with requirements in Section 26 05 00 for concrete bases and Section 26 05 48 for seismic restraints.

3.5 CIRCUIT INDEX

- A. For each branch circuit panelboard, prepare typewritten index listing each circuit in panelboard by number with load designation. Install within a transparent protective cover inside cabinet door. Listing shall match circuit breaker arrangements, typically with odd numbers on left and even numbers on right. Room numbers used shall be final room numbers used in building as verified with the Owner and not room numbers indicated on the Drawings.

3.6 FIELD QUALITY CONTROL

- A. Comply with requirements in Section 26 08 00. Include copy of field test reports in the Operation and Maintenance Manual.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections and Section 26 05 00, apply to this Section.

1.2 SUMMARY

- A. Section includes equipment for electricity metering by utility company.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated and per 26 05 00.
- B. Shop Drawings: For electricity-metering equipment.
 - 1. Dimensioned plans and sections or elevation layouts.
 - 2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION

- A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Meters will be furnished by utility company.
- B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.
- C. Meter Sockets: Comply with requirements of electrical-power utility company.
- D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with equipment installation requirements in NECA 1.
- B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

3.2 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes wall switches, receptacles, device plates, box covers, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. Federal Specification W-C-596, Electrical Power Connector, Plug, Receptacle, and Cable Outlet.
 - 2. Federal Specification W-S-896, Switch, Toggle.
 - 3. NEMA WD 1, General Color Requirements for Wiring Devices.
 - 4. NFPA 70, National Electrical Code (NEC).
 - 5. UL 498, Standard for Attachment Plugs and Receptacles.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Submit manufacturer's technical product data for each type of
- D. wiring device and appurtenance.

- E. Provide plate engraving schedule.
- F. Test Reports:
 - 1. Field test reports.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Manufacturers: Leviton, Bryant Electric, General Electric, Hubbell, Pass and Seymour, or approved. Leviton model numbers are listed.
- B. Finish: White.
- C. Wall Switches for Lighting Circuits: NEMA WD 1. General use snap switch with white colored toggle handle rated 20 Amps and 120/277 Volts AC. Switch with back and side wired screw type terminals. Units specification grade.
 - 1. Single-Pole Toggle Switch: Leviton Model 1221-2.
 - 2. Double-Pole Toggle Switch: Leviton Model 1222-2.
 - 3. Three-Way Toggle Switch: Leviton Model 1223-2.
 - 4. Four-Way Toggle Switch: Leviton Model 1224-2.
- D. Key Type Switches: Rating same as for wall switches:
 - 1. Single-Pole Key Switch: xxxx
 - 2. Double-Pole Key Switch: xxxx
 - 3. Three-Way Key Switch: xxxx
 - 4. Four-Way Key Switch: xxxx
- E. Pilot Light Type: Red pilot handle. Handle lighted when switch is ON. Rating same as for wall switches. Leviton Model 1221-PLR (120V)/1221-7PR (277V).
- F. Momentary Contact Line Voltage Switches: Single pole, double throw, 3-wire, normally open. Rating same as for wall switches. Leviton Model 1257.
- G. Weatherproof: Switches mounted in a cast metal box with gasketed, weatherproof device plate.

2.2 LOW VOLTAGE CONTROL

- A. Manufacturer: General Electric, Square-D, Cutler Hammer, Siemens, or approved.
 - 1. Relays: General Electric Type RR-7.
 - 2. Switches: General Electric Type RTS-5.
 - 3. Transformers: General Electric Type RT1 and RT2.
 - 4. Rectifiers: General Electric Type RA16.
 - 5. Device Plates: As specified in Article "Device Plates."
 - 6. Finish: White.

- B. Wire: Copper conductor for low voltage control purpose furnished by supplier of low voltage relays and switches.

2.3 RECEPTACLES

- A. Manufacturers: Leviton, Bryant Electric, Crouse Hinds, General Electric, Hubbell, Pass and Seymour, or approved. Leviton model numbers are listed.
- B. Finish: White.
- C. Convenience and Straight-Blade Receptacles: NEMA WD 1. Units specification grade.
 - 1. Provide for 10 extra duplex receptacles with 50' of 3/4" conduit and 2 #12 AWG CU & 1#12 G. for each.
- D. Convenience Receptacle Configuration:
 - 1. Duplex Receptacle: (20A-125V NEMA 5-20R), straight blade grounding type. Leviton Model 5362.
 - 2. Single Receptacle: Leviton Model 5361.
 - 3. Isolated Ground Duplex Receptacles: Leviton Model 5362-IG.
 - 4. Controlled Duplex Receptacles: Leviton Model 5362-S2. Provide in color blue.
- E. Weatherproof Receptacles: Receptacles mounted in a cast steel box with gasketed, weatherproof device plate. Leviton W7899-TRW.
- F. Specific Receptacle Configuration: NEMA WD 1. Type as indicated on the Drawings, with black plastic face.
- G. GFCI Receptacles: Duplex convenience receptacle with integral ground fault circuit interrupter. Units feed-through type for downstream device protection. Leviton Model N7899.
 - 1. Provide for 10 extra GFCI duplex receptacles with 50' of 3/4" conduit and 2 #12 AWG CU & 1#12 G. for each.
- H. Tamper Resistant Receptacles:
 - 1. Leviton Model 5362-SG.
 - 2. Provide for 25 extra duplex tamper resistant receptacles with 50' of 3/4" conduit and 2 #12 AWG CU & 1#12 G. for each.
- I. Tamper Resistant GFCI Receptacles:
 - 1. Leviton Model X7899
 - 2. Provide for 20 extra GFCI duplex receptacles with 50' of 3/4" conduit and 2 #12 AWG CU & 1#12 G. for each.

2.4 DEVICE PLATES

- A. Manufacturers: Bryant Electric, Hubbell, Leviton, Pass and Seymour, or approved. Bryant Electric and Leviton model numbers are listed.

- B. Plates in Finished Areas: Type 302 non-magnetic stainless steel except as noted below:
 - 1. Wall plates for isolated ground receptacles to be with 1/4 inch specially engraved black letters "COMPUTER ONLY".
 - 2. Wall plates for emergency receptacles with 1/4 inch red letters "EMERGENCY". Leviton 84003-E40.
 - 3. Wall plates for dedicated receptacles with 1/4 inch specially engraved black letters "DEDICATED".
 - 4. Wall plates for receptacles protected by a GFCI circuit breaker or feed through GFCI receptacle with 1/4 inch black letters "GFCI PROTECTED". Bryant Electric S601 GFP.
 - 5. Wall plates for receptacles other than NEMA 5-20R with 1/4 inch specially engraved black letters which show ampere rating, voltage, and phase.
- C. Plates on Surface Mounted Boxes: Sized to fit box without extending over sides of box.
- D. Cast Metal Plates: Cast metal box. Steel plates with steel boxes and copper-free aluminum with aluminum boxes. Stainless steel screws.
- E. Raised Sheet Steel Plates: 1/2 inch high zinc or cad-plated covers with surface mounted sheet steel boxes.
- F. Weatherproof Cover Plate: Cast metal with hinged gasketed device covers. Leviton M5979-GY.
- G. Finish of Attachment Screws: Match that of its respective device plate.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 WIRING DEVICE INSTALLATION

- A. Install wiring devices in clean electrical boxes, free from excess building materials, dirt, and debris.
- B. Install jumbo size plates for outlets in masonry walls.
- C. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- D. Install devices and wall plates flush and level.
- E. Fasten each device to outlet box at wall surface to bring receptacle flush with plate or for switch handle the proper distance through plate.

3.5 ORIENTATION

- A. Install switches vertical with handle operating vertically, up position "ON". Install center at 44 inches above finished floor unless noted otherwise on the Drawings.
- B. Install receptacles vertical with ground slot down centered at 18 inches above finished floor and 6 inches above counters.
- C. Install exterior receptacles horizontal at 18 inches above finished grade.

3.6 RECEPTACLE GROUNDING

- A. Install bare bonding wire between receptacle grounding terminal and box. Plaster ear screws connecting frame to box not acceptable for grounding

3.7 HANDICAPPED ACCESS

- A. Comply with requirements of Washington State Handicapped Access Code.

3.8 FIELD QUALITY CONTROL

- A. Comply with requirements in Section 26 08 00. Include copy of field test reports in the Operation and Maintenance Manual.
- B. Prior to energizing circuitry, test wiring devices for electrical continuity and polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes overcurrent protective devices for operation at 600 Volts and below, including circuit breakers and fuses as individual components in separate enclosures and for installation as integral components of switchboards and panelboards and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards: NFPA 70, National Electrical Code (NEC).
- C. Comply with NEMA and ANSI standards as applicable to construction and installation of overcurrent protective devices.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Submit manufacturer's technical product data on overcurrent protective devices, including catalog cuts, time-current trip characteristic curves, and mounting requirements.
- D. Shop Drawings: Include layouts of circuit breakers with spatial relationships to proximate equipment.

- E. Test Reports: Comply with requirements of 26 08 10.
 - 1. Field test reports.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.5 EXTRA MATERIALS

- A. Fuses: For each type and rating, furnish additional fuses amounting to 1 unit for every 5 units installed, but not less than 2 units of each size and type.
- B. Spare Fuse Cabinet: Provide one, sized to house spare fuses provided under this contract plus 25% additional space for future.
- C. Electronic Trip Unit Test Set: Furnish one set, including associated software, capable of testing all circuit breakers.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Circuit Breakers: Circuit breaker manufacturer shall be same as panelboard and switchboard manufacturer when installed therein.
- B. Fusible Circuit Breakers: Bussmann Mfg. Co.
- C. Fuses: Bussmann Mfg. Co. or Ferraz Shawmut. No substitutions. Fuses shall be by one manufacturer.

2.2 CIRCUIT BREAKERS

- A. General:
 - 1. Fixed mounted molded case type with unless indicated otherwise.
 - 2. overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication.
 - 3. Common trip for two and three pole Circuit breakers. Handles permitted on approval of samples.
 - 4. Trip ratings imprinted on handle or visible through deadfront cover.
 - 5. Constructed for mounting and operating in any physical position and calibrated for operation in ambient temperature up to 40 C.
 - 6. Mechanical screw type removable connector lugs, AL/CU rated, to accommodate conductors specified. Rated for 75 C conductors for 60 Amp and larger circuit breakers.
 - 7. Amperage and Voltage as indicated.
 - 8. Short circuit rating: RMS interrupting rating as indicated. Minimum 10,000 AIC rating at 120, 208 and 240 Volts. Minimum 14,000 AIC rating at 277 and 480 Volts.
 - 9. Ground Fault Interrupter (GFI) circuit breakers: Equipped with integral Class B ground fault interrupter set to trip on ground fault of thirty milliamps or greater. Adjustable settings shall not exceed 1200 amperes.
 - 10. Ground Fault Circuit Interrupter (GFCI) circuit breakers: Equipped with integral Class A ground fault circuit interrupter set to trip on ground fault of six milliamps or greater.

11. Arc Fault Circuit Interrupter (AFCI) where indicated.
12. Switching rated for 120 Volt and 277 Volt lighting branch circuits.
13. HACR rating where serving air conditioning and refrigeration equipment.
14. Current limiting, utilizing non-fuse type current limiting, where indicated.
15. Tandem-mounted circuit breakers not acceptable.
16. Minimum Frame Size: To match trip rating, unless indicated otherwise.
17. Keyed Interlocks: Externally-mounted to prohibit circuit breaker operation. Provide nameplates at each keyed interlock indicating interlocked circuit breaker and sequence of operation.
18. Zone-Selective Interlocking: Integral with ground fault trip unit for interlocking ground fault protection function.

B. Insulated Case Circuit Breakers:

1. Individually –mounted fixed type.
2. Electronic trip unit.

C. Trip Units:

1. Thermal magnetic unless indicated otherwise. Adjustable magnetic trip setting for sizes 250 Amps and larger.
2. Electronic trip unit: where indicated, specified or required by Selective Coordination Study.
3. Electronic Trip Unit: Field-replaceable rating plug, RMS sensing Adjustable settings: Instantaneous trip; long and short-time time adjustments; long and short-time pickup adjustments; where ground fault protection indicated, ground fault pickup level, time delay and I²t response. Built-in test points for testing the long time, short time, delay, instantaneous, and ground fault functions of the circuit breaker. Required for circuit breakers:
 - a. Sized 400 Amps and larger on 480 Volt systems.
 - b. Sized 800 Amps and larger on systems 250 Volts and lower.
 - c. Sized 100 Amps and larger serving emergency and legally-required standby systems and equipment.
 - d. Where indicated.
 - e. Where required by the Selective Coordination Study.

2.3 FUSES

A. General:

1. Fuses of type, sizes, ratings, and electrical characteristics of single manufacturer.
2. Fuses labeled UL Class L, UL Class R, current limiting, rated for up to 200,000 Amps.

B. Where fuses are shown on the Drawings feeding individual or groups of equipment items, comply with manufacturer's recommendation for fusing. Adjust fuse size and type to comply with manufacturer's recommendation.

C. Main Service, Feeder and Branch Circuit Fuses:

1. For fuse ratings over 600 Amps: UL Class L (KRP-C or A4BY).
2. For fuse ratings up to 600 Amps: UL Class J.
3. Feeder or branch circuit directly feeding motors, transformers, and other inductive load: UL RK5 time delay (FRN-R, FRS-R or TR-R or TRS-R).

4. Other Branch Circuits: UL Class RK1, (KTN-R, KTS-R or A2K-R, A6K-R).

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 CIRCUIT BREAKERS

- A. Install in panelboards, switchboards and enclosures, in accordance with the manufacturer's recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards.
- B. Adjust circuit breaker settings in accordance with the Selective Coordination Study report.

3.5 FUSES

- A. Install fuses in switches, panelboards, switchboards and enclosures. Install fuses so current rating is visible from front when cover is open.
- B. Do not install until equipment is ready to be energized.
- C. Coordinate with equipment furnished by others for proper fuse type and size.
- D. For motor and equipment circuits, fuse sizes shown on the Contract Drawings are for general guidance only. Size fuses in accordance with fuse manufacturer's recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) for nuisance free tripping. Adjust fuse size for ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times.

3.6 FIELD QUALITY CONTROL

- A. Test circuit breakers as specified in Section 26 08 00.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes disconnect switches, enclosed circuit breakers and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. NFPA 70, National Electrical Code (NEC).
 - 2. UL 98, Enclosed and Dead-Front Switches.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Submit manufacturer's technical product data and maintenance data for each type of equipment and appurtenance. Include equipment characteristics such as ratings, enclosure type, dimensions and weight.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Disconnect Switches and Enclosed Circuit Breakers: Manufacturer shall be same as panelboard and switchboard manufacturer, unless prior approved.

2.2 GENERAL

- A. Ratings: Voltage, Amperage and horsepower rating suitable for circuit and equipment controlled. Service entrance rated where indicated or required.
- B. Enclosures: Surface-mounted.
 - 1. NEMA Type 1, in general.
 - 2. NEMA Type 3R where exposed to moisture and where shown on the Drawings.
- C. Accessories:
 - 1. Padlockable in "OFF" position.
 - 2. Labeled "ON"/"OFF" position.
 - 3. Ground lug.
 - 4. Neutral lug where applicable.
 - 5. Other accessories as indicated.
- D. Nameplates: Per Section 26 05 53.

2.3 DISCONNECT SWITCHES

- A. General: Heavy duty, UL 98, horsepower rated with external handle.
- B. Interlock: Defeatable door interlock that prevent door from opening when operating handle is in "ON" position.
- C. Fusible or non-fusible as indicated. Fuse rejection clips where Class R fuses are specified.
- D. Quick-make, quick-break mechanism. Visible blades.

2.4 ENCLOSED CIRCUIT BREAKERS

- A. Circuit Breaker: Thermal magnetic circuit breaker per Section 26 28 13. One form "C" auxiliary contact activated when circuit breaker open.
- B. Short Circuit Interrupting Rating: Fully-rated for available fault current indicated; 42,000 Amps symmetrical minimum.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Comply with applicable requirements of NEC, NEMA and NECA standards, and with recognized industry practice. Where these may be in conflict, the more stringent requirements govern.
- B. Install where indicated on the Contract Drawings and where required. Mount independent of equipment served; do not attach to equipment served.
- C. Coordinate installation work with electrical raceway, wire, and cable work as necessary for proper interface. Comply with requirements in Section 26 05 33.
- D. Install within sight of equipment or controller served.
- E. Where locations are not shown on Contract Drawings, locate on wall adjacent to equipment being served or on formed steel channel frame at face of equipment. Coordinate location to maintain equipment clearances.

3.4 FIELD QUALITY CONTROL

- A. Comply with requirements in Section 26 08 00 and 26 08 10. Include copy of field test reports in the Operation and Maintenance Manual.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes motor controls for electrical motor driven equipment and associated appurtenances. Refer to Section 26 05 11 for electrical mechanical coordination and responsibilities.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Section 26 05 00, and 26 05 11 apply to Work of this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Code and Standards:
 - 1. NFPA 70, National Electrical Code (NEC).
 - 2. UL 98, Enclosed and Dead-Front Switches.
 - 3. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
 - 4. UL 508, Industrial Control Equipment.
- C. Comply with NEMA for appropriate size of motor protection. For units not using NEMA rating, use equivalent NEMA size.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: For each type and size of motor controller and appurtenance.

- D. Shop Drawings: Wiring diagrams for each type and size of motor controller.

1.5 SPARE MATERIALS

- A. Include 1 spare starter coil for each starter size specified.

1.6 MOTOR VOLTAGE INFORMATION

- A. Voltages Available: 115, 208 and 277 Volt, single phase and 208 and 480 Volt, 3 phase.
- B. Circuits Designed (in general) for Motors as Follows:
 - 1. Smaller than 3/4 HP: 115, 208 Volts, single phase.
 - 2. 3/4 HP and Larger: 208 Volts, 3 phase.
- C. Verify motor sizes and voltages provided under other divisions and notify the A/E if any discrepancies are noted.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Size starters as indicated on the Drawings and specified in this section. Coordinate starter sizes with associated motors and furnish starters matched to motor horsepower.

2.2 MANUFACTURERS

- A. Manufacturers: Cerus Industrial Building Automation Starter, Square D, BAS Franklin Control Systems, Allen-Bradley. No substitutions.

2.3 MOTOR STARTERS

- A. Magnetic Motor Starter:
 - 1. General: NEMA rated. NEMA size rated for motor horsepower or as indicated, NEMA size 1 minimum. Full-voltage, non-reversing (FVNR), unless indicated otherwise. Full-voltage, non-reversing (FVNR), unless indicated otherwise.
 - 2. Enclosure: Surface-mounted, NEMA 1 enclosure for indoor and NEMA 3R for locations subject to moisture, unless indicated otherwise.
 - 3. Contactor and Overload Relay: Contactor with minimum 1 NO and 1 NC auxiliary contact and solid state electronic overload relay to protect all phases with field adjustable current setting and trip class for specific motor full load amps. Overload relay with phase failure, phase loss, locked rotor, and stall protection. Include manual reset pushbutton on starter cover to restore normal operation after trip or fault condition.
 - 4. Integral Control Power Transformer: 50 VA capacity with circuit breaker protected secondary selected for available line voltage and maximum 120 Volt control voltage.
 - 5. Automation System Control: Include remote run terminals in starter to accept voltage input signal and contact closure. Input voltage shall accept 24 VAC, 120 VAC, 24 VDC, and 48 VDC to allow direct connection of input signal to starter.

6. Interlocks: Where motor is interlocked with a control damper or control valve, actuator control shall reside within starter enclosure. Starter shall provide voltage output to operate actuator without closing motor circuit. Starter shall close motor circuit and start motor upon receipt of contact closure from limit or end switch confirming control damper or control valve position.
 7. Fireman's Override Operation: Include to allow starter to run in any mode (HAND, OFF, or AUTO) regardless of other inputs or lack of inputs, either manual or automatic. Fireman's override shall have priority over emergency shutdown input.
 8. Starter Control by Fire Alarm or Life Safety System: Include emergency shutdown input to disable starter from operating in "HAND" or "AUTO" mode regardless of other inputs, either manual or automatic.
- B. Combination Magnetic Starter: Include magnetic motor starter requirements previously specified and a disconnecting method by means of motor circuit protection, UL 489 circuit breaker, or fused disconnect. Include disconnect with lock-out mechanism when starter is in "OFF" position. Disconnecting method as follows:
1. Current limiting manual motor starter with magnetic trip elements, UL 508 listed. Breaker with UL 508 Type F rating for maximum 100 Amp frame size. Coordinate short circuit rating for use with motor contactor with 30,000 AIC minimum interrupting rating for combination starter.
 2. Fused disconnect with time delay J-style fuses, UL 98 suitable for service entrance protection.
 3. UL 489 breaker with thermal and magnetic mechanisms.
- C. Manual Motor Starter:
1. Horsepower-rated toggle switch type, lockable in "OFF" position to function as motor disconnect. Include thermal overload protection, run status pilot light, and fault pilot light for operation in both manual and automatic control modes. In automatic mode, starter shall integrate with building automation system with terminals within starter for run input, run status output, and fault output. Include interposing run relay and current sensing status output relay within surface mounted enclosure with electronic solid state overload relays, red "RUNNING" pilot light, nameplate, and enclosure.
 2. Enclosures: Surface-mounted, NEMA 1 enclosure for indoor and NEMA 3R for locations subject to moisture, unless indicated otherwise.
- D. Pushbuttons, Selector Switches, Pilot Lights, and Similar Devices: Include "HAND", "OFF", "AUTO" operation switch and watertight and dust-tight LED pilot lights for "HAND", "OFF", "AUTO", "RUN", and "OVERLOAD" conditions.
- E. Overload Relays: Electronic solid state, sized for nameplate ampacity of motor served.

2.4 ADDITIONAL FEATURES

- A. Include the following features to meet design performance:
1. Over and under voltage and phase monitoring, field adjustable for over and under voltage levels. Include time delay before returning to normal operation after trip occurrence.
 2. Measure and display output current on front cover.
 3. Monitor and calculate power consumption (kWh) of motor load and display kW and kWh. Include pulse output (kWh) or 4 to 20 mA analog signal (kW) to automation system to monitor power consumption.

4. Communication to automation system over BACnet MS/TP to report starter mode, terminal input status, run status, and fault status, voltage, current, power factor, kW, and kWh.
- B. Power Factor Correction: Include capacitors for motors 25 horsepower and larger. Size to bring power factor to within range of 0.9 to 0.95. Capacitors fused type with blown fuse indicators mounted on front of starter enclosure. Include discharge resistors when required by NEC.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 MOTOR CONTROLLER INSTALLATION

- A. Install generally in location shown on the Drawings with exact location chosen to provide necessary code clearances and to preserve maintenance access.
- B. In finished areas, install motor protection switches flush and provide suitable stainless steel coverplates.
- C. Install on steel frame anchored to the structure adjacent to, but independent of equipment served. Do not fasten to motor, mechanical equipment enclosure, or related supports.
- D. For roof-mounted or exterior side-mounted equipment, coordinate supports with architectural and structural to maintain roof/exterior envelope integrity. Submit shop drawings.
- E. Check for proper motor rotation and reconnect conductors as necessary to provide proper rotation.
- F. Comply with requirements in Section 26 05 53 for nameplates.
- G. Install fuses in fuseholder so fuse size is visible.

- H. Prior to air and water system balancing, verify overload relays match motor nameplate rating. After balancing, adjust overload settings to match actual motor current.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. This section specifies the bidder design, furnishing, installation, connection, testing, and commissioning of solar energy electrical power generation systems. Design and provide a complete and functional photovoltaic system as specified and as shown on the drawings. The system shall include photovoltaic cells, string inverters, disconnects, combiner box, grid tie, metering, wire and conduit and all other equipment and installation necessary for a complete and fully functional solar photovoltaic system.
- B. The requirements of this Section apply to all sections of Division 26 related to solar energy electrical power generation systems. Drawings and general provisions of the Contract, including General and Supplemental Conditions, Division 1 and Section 26 05 00 apply to Work in this section.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS: General construction practices.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES: Submittals.
- C. Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS: General requirements for commissioning.
- D. Section 26 05 00, GENERAL ELECTRICAL PROVISIONS: Requirements that apply to all sections of Division 26.
- E. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS: Requirements for low-voltage conductors.
- F. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and requirements for providing a low impedance path for possible ground fault currents.
- G. Section 26 05 33, RACEWAY SYSTEMS: Requirements for boxes, conduits, and raceways.
- H. Section 26 08 00, COMMISSIONING OF ELECTRICAL SYSTEMS: Requirements for commissioning the electrical system, subsystems, and equipment.
- I. Section 26 08 10, ELECTRICAL TESTING: Requirements for testing the electrical system, subsystems and equipment.
- J. Section 26 28 16 DISCONNECT SWITCHES AND ENCLOSED CIRCUIT BREAKERS: Requirements for enclosed disconnect switches.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet

the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

- B. Review Section 26 05 00 for all requirements. Provide all documentation required to comply with Credit EA 5 Renewable Energy Production for the 5% renewable energy (2 points for (except Core and Shell)). This requirement is a minimum. The Contract Document requirements are based on a Bidder Designed 25kW system. Provide the larger of the two.

1.4 DEFINITIONS

- A. Unless otherwise specified or indicated, electrical and electronics terminology used in these specifications, and on the drawings, shall be as defined in IEEE 100 CD.
- B. Unless otherwise specified or indicated, solar energy conversion and solar photovoltaic energy system terminology used in these specifications, and on the drawings, shall be as defined in ASTM E772.

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable City, County and State codes and ordinances.
- B. Codes and Standards:
 - 1. NFPA 70, National Electrical Code (NEC)
 - 2. UL 1741
 - 3. IEEE 929
 - 4. Local Codes
- C. Comply with the current applicable codes, ordinances and regulations of the authority or authorities having jurisdiction, the rules, regulations and requirements of the utility companies serving the project and the Owner's insurance underwriter.
- D. Products and Services pertaining to this specification shall comply with Section 26 05 00, GENERAL ELECTRICAL PROVISIONS.
- E. Solar Energy Electrical Power Generation System designer(s)/installer(s) shall demonstrate that they have successfully installed at least four projects within the past five years that, in aggregate, equal or exceed the size of the proposed project. References shall be provided for each of the referenced qualified projects. Solar installer shall be NABCEP Certified PV Installation Professional.
- F. Solar installation contractor shall provide electrical design prepared under the seal of a licensed Professional Electrical Engineer. Electrical design to reference current equipment approved by submittal and installed. Contractor to submit to area having jurisdiction for all required plan review and permits.
- G. Supports and racking for solar photovoltaic system designs shall be prepared under the seal of a licensed Professional Structural Engineer (PE). Where applicable, such as roof top installations, the engineer shall also provide adequate review and structural analysis of the existing structure that will be supporting the proposed solar photovoltaic system. Among the documents that shall be submitted by the engineer are environmental loading analyses (including wind, snow, hail, and where applicable, seismic) and the rack and substrate's ability

to withstand these environmental forces. In the instance where the rack is installed on the ground, adequate information shall be presented to demonstrate the earth's ability to support the proposed design.

- H. If paralleling arrangement is desired, the system shall have anti-islanding capability such that it is incapable of exporting power to the utility distribution system in the absence of utility power. Paralleling must be approved by serving electric utility. Provide written correspondence from the utility confirming its requirements.
- I. Investigate any other local ordinances that may apply to installation of a solar energy electrical generating system in the proposed location. Bring any conflicts with the drawings and specifications to the attention of the design team.
- J. Warranties: The solar energy electrical generating system shall be subject to the terms of FAR Clause 52.246-21, except that the warranty period shall be as noted for the items below:
 - 1. Solar photovoltaic modules and inverter: 25 year manufacturer's warranty against defects in materials and workmanship.
 - 2. Power output: 25 year manufacturer's power output warranty, with the first 10 years at 90% minimum rated power output and the balance of the 25 years at 80% minimum rated power output.

1.6 SUBMITTALS

- A. Where proposed system shall be a Net Meter project, prepare appropriate applications and submittal. Provide written documentation confirming the utility's approval of the interconnection of the solar energy electrical power generation system with the utility system.
- B. Design Study: Submit a study which evaluates and determines the best orientation and slope of the solar panel arrays. The study shall examine and evaluate the associated energy production (kWh) for mounting at 10 deg. on the essentially flat roof deck for peak operation. Study shall include average bi-annual (Summer and Winter) energy production and energy cost savings for panels set at the optimum orientation and for 5 degrees above and 5 degrees below the optimum angle and orientation to illustrate that the best orientation has been found. The Study shall make final recommendations for the best orientation that will net the highest utility cost savings. The Study shall take into consideration the adjacent obstructions and typical local weather conditions such as typical occurrences of fog or high clouds. In the condition that all panel arrays are not all in the same orientation, the Study shall address any impacts this may have on the overall system performance.
- C. Sustainable Design Submittals:
 - 1. Product Data for Credit EA 5: Provide as required by 2019 LEED v4 BD C.
 - 2. Calculations for Credit EA 5: Provide as required by 2019 LEED v4 BD C.
- D. Submittals shall comply with paragraph, SUBMITTALS, in Section 26 05 00, GENERAL ELECTRICAL PROVISIONS, and the following requirements:
 - 1. Shop Drawings:
 - a. Submit sufficient information to demonstrate compliance with drawings and specifications.

- b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, wiring and connection diagrams, accessories, and nameplate data.
 - c. Include shop drawings for racking and other support structures.
2. Product Data:
 - a. Include detailed information for components of the solar energy electrical generation system.
3. Wiring.
4. Inverter(s).
5. Photovoltaic modules.
6. Rack and support assemblies.
7. Instrumentation.
8. Switchgear.
9. DC and AC disconnects.
10. Combiner boxes.
11. Rapid Shutdown.
12. Online Monitoring systems.
13. Manuals:
 - a. Submit, upon substantial completion with the As-Built shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
14. Safety precautions.
15. Operator restart.
16. Startup, shutdown, and post-shutdown procedures.
17. Normal operations.
18. Emergency operations.
19. Environmental conditions.
20. Preventive maintenance plan and schedule.
21. Troubleshooting guides and diagnostic techniques.
22. Wiring and control diagrams.
23. Maintenance and repair procedures.
24. Removal and replacement instructions.
25. Tracking systems (where applicable).
26. Spare parts and supply list.
27. Parts identification.
28. Testing equipment and special tool information.
29. Warranty information.
30. Testing and performance data.
31. Contractor information.
 - a. If changes have been made to the maintenance and operating manuals originally submitted, then submit updated maintenance and operating manuals two weeks prior to the final inspection.
32. Certifications: Two weeks prior to final inspection, submit the following.
 - a. Certification by the manufacturers of all major items of the solar energy electric generation system that the system conforms to the requirements of the drawings and specifications, and that they have jointly coordinated and properly integrated their equipment and controls to provide a complete and functional installation.

- b. Certification by the Contractor that the solar energy electric generation system has been properly installed, adjusted, tested, commissioned, and warranted. Contractor shall make all necessary field measurements and investigations to ensure that the equipment and assemblies meet contract requirements.
33. Estimated Annual Power Output: Submit calculated annual power output for each of the proposed solar photovoltaic systems. Provide independent calculations for each array.
- E. If equipment submitted differs in arrangement from that shown on the drawings, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract and acceptable to submittal review approval.
 - F. Submittals and shop drawings for independent but related items shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group. Final review and approval will be made only by groups.
 - G. Solar installation contractor to prepare, request needed signatures and submit on behalf of owner for available grants, incentive and subsidies. Provide support and direction to applicants.
 - H. Solar installation contractor to prepare, request needed signatures and submit on behalf of owner to utility for Net Metering, Interconnection and incentive certification as applicable. Solar contractor to receive written approval to construct prior to beginning work. Upon completion and receipt of final electrical inspection approval from the AHJ, solar contractor to order solar meters and track status until meters are installed and system is complete and operational. Notification when meters are installed shall be provided to facility operator.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - 1. E772-15 Standard Terminology of Solar Energy Conversion
 - 2. E1038-15 Standard Test Method for Determining Resistance of Photovoltaic Modules to Hail by Impact with Propelled Ice Balls
- C. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. CD-13 The Authoritative Dictionary of IEEE Standards Terms
 - 2. 519-14 Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
 - 3. 937-07 Recommended Practice for Installation and Maintenance of Lead-Acid Batteries for Photovoltaic (PV) Systems
 - 4. 1013-07 Recommended Practice for Sizing Lead-Acid Batteries for Stand-Alone Photovoltaic (PV) Systems
 - 5. 1361-14 Guide for Selection, Charging, Test and Evaluation of Lead-Acid Batteries Used in Stand-Alone Photovoltaic (PV) Systems
 - 6. 1526-03 Recommended Practice for Testing the Performance of Stand-Alone Photovoltaic Systems

7. 1547-03 Standard for Interconnecting Distributed Resources with Electric Power Systems
 8. 1561-07 Guide for Optimizing the Performance and Life of Lead-Acid Batteries in Remote Hybrid Systems
 9. 1562-07 Guide for Array and Battery Sizing in Stand-Alone Photovoltaic (PV) Systems
 10. 1661-07 Guide for Test and Evaluation of Lead-Acid Batteries Used in Photovoltaic (PV) Hybrid Power Systems
- D. International Code Council (ICC):
1. IBC-15 International Building Code
 2. IFC-15 International Fire Code
- E. National Electrical Manufacturer's Association (NEMA):
1. 250-14 Enclosures for Electrical Equipment (1000 Volts Maximum)
- F. National Fire Protection Association (NFPA):
1. 70-17 National Electrical Code (NEC)
- G. Underwriters Laboratories (UL):
1. 6-07 Electrical Rigid Metal Conduit – Steel
 2. 94-13 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Ed 6
 3. 797-07 Electrical Metallic Tubing – Steel
 4. 969-17 Standard for Marking and Labeling Systems
 5. 1242-14 Standard for Electrical Intermediate Metal Conduit – Steel
 6. 1703-02 Standard for Flat-Plate Photovoltaic Modules and Panels
 7. 1741-10 Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources

1.8 IDENTIFICATION

- A. Provide an identification nameplate for each photovoltaic inverter and each feeder overcurrent protection device.
- B. Provide additional markings and identification of equipment as required by NEC 690.13 and 690.51 through 690.56.

1.9 COORDINATION

- A. Coordinate layout and installation of PV system and accessories with other roof-mounted equipment.
- B. Coordinate and communicate the final approved PV panel mounting conditions, orientation and tilt angle with the project structural engineer. Coordinate final support detailing with structural engineer.
- C. Coordinate installation of equipment supports and roof/wall penetrations. These items are specified in other Divisions of the specifications.

- D. Coordinate size and location of housekeeping bases and support points.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide materials to fabricate functioning photovoltaic system in accordance with NEC, Electric Utility, AHJ, ASTM, IEEE, NEMA, NFPA, and UL, as specified in this section, and as shown on the drawings.
- B. Factory-prefabricated solar equipment packages which include photovoltaic modules, inverters, racking and controls and which meet the requirements of this section are acceptable.

2.2 GROUNDING

- A. All applicable components of the solar energy electrical power generating system must be grounded per latest NEC requirements.
- B. DC Ground-Fault Protector:
 - 1. Shall be listed per UL 1703.
 - 2. Shall comply with requirements of the NEC.

2.3 SWITCH/DISCONNECTING MEANS

- A. Shall be UL-listed, in accordance with the NEC, as shown on the drawings, and as specified.
- B. Utility External Disconnect Switch as several states do not require UEDS for small solar photovoltaic systems if the inverter provides the same function per NEC. Coordinate requirements with serving electric utility.

2.4 WIRING SPECIALTIES

- A. Direct Current Conductors:
 - 1. If Exposed: Shall be PV Wire or USE-2, UF (inadequate at 60°C [140°F]), or SE, 90°C [194°F] wet-location rated and sunlight-resistant (usually for tracking modules).
 - 2. If in Conduit: Shall be RHW-2, THWN-2, or XHHW-2 90°C [194°F], wet-location rated.
- B. Conduits and Raceways:
 - 1. Shall use steel conduit listed per UL 6, UL 1242, UL 797 (as appropriate), except for tracking modules. Weathertight EMT installations shall be allowed for DC wiring in weather-protected areas.
 - 2. Shall use expansion joints on long conduit runs.
 - 3. Shall not be installed on photovoltaic modules.
- C. Enclosures subject to weather shall be rated NEMA 3R or better.
- D. Cable Assemblies and Junction Boxes:

1. Shall be UL-listed.
2. Shall be rated to 5VA flammability per UL 94.

E. Prohibited Wiring Materials: Those which are not UL-listed, or listed materials used in environments outside those covered in their listing.

2.5 DC-AC INVERTER

- A. Inverters shall be one SolarEdge SE14.4KUS and one SolarEdge SE 9KUS or latest equal models. No substitutions.
- B. Shall be listed to UL 1741.
- C. Shall comply with IEEE 519 and IEEE 1547.
- D. Shall be listed per FCC Part 15 Class A.1.
- E. Shall have stand-alone, utility-interactive, or combined capabilities.
- F. Shall include maximum power point tracking (MPPT) features.
- G. Shall include anti-islanding protection if paralleling arrangement is required.
- H. Shall include compatible Power Optimizer for specified solar module providing rapid shutdown requirement for current NEC code.

2.6 SOLAR PHOTOVOLTAIC (PV) MODULES

- A. Solar Modules shall be LG405W or latest equal model. No Substitutions.
- B. Minimum Performance Parameters as per IBC 1509.7.4, IRC M2302.3, UL 1703.
- C. Photovoltaic Panel Types:
 1. Monocrystalline: Listed to UL 1703.
- D. Module and System Identification
 1. Module or Panel:
 - a. Listed to UL 969 for weather resistance.
 - b. Listed to UL 1703 for marking contents and format.
 2. Main Service Disconnect: per NEC.
 3. Identification Content and Format: per NEC.
 4. Identification for DC Conduit, Raceways, Enclosures, Cable Assemblies, and Junction Boxes: IFC 605.
 5. Identification for Inverter: per NEC.
- E. Bypass diodes shall be built into each PV module either between each cell or each string of cells.
- F. Other Components: per UL 1703.

- G. Hail Protection: Compliant with testing procedure per ASTM E-1038.
- H. Lightning Protection: Shall ground according to manufacturer instructions per UL 1703.
- I. Access, Pathways, and Smoke Ventilation: Per IFC 605.3, access and spacing requirements must be observed in order to: ensure access to the roof, provide pathways to specific areas of the roof, provide for smoke ventilation opportunities area, and, where applicable, provide emergency access egress from the roof.
- J. Fire Classification:
 - 1. IBC 1505.8 for building-integrated photovoltaic and solar shingles.
 - 2. IBC 1509.7.2: Although not technically enforceable, every effort shall be made to ensure the solar photovoltaic module is not combustible.

2.7 RACKING

- A. Racking Rails: Unirac RM10 or approved equal.
- B. Attachment: Solar Contractor to provide structural engineering calculations and approval for roof mount and attachment method. Structural engineering calculations and approval to satisfy permitting requirements by Area Having Jurisdiction. Coordinate with roofing vendor for feasibility and warranty compatibility. Coordinate roofing slip sheets or supplemental roofing membrane as required by roofing vendor.

2.8 INSTRUMENTATION

- A. Meters: If applicable and system is grid-connected, use net meter provided by the serving electric utility. Provide Production Meter base as required by utility.
- B. Data logger/Monitoring System: Shall be SolarEdge online monitoring platform with cellular service and 10-year subscription. Contractor to setup and activate online account, provide access to module level monitoring, and provide login credentials to facility operator.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the solar photovoltaic system in accordance with the NEC, this section, and the printed instructions of the manufacturer.
- B. Prior to system start-up, ensure no copper wire remains exposed with the exception of grounding wire as allowed in certain circumstances per manufacturer's instructions.
- C. In seismic areas, systems shall be adequately anchored and braced per structural engineering details to withstand seismic forces at the locations where installed.
- D. Wiring Installation: Workers shall be made aware that photovoltaic modules will be live and generating electricity when there is any ambient light source and shall take appropriate precautions. Utilize on-site measurements in conjunction with engineering designs to accurately cut wires and layout before making permanent connections. Locate wires out of the way of windows, doors, openings, and other hazards. Ensure wires are free of snags and

sharp edges that have the potential to compromise the wire insulation. All cabling shall be mechanically fastened. If the system is roof-mounted it shall have direct current ground fault protection according to NEC. Ensure breakers in combiner box are in the off position (or fuses removed) during combiner box wiring.

- E. Instrumentation: Install instruments as recommended by the manufacturer. Locate control panels inside a room accessible only to qualified persons.
- F. Rack-Mounted Photovoltaic Installations: Rack-mounted photovoltaic modules shall be installed in accordance with the manufacturer's installation instructions.
- G. Provide safety signage per NEC.
- H. Remove, replace, patch, and repair existing roofing materials and surfaces cut or damaged during installation of the solar energy electrical power generation system, by methods and with materials so as not to void existing roofing system warranty. Notify roof warrantor before proceeding.

3.2 FIELD QUALITY CONTROL

- A. Field Inspection: Perform in accordance with manufacturer's recommendations. Prior to initial operation, inspect the solar energy electrical power generation system for conformance to drawings, specifications, and NEC. In addition, include the following:
 - 1. Visual Inspection and Tests:
 - a. Compare equipment nameplate data with specifications and approved shop drawings.
 - b. Inspect physical, electrical, and mechanical condition.
 - c. Verify required area clearances.
 - d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method or performing thermographic survey after energization.
 - e. Verify the correct operation of all sensing devices, alarms, and indicating devices.
 - f. Verify that all cable entries from top of junction boxes are sealed per junction box rating.
 - g. Verify all connections and integrity of printed circuit boards in all applicable junction boxes.
- B. Tests: Provide equipment and apparatus required for performing tests. Correct defects disclosed by the tests and repeat tests. Conduct tests in the presence of the commissioning agent and their guidelines.
 - 1. Module String Voltage Test: Prior to connecting wiring to the combiner box, use a digital multi-meter to ensure each series string's polarity is correct.
 - 2. Operational Tests: Perform tests in accordance with the manufacturer's written recommendations. Tests for stand-alone systems shall be performed per IEEE 1526.
 - 3. Inspect and test each Solar Photovoltaic (PV) module. PV module shall be considered defective if it does not pass inspections and tests.

3.3 FOLLOW-UP VERIFICATION

- A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the solar photovoltaic electrical power generation system is in

good operating condition and properly performing the intended function. Inverter and online monitoring review shall be conducted with commissioning agent and facility operator during owner training.

3.4 COMMISSIONING

- A. Comply with the requirements of Section 01 91 13, GENERAL COMMISSIONING REQUIREMENTS.
- B. If the system is grid-tied, the Contractor shall coordinate with the serving electric utility to establish an interconnection agreement.
- C. Connect the solar photovoltaic electrical power generation system to the serving electric utility grid only after receiving prior approval from the utility company.
- D. Only qualified personnel shall connect the solar photovoltaic electrical power generation system to the serving electric utility grid.
- E. Conduct commissioning with commissioning agent follow their guidelines to verify system function and performance.

3.5 INSTRUCTION

- A. A complete set of operating instructions for the solar photovoltaic electrical power generation system shall be provided following O&M requirements.
- B. Furnish the services of a factory-trained technician for one, 4-hour training period for instructing personnel in the maintenance and operation of the solar photovoltaic electrical power generation system, on the date requested by the facility operator.
 - 1. Provide video of training sessions per Division 01.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description: Work includes packaged diesel engine-generator sets for emergency and optional standby power supply as indicated on the Drawings with unit mounted cooling system, unit mounted and remote mounting control and monitoring, outdoor sound attenuated enclosure and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county and state codes and ordinances.
- B. Codes and Standards:
 - 1. ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 - 2. ASME B15.1, Safety Standard for Mechanical Power Transmission Apparatus.
 - 3. NEMA AB1, Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
 - 4. NEMA ICS 6, Industrial Controls and System Enclosures.
 - 5. NEMA MG-1, Motors and Generators.
 - 6. NEMA 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 7. NFPA 30, Flammable and Combustible Liquids Code.
 - 8. NFPA 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
 - 9. NFPA 70, National Electrical Code (NEC)
 - 10. NFPA 110, Standard for Emergency and Power Standby Systems.
 - 11. UL 142, Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids.
 - 12. UL 489, Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
 - 13. UL 1236, Standard for Battery Chargers for Charging Engine-Starter Batteries.
 - 14. UL 2200, Standard for Safety Stationary Engine Generator Assemblies.
- C. Manufacturer and/or Supplier Qualifications:
 - 1. Minimum of 5 years in business of distributing and installing and maintaining specific type of generation equipment in geographical area under present firm name.
 - 2. Capable of dispatching maintenance and repair truck with qualified factory trained repairman and spare parts to the job site within 1 hour of request for service on equipment.
 - 3. Equipment manufacturer with minimum of 5 years experience to regularly assembled and manufactured such equipment.
 - 4. Supplier with local office within 50 miles of project site, with factory trained representatives employed for minimum of 1 year.

5. Supplier shall maintain spare parts stock to minimize down time in case of equipment failure.
 6. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those included for this Project. Comply with requirements in Section 26 05 48.
- D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70 by a testing agency acceptable to the AHJ and marked for intended use.
- F. Engine Exhaust Emissions: Comply with applicable state and local government requirements.
- G. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.3 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Product Data: Submit manufacturer's technical product data and for each component and appurtenance. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include the following:
1. Thermal damage curve for generator.
 2. Time current characteristic curves for generator protective device.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Include the following:
1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 2. Design Calculations: Signed and sealed by a qualified professional engineer. Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights. Comply with requirements in Section 26 05 48.
 3. Wiring Diagrams: Power, signal, and control wiring.
- D. Certification: Manufacturer seismic qualification certification that fuel tank, engine-generator set, batteries, battery racks, accessories, and components will withstand seismic forces. Comply with requirements in Section 26 05 48.
1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- E. Test Reports: Comply with requirements of 26 08 10.
 - 1. Factory start-up and test reports.
 - 2. Field start-up and test reports.
 - 3. Report of exhaust emissions showing compliance with applicable regulations.
 - 4. Certified Torsional Vibration Compatibility: Comply with requirements in NFPA 110.
 - 5. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.4 OPERATION AND MAINTENANCE MANUALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Include step by step instructions for startup and shutdown.
- C. Include copies of test forms, service forms, and maintenance data, including test and servicing intervals, fluid levels, lubrication requirements, filters, antifreeze, and recommended lubricants.

1.5 WARRANTY

- A. Packaged Engine Generator: Two years from date of Substantial Completion.
- B. Warranty shall cover parts, labor and travel time for the entire system. Make available replacement within 48 hours of initial notification.

1.6 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Packaged Engine Generator: Onan/Cummins Power Generation, Kohler, or prior approved by engineer. Generator set, including base fuel tank and weatherproof enclosure, must meet dimensional parameter set at a maximum length of 220", maximum width of 72" and a maximum height (including base fuel tank) of 116".

2.2 ENGINE-GENERATOR SET

- A. Factory assembled and tested, engine generator set.

- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation. Include lifting attachments.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Nominal ratings as indicated on the Drawings.
 - 2. Output Connections: Three-phase, four wire.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
- D. Generator Set Performance:
 - 1. Steady State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Maximum 20 percent variation for 50 percent step load increase or decrease. Voltage shall recover and remain within steady state operating band within 3 seconds.
 - 3. Steady State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
 - 4. Steady State Frequency Stability: No random speed variations outside steady state operational band and no hunting or surging of speed when system is operating at any constant load within the rated load.
 - 5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step load increase or decrease. Frequency shall recover and remain within steady state operating band within 5 seconds.
 - 6. Output Waveform: At no load, harmonic content measured line-to-line and line-to-neutral not to exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, not to exceed 50 percent.
 - 7. Sustained Short Circuit Current: For 3-phase, bolted short circuit at system output terminals, system shall supply minimum 250 percent of rated full load current for not less than 10 seconds and then clear fault automatically without damage to generator system components.
 - 8. Start Time: Comply with requirements in NFPA 110 for Type 10 system requirements.
 - 9. Excitation System: Performance unaffected by voltage distortion caused by nonlinear load.
 - a. Include permanent magnet excitation for power source to voltage regulator.

2.3 ENGINE

- A. Fuel: Fuel oil, Grade DF-2.
- B. Rated Engine Speed: 1800 rpm.
- C. Maximum Piston Speed for Four-Cycle Engines: 2250 fpm.
- D. Lubrication System: Include the following items mounted on engine or skid:
 - 1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
 - 2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit capable of full flow and designed to be fail safe.

3. Crankcase Drain: Arranged for complete gravity drainage to removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- E. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine to ensure adequate primary fuel flow under starting and load conditions.
 2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.
- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with requirements in NFPA 110 for Level 1 equipment for heater capacity.
1. Jacket heater shall be 120VAC.
- G. Governor: Control engine speed within plus or minus 3 Hz at 60 Hz (speed regulation 5 percent) from no load to full load generator output. Maintain steady state frequency at any constant load, including no load, within band of plus or minus 0.25 Hz rated frequency. Governor not to permit frequency modulation, defined as number of times per second that frequency varies from average frequency in cyclic manner, in excess 1 Hz per second.
- H. Cooling System: Closed loop, liquid cooled with radiator factory mounted on engine generator set mounting frame, engine driven fan, and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene glycol based antifreeze and 50 percent water with anticorrosion additives as recommended by engine manufacturer.
 2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed loop coolant system pressure for engine used. Include gage glass and petcock.
 4. Temperature Control: Self contained, thermostatic control valve that modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging, ultraviolet, and abrasion resistant fabric.
 - a. Rating: 50 psig maximum working pressure with coolant at 180 F and non-collapsible under vacuum.
 - b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.
- I. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system not to exceed engine manufacturer's engine backpressure requirements.
1. Sound Attenuation: Minimum 25 dB at 500 Hz.
 2. Maximum 65 dBA sound level measured at distance of 10 feet from exhaust discharge.
 3. Overall sound levels under paragraph 2.7 shall take precedence.
- J. Engine Exhaust Flexible Connectors: Sized to match engine exhaust outlet connection and as recommended by engine manufacturer.

- K. Air-Intake Filter: Heavy duty, engine mounted air cleaner with replaceable dry filter element and "blocked filter" indicator.

- L. Starting System:
 - 1. Components: Sized not to be damaged during full engine cranking cycle at maximum ambient temperature.
 - 2. Cranking Motor: Heavy duty unit that automatically engages and releases from engine flywheel without binding.
 - 3. Cranking Cycle: Minimum 60 seconds.
 - 4. Battery: Capacity within ambient temperature range for specified cranking cycle at least twice without recharging. Include 120 VAC battery heater.
 - 5. Battery Cable: Size as recommended by engine manufacturer. Include required interconnecting conductors and connection accessories.
 - 6. Battery Charging Alternator: Factory mounted on engine with solid state voltage regulation and 35-A minimum continuous rating.
 - 7. Battery Charger: Current limiting, automatic equalizing and float charging type. Comply with UL 1236. Include the following features:
 - a. Battery charger shall be 120VAC.
 - b. Operation: Equalizing charging rate of 10 Amps initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
 - c. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 C to plus 60 C to prevent overcharging at high temperatures and undercharging at low temperatures.
 - d. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
 - e. Ammeter and Voltmeter: Flush mounted in door to indicate charging rates.
 - f. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of AC input or DC output of battery charger. Either condition shall close contacts that provide a battery charger malfunction indication at system control and monitoring panel.
 - g. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with requirements in NFPA 30.

- B. Base Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Include the following features:
 - 1. Tank level indicator.
 - 2. Capacity: Provide fuel tank sized for 48 hours of emergency operation at rated load.
 - 3. Vandal resistant fill cap.
 - 4. Containment Provisions: Tank shall be double-walled. Comply with requirements of the AHJs.
 - 5. Low level alarm sensor.
 - 6. Secondary containment leak alarm sensor.
 - 7. High level alarm sensor.
 - 8. All venting required by current code.

- C. Normal atmospheric vent shall not be less than 12 ft above adjacent grade, nor located for trapped vapors under eaves, and at least 5 feet from building openings or property lines per IFC 5704.2.7.3.3.
- D. Filling, emptying and vapor recovery openings shall be located outside the building or weatherproof housing, not less than 5 feet from building openings or lot lines per IFC 5704.2.7.5.2.
- E. The tank emergency vents shall not vent inside a building or the weather housing, IFC 5704.2.7.4.2.

2.5 CONTROL AND MONITORING

- A. Automatic Starting System Sequence of Operation: When mode selector switch on control and monitoring panel is in "AUTO" position, remote control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode selector switch is switched to "ON" position, generator set starts. "OFF" position of same switch initiates generator set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of remote emergency stop switch also shuts down generator set.
- B. Include the Following Indicating and Protective Devices and Controls:
 - 1. AC voltmeter.
 - 2. AC ammeter.
 - 3. AC frequency meter.
 - 4. DC voltmeter (alternator battery charging).
 - 5. Engine coolant temperature gage.
 - 6. Engine lubricating oil pressure gage.
 - 7. Running time meter.
 - 8. Ammeter and voltmeter and phase-selector switch(es).
 - 9. Generator voltage adjusting rheostat.
 - 10. Start/stop switch.
 - 11. Overspeed shutdown device.
 - 12. Coolant high temperature shutdown device.
 - 13. Coolant low level shutdown device.
 - 14. Oil low pressure shutdown device.
 - 15. Fuel tank low level alarm.
 - 16. Fuel tank high level shutdown of fuel supply alarm.
 - 17. Fuel tank leak alarm.
 - 18. Generator overload.
- C. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated on the Drawings.
- D. Alarm Contacts: Include separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication for connections for data link transmission of indications to remote data terminals.
- E. Remote Alarm Annunciator: Comply with NFPA 99. LED labeled with respective alarm conditions shall identify each alarm event and common audible signal shall sound for each alarm condition. Silencing switch on face of panel shall silence signal without altering visual

indication. Connect so that after alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate flush mounting type to suit mounting conditions indicated on the Drawings.

- F. Generator Circuit Breakers: Molded-case, thermal-magnetic type, 80 percent rated. Comply with requirements in NEMA AB 1. UL 489.
 - 1. Tripping Characteristic: Designed specifically for generator protection.
 - 2. Trip Rating: Matched to generator rating.
 - 3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
 - 4. Mounting: Adjacent to or integrated with control and monitoring panel.
 - 5. Loads: NEC 700 ATS and NEC 702 ATS
- G. Ground Fault Indication: Comply with requirements in NFPA 70 for emergency system signals for ground fault. Integrate ground fault alarm indication with other generator set alarm indications.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with requirements in NEMA MG 1.
- B. Drive: Generator shaft directly connected to engine shaft. Exciter rotated integrally with generator rotor.
- C. Electrical Insulation: Class H.
- D. Stator Winding Leads: Terminate at terminal box to permit future reconnection for other voltages.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Enclosure: Drip-proof.
- G. Voltage Regulator: Solid state type, separate from exciter, for performance specified in this section. Include adjustable rheostat on control and monitoring panel for plus or minus 5 percent of output-voltage operating band.
- H. Alternator shall be capable of accepting 368kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor to the generator set.
- I. Temperature Rise: 125°C over a 40°C environment.
- J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point. Provide strip heater as 120VAC.

2.7 OUTDOOR GENERATOR SET ENCLOSURE

- A. Description: Weatherproof steel housing. Multiple panels lockable with adequate access to components requiring maintenance. Panels removable by one person without tools. Instruments and control mounted within enclosure.
- B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
 - 1. Louvers: Fixed engine, cooling air inlet and discharge. Storm proof and drainable louvers to prevent entry of rain and snow.
- C. Sound performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 70 dBA measured at any location 7 meters from the engine generator in a free field environment.

2.8 VIBRATION ISOLATION DEVICES

- A. Elastomeric Isolator Pads: Oil and water resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area. Factory cut to sizes that match requirements of supported equipment.

2.9 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
- B. Project Specific Equipment Tests: Before shipment, factory test engine generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 - 1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
 - 2. Full load run.
 - 3. Maximum power.
 - 4. Voltage regulation.
 - 5. Transient and steady-state governing.
 - 6. Single-step load pickup.
 - 7. Safety shutdown.
 - 8. Sound generation.
 - 9. Provide 14 days' advance notice of tests and opportunity for observation of tests by the Owner's representative.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 PACKAGED ENGINE GENERATOR INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.
- B. Install packaged engine generator to provide access without removing connections or accessories, for periodic maintenance.
- C. Secure sets to anchor bolts installed in concrete bases. Comply with requirements in Section 26 05 00 for concrete bases and Section 26 05 48 for seismic restraints.
- D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.5 CONNECTIONS

- A. Piping installation requirements are specified in Division 26 Sections.
- B. Connect fuel, cooling system, and exhaust system piping adjacent to packaged engine generator to allow service and maintenance.
- C. Ground equipment according to Section 26 05 26.
- D. Connect wiring according to Section 26 05 19.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Tests and Inspections:
 - 1. Comply with requirements in Section 26 08 00 and 26 08 10.
 - 2. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified in this section including, but not limited to, single step full load pickup test.
 - 4. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages for the following.
 - a. Measure charging voltage and voltages between available battery terminals for full charging and float charging conditions. Check electrolyte level and specific gravity under both conditions.
 - b. Test for contact integrity of connectors. Perform integrity load test and capacity load test for battery.
 - c. Verify acceptance of charge for each element of battery after discharge.
 - d. Verify that measurements are within manufacturer's specifications.
 - 5. Battery Charger Tests: Verify specified rates of charge for both equalizing and float charging conditions.
 - 6. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
 - 7. Exhaust Emissions Test: Comply with applicable government test criteria.
 - 8. Voltage and Frequency Transient Stability Tests: Measure voltage and frequency transients for 50 and 100 percent step load increases and decreases and verify that performance is as specified.
 - 9. Harmonic Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
- C. Coordinate tests with tests for transfer switches specified in Section 26 36 00 and run them concurrently.
- D. Test instruments shall have been calibrated within last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.
- E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- H. Remove malfunctioning units and provide new. Retest as specified above.
- I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.
- J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach label or tag to each tested component indicating satisfactory completion of tests.
- K. Infrared Scanning: After date of Substantial Completion, but not more than 60 days after final acceptance, perform infrared scan of each power wiring termination and each bus connection. Remove access panels so terminations and connections are accessible to portable scanner.
 - 1. Follow-up Infrared Scanning: Perform additional follow-up infrared scan 11 months after date of Substantial Completion.
 - 2. Instrument: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 3. Record of Infrared Scanning: Prepare certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- L. Include copy of test reports in the Operation and Maintenance Manual.

3.7 DEMONSTRATION

- A. Demonstrate proper system operation to the A/E and Owner utilizing factory-trained field service personnel.

3.8 TRAINING

- A. Conduct one 2 hour training session for Owner's representatives at project site. Include training on installed equipment, system operation, emergency procedures, location, and maintenance. Training conducted by factory-trained service personnel.
 - 1. Provide video of training sessions per Division 01.

3.9 FUEL FILL

- A. Fill fuel storage system with fuel after all tests and demonstrations have been completed.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description: Work includes Service Entrance Rated automatic transfer switches with utility and generator disconnects integral, automatic open transition transfer switches, remote annunciation system, remote annunciation and control system, and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01, and Section 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. IEEE C62.41, Surge Voltages in Low-Voltage AC Power Circuits.
 - 2. NEMA ICS 1, Industrial Control & Systems General Requirements.
 - 3. NEMA ICS 6, Industrial Control and System Enclosures.
 - 4. NETA ATS, NETA Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - 5. NFPA 70, National Electrical Code (NEC).
 - 6. NFPA 99, Standard for Healthcare Facilities.
 - 7. NFPA 110, Standard for Emergency and Standby Power Systems.
 - 8. UL 486A and 486B, Wire Connectors.
 - 9. UL 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - 10. UL 508, Standard for Industrial Control Equipment.
 - 11. UL 869A, Reference Standard for Service Equipment.
 - 12. UL 1008, Standard for Transfer Switch Equipment, unless requirements of this section are stricter.
- C. Manufacturer and Supplier Qualifications:
 - 1. In business of distributing and installing and maintaining specific type of equipment under present firm name for minimum of 5 years.
 - 2. Capable of dispatching qualified factory trained repairman and spare parts to job site within 2 hours of request for service on equipment.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, for emergency service under UL 1008, by testing agency acceptable to AHJ, and marked for intended use.

1.3 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Product Data: Submit manufacturer's technical product data and maintenance data for each type of transfer switch and appurtenance. Include accessories, dimensioned shop drawings, and wiring diagrams specific to project. Wiring diagrams shall include block diagram depicting control wiring scheme and point to point interconnections.
- C. Test Reports: Comply with requirements of 26 08 10.
 - 1. Factory test reports.
 - 2. Field test reports.
 - 3. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.4 WARRANTY

- A. General: Warrant transfer switches for 2 years after Substantial Completion. Warranty shall cover parts, labor, and travel time for the entire system. Make available replacement within 48 hours of initial notification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Transfer Switches: Cummins, Kohler or pre-approved by engineer.
- B. Shall be provided by the same vendor as 26 32 13 Packaged Engine Generator for warranty, service and startup continuity.

2.2 GENERAL TRANSFER SWITCH PRODUCT REQUIREMENTS

- A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating unless otherwise indicated on the Drawings.
- B. Shall be Service Entrance Rated, with utility and generator service disconnects integral to unit. See One Line Diagram for additional information.
- C. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations under fault conditions indicated on the Drawing based on testing according to UL 1008.
- D. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation locations.
- E. Annunciation, Control, and Programming Interface Components: Ensure that devices at transfer switches for communicating with remote programming devices, annunciators, and annunciator and control panels have communication capability matched with remote device.

- F. Solid-State Controls: Repetitive accuracy of settings is plus or minus 2 percent or better over operating temperature range of minus 20 to plus 70 C.
- G. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.
- H. Neutral Terminal: Solid and fully rated, unless otherwise indicated on the Drawings.
- I. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508 unless otherwise indicated on the Drawings.
- J. Factory Wiring: Train and bundle factory wiring and label consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.
 - 1. Designated Terminals: Pressure type suitable for types and sizes of field wiring.
 - 2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors.
 - 3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
- K. Electrical Operation: Accomplish by nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
- L. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
 - 1. Limitation: Switches using molded-case switches, circuit breakers, or insulated-case circuit-breaker components not acceptable.
 - 2. Switch Action: Double throw. Mechanically held in both directions.
 - 3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer switch units, rated 225 Amp and higher, with separate arcing contacts.

2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with Level 1 equipment requirements according to NFPA 110.
- B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning unless otherwise indicated on the Drawings.
- C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.
- D. Signal-Before-Transfer Contacts: Include set of normally open/normally closed dry contacts to operate in advance of retransfer to normal source. Interval adjustable from 1 to 30 seconds.
- E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.
- F. Transfer Switches Based on Molded-Case-Switch Components: Comply with UL 489 and UL 869A.

- G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the 2 sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2.4 AUTOMATIC TRANSFER SWITCH FEATURES

- A. Undervoltage Sensing for Each Phase of Normal Source: Senses low phase-to-ground voltage on each phase. Pickup voltage adjustable from 85 to 100 percent of nominal. Dropout voltage adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
- B. Time delay for override of normal-source voltage sensing delays transfer and engine start signals. Adjustable from 0 to 6 seconds. Factory set for 1 second.
- C. Voltage/Frequency Lockout Relay: Prevents premature transfer to generator. Pickup voltage adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
- D. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes. Factory set for 10 minutes. Include automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source if normal supply has been restored.
- E. Test Switch: Simulates normal-source failure.
- F. Switch-Position Pilot Lights: Indicate source to which load is connected.
- G. Source-Available Indicating Lights: Supervise sources via transfer switch normal- and emergency-source sensing circuits.
 - 1. Normal Power Supervision: Green light with nameplate engraved "NORMAL SOURCE AVAILABLE."
 - 2. Emergency Power Supervision: Red light with nameplate engraved "EMERGENCY SOURCE AVAILABLE."
- H. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 Amp at 240 Volt AC.
- I. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
- J. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open. Rated 10 Amp at 32 Volt DC minimum.
- K. Engine Shutdown Contacts: Time delay adjustable from 0 to 5 minutes. Factory set for 5 minutes. Contacts shall initiate shutdown at packaged engine generator controls after retransfer of load to normal source.

- L. Packaged Engine Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods adjustable from 10 to 30 minutes. Factory settings for 7 day exercise cycle, 20 minute running period, and 5 minute cool-down period. Exerciser features include the following:
 - 1. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
 - 2. Push-button programming control with digital display of settings.
 - 3. Integral battery operation of time switch when normal control power is not available.

2.5 REMOTE ANNUNCIATOR SYSTEM

- A. Functional Description: Remote annunciator panel annunciates conditions for indicated transfer switches. Annunciation includes the following:
 - 1. Sources available, as defined by actual pickup and dropout settings of transfer switch controls.
 - 2. Switch position.
 - 3. Switch in test mode.
 - 4. Failure of communication link.
- B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
 - 1. Indicating Lights: Grouped for each transfer switch monitored.
 - 2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
 - 3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated on the Drawings.
 - 4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.6 FINISHES

- A. Enclosures: Manufacturer's standard enamel over corrosion-resistant pretreatment and primer.

2.7 SOURCE QUALITY CONTROL

- A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1. Submit test results and include copy in the Operation and Maintenance Manual.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 TRANSFER SWITCH INSTALLATION

- A. Comply with requirements in Section 26 05 48 for mounting and anchoring.
- B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated on Drawings.
- C. Identify components according to Section 26 05 53.

3.5 WIRING TO REMOTE COMPONENTS

- A. Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

3.6 CONNECTIONS

- A. Comply with requirements in Section 26 05 26 for grounding.
- B. Comply with requirements in Section 26 05 22 for wiring connections.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not available, use those specified in UL 486A and UL 486B.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Comply with requirements in Section 26 08 00 and 26 08 10. Include copy of field test reports in the Operation and Maintenance Manual.
- B. Perform the following field tests and inspections:
 - 1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS. Certify compliance with test parameters.
 - 3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
 - a. Check for electrical continuity of circuits and for short circuits.
 - b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
 - c. Verify that manual transfer warnings are properly placed.
 - d. Perform manual transfer operation.
 - 4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least 3 times.
 - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
 - b. Simulate loss of phase-to-ground voltage for each phase of normal source.
 - c. Verify time-delay settings.
 - d. Verify pickup and dropout voltages by data readout or inspection of control settings.
 - e. Test bypass/isolation unit functional modes and related automatic transfer switch operations.
 - f. Verify proper sequence and correct timing of automatic packaged engine generator starting, transfer time delay, retransfer time delay on restoration of normal power, and generator cool-down and shutdown.
 - 5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
 - a. Verify grounding connections and locations and ratings of sensors.
 - b. Observe reaction of circuit-interrupting devices when simulated fault current is applied at sensors.
 - 6. Coordinate tests with tests of packaged engine generator and run them concurrently.
 - 7. Submit report results of tests and inspections and include copy in the Operation and Maintenance Manual. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach label or tag to each tested component indicating satisfactory completion of tests.
 - 8. Remove and replace malfunctioning units and retest as specified above.

3.8 DEMONSTRATION AND TRAINING

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Comply with requirements in Section 26 05 00.
 - 1. Provide video of training sessions per Division 01.
- B. Coordinate training with that for packaged engine generator equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description: Work includes interior and exterior light fixtures, drivers, LED's and associated appurtenances.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Section 26 05 00 apply to Work in this section.
- C. Comply with requirements in other specification sections for concrete for embedding poles, pole foundations, and footings for exterior area lighting poles, standards, and foundations. Pole bases included in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards: NFPA 70, National Electrical Code (NEC).
- C. Comply with NEC and NEMA for installation and construction of lighting fixtures. Comply with NEC for recessed incandescent lighting fixtures. Lighting fixtures UL listed and labeled.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Data for Credit MR 4 Credit MR 5 For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
 - a. Include statement indicating costs for each product having recycled content.
- C. Product Data: Submit manufacturer's technical product data and maintenance data for each type of lighting fixtures and appurtenance. Submit product data for each lamp type and each ballast type, with a matrix indicating which fixtures apply to submitted ballast and lamp type.

D. Shop Drawings:

1. Submit dimensioned drawings of each type of lighting fixtures. Submit in booklet form with separate sheet for each fixture, assembled in luminaire "type" in alphabetical order with proposed fixture and appurtenance clearly indicated on each sheet.
2. Submit support and hanging details for lighting fixtures weighing more than 56 pounds and pendant hung lighting fixtures requiring support design approved by the AHJ.

E. Test Reports:

1. Field test reports.
2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.
3. Field test reports.
4. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

1.5 EXTRA MATERIALS

- A. Exit Signs: Furnish and install ten percent (but not less than one exit sign) of each type used on the project. For each exit sign, include rough-in and fifty feet of branch circuit raceway and wiring connected to a local circuit. Location of spare exit signs as required by authority having jurisdiction. Turn over any unused spare exit signs to the Owner and obtain signed receipt.

1.6 DEFINITIONS

- A. Average Life: All LED modules shall meet L70 standards at 50,000 hours minimum.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. Fixture: A complete lighting unit or exit sign. Fixtures include LED modules and parts required to distribute the light.
- E. LER: Luminaire efficacy rating.
- F. Lumen: Are defined as delivered lumens as measured as the output of the fixture.
- G. Luminaire: Fixture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following (for each type of fixture):
1. Luminaires: Refer to Light Fixture Schedule on Contract Drawings.

- B. Comply with manufacturer's written recommendations for LED modules and drivers. Drivers shall be compatible with specified controls. Section 26 93 00

2.2 FIXTURE COMPONENTS, GENERAL

- A. Metal Parts: Free from burrs and sharp corners and edges.
- B. Sheet Metal Components: Steel, except as indicated. Components are formed and supported to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating and free from light leakage under operating conditions. Arrange to permit maintenance without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during maintenance and when secured in the operating position.
- D. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or water white, annealed crystal glass except as indicated.
 - 1. Plastic: Highly resistant to yellowing and other changes due to aging, exposure to heat and UV radiation.
 - 2. Lens Thickness: 0.125 inches minimum.
- E. LED batching shall meet ANSI C78.377.2015 standards.
- F. Inrush and surge protection shall meet NEMA 410 qualifications.
- G. Coordinate dimming controls with project documents and manufactures recommended dimming requirements. See specification section 26 59 10.
- H. Tested per IES LM-79, LM-80 and TM-21 parameters.

2.3 INTERIOR AND EXTERIOR LIGHT FIXTURES

- A. General:
 - 1. Light fixtures of sizes, types, and ratings indicated on the Drawings complete with, but not necessarily limited to, housings, LED modules, reflectors, drivers, and wiring.
 - 2. Label each fixture with manufacturer's name and catalog number.
 - 3. Include positive latch mechanisms for enclosed fixtures. Spring tension clips not acceptable.
 - 4. Include exterior fixtures with damp or wet location label as required by application.
- B. LED's: Rated for utilization voltage.
- C. Diffusers:
 - 1. 100 percent virgin acrylic compound.
 - 2. Minimum thickness 0.125 inches.
- D. Fuses for Exterior Parking Area Fixtures: Include fuses in each phase conductor, sized for 1-1/2 times maximum full load LED driver current served by each conductor, Bussman KTK or approved. Do not exceed circuit overcurrent protective device rating. Include fuse holder

at hand hole or in base junction box with "breakaway" receptacles for conductors running to top of poles, Bussman HEB or approved. Include fuse blanks in neutral conductors.

E. Support Requirements:

1. Include flexible ball joint hangers for pendant and stem hung fixtures at points of support.
2. Equip hooks used to hang fixtures with safety latches. Include supports, brackets, clips, screws, and miscellaneous items for mounting fixtures.
3. Include locking catches, screws, safety chain, or safety cable for detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 INTERIOR LIGHTING FIXTURE INSTALLATION

- A. Install lighting fixtures at locations and heights as indicated on the Drawings, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NESC, NECA's "Standards of Installation", NEMA standards, and recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other work as appropriate to properly interface installation of lighting fixtures with other work. Consult architectural reflected ceiling plan and interior elevations for location of lighting fixtures.
- C. Lighting Fixture Supports:
1. General: Comply with NEC as interpreted by AHJ or IBC, whichever is more stringent, for fixtures mounted in suspended ceilings.
 2. Seismic Restraints:

- a. For Lighting Fixtures Weighing Less than 10 Pounds: Install 1 slack No. 12 gage hanger wire from fixture to structure above.
 - b. For Lighting Fixtures Weighing 10 to 56 Pounds: Install 2 slack No. 12 gage hanger wires from fixture to structure above.
 - c. For Lighting Fixtures Weighing More than 56 Pounds: Support directly from the structure above by hangers approved by the AHJ. Comply with requirements in Section 26 05 48 for seismic restraints.
 - d. For Pendant Hung Lighting Fixtures: Support directly from structure with No. 9 gage hanger wire or alternate support without using ceiling suspension system for direct support approved by the AHJ. Comply with requirements in Section 24 05 48 for seismic restraints.
- D. Provide gypsum board protection acceptable to the AHJ to ensure fire rating of ceiling in which fixtures are installed.
- E. Coordination Meetings:
1. Meet at least twice with ceiling installer. Hold first meeting before submittal of Shop Drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area.
 2. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of fixtures and duct work in areas.
- F. Clean lighting fixtures of dirt and debris upon completion of installation.
- G. Protect installed fixtures from damage during construction period. Repair nicks and scratches to appearance of original finish.

3.5 EXTERIOR AREA LIGHTING FIXTURE INSTALLATION

- A. Coordinate with other work as necessary to properly interface installation of roadway and parking area lighting.
- B. Install lighting poles and standards plumb on concrete pole bases as indicated on the Drawings with anchor bolts and reinforcing bars. Coordinate size and location of bases prior to installation. Hand rub exposed concrete to uniform, smooth finish. Support during backfilling and anchoring to foundations. Comply with requirements in Section 24 05 10 for excavation and backfilling.
- C. Install with sufficient space for hand access and cable entrance holes for installation of underground cabling. Make splices in pole or pole base using Scotchcast 400 Resin for watertight connections.

3.6 FIELD QUALITY CONTROL

- A. Upon completion of installation of lighting fixtures and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Repair malfunctioning units on site, then retest to demonstrate compliance. If not possible to repair on site, remove and provide new units and retest. Include copy of test reports in the Operation and Maintenance Manual.

3.7 COMMISSIONING

- A. The equipment and systems referenced in this section are to be commissioned per Section 01 91 13 – General Commissioning Requirements and Section 26 08 00 – Commissioning of Electrical Systems. The contractor has specific responsibilities for scheduling, coordination, startup, test development, testing and documentation. Coordinate all commissioning activities with the Commissioning Authority.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All construction shall be in accordance with Appendix A – Pavement Markings, Signing, Traffic Signal, and Illumination System Specifications.
- B. This Section specifies traffic signal and illumination systems, including but not limited to, construction requirements, materials, configuration, and testing, for but not limited to, the following:
 - 1. Illumination poles and foundations
 - 2. LED luminaire fixtures
 - 3. Electrical service cabinets and foundations
 - 4. Junction boxes, conduits, and conductors
- C. Related Sections include the following:
 - 1. Appendix A – Pavement Markings, Signing, Traffic Signal, and Illumination System Specifications.
 - 2. Division 1 Section "Submittal Procedures" for submittal requirements.
 - 3. 10 14 53 – Traffic Signage.
 - 4. 32 17 23 – Pavement Markings.
 - 5. 34 41 00 – Roadway Signaling and Control Equipment.

1.2 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project.

1.3 SUBMITTALS

- A. Comply with requirements of Part 1.1.C above.
- B. Submit complete manufacturer's product literature, cut sheets, shop drawings, installation instructions, etc. for each of the materials used if available.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of Part 1.1.C above.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Part 1.1.C above.

1.6 WARRANTY

- A. Comply with requirements of Part 1.1.C above.

PART 2 - PRODUCTS

- A. Comply with requirements of Part 1.1.C above.

PART 3 - EXECUTION

- A. Comply with requirements of Part 1.1.C above.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Description: Work includes an integrated, energy saving lighting control system including lighting control panels, emergency lighting transfer devices, and associated accessories.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Section 26 05 00 apply to Work in this section.
- C. The contractor shall provide all related conduit, wire, boxes, and mounting hardware to provide a complete and functional installation.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. NEMA 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts.
 - 2. NFPA 70, National Electrical Code (NEC).
 - 3. UL 508, Standard for Industrial Control Panels.
 - 4. UL 916, Standard for Energy Management Equipment.
 - 5. UL 924, Standard for Emergency Lighting and Power Equipment.
- C. Manufacturers: Firms regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.
- D. Factory Assembly: All relays, touch tablet graphic user interfaces, controllers, enclosures, switch stations, photo sensors, occupancy sensors and miscellaneous components shall be factory assembled and tested. All system components shall arrive at the job site completely pre-wired and ready for installation, requiring only the connection of lighting circuits and network terminations. All connections shall be made to clearly and permanently labeled termination points. Systems that require field assembly shall not be acceptable.
- E. All system components shall comply with all applicable sections of NEC, NEMA, and FCC.
- F. UL Approvals: All applicable equipment shall be tested to and listed under UL standard 508 and shall bare labels to indicate compliance. Lighting control relays shall be tested to UL standard 508 for both safety and endurance. System listed other ETL or other UL sections shall provide documentation proving compliance with UL standard 508.
- G. Contractor responsible for confirming panels and sensor interoperate as a single system.

- H. Certification: Manufacturer shall certify that products will meet product specifications and local energy codes. If any additional equipment is required to meet coverage patterns and local energy codes, provide additional equipment at no additional cost to the Owner.

1.3 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Product Data: Submit manufacturer's technical product data and maintenance data for each type of lighting control system and components prior to fabrication and shipment.
- C. Specifications Compliance: Submit a line-by-line comparison that describes the differences between each specifications requirement and the equipment / systems being proposed. Comparison shall include a complete listing of how the proposed equipment / systems differ from that specified with regard to size, quantity, quality, method of control, features and functions, control software functions and installation requirements.
- D. Bill of Materials: Provide as part of the submittal package a detailed itemized listing of all proposed equipment, including quantities and capacities for all major system components.
- E. It shall be the responsibility of the contractor to verify all control wire requirements with the lighting controls manufacturer prior to rough in.
- F. Shop Drawings:
 - 1. Floor plans and reflected ceiling plans showing occupancy and daylight sensor locations. Include typical mounting details for occupancy and daylight sensors.
 - 2. Detailed point to point wiring diagrams.
 - 3. System one-line diagram showing panels, number and type of switches and sensors, low voltage switches, and building energy management system computer.
 - 4. Drawings for each panel showing hardware configuration and numbering.
 - 5. Panel wiring schedules.
 - 6. Typical wiring diagrams for each component.
- G. Test Reports: Comply with requirements of 26 08 00 and 26 08 10.
 - 1. Field test reports.
 - a. Mapping of devices by space identification and settings of each control device.
 - b. System schedule and grouping shall be included.
 - c. Network communication verification report.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.
- H. It shall be the responsibility of the contractor to verify all control wire requirements with the lighting controls manufacturer prior to rough in.

1.4 PROJECT CONDITIONS

- A. The contractor shall not install lighting control system components in spaces where the ambient temperature cannot be maintained between 0 degrees to 40 degrees C (32 degrees to 104 degrees F) with a maximum humidity of 90%, non-condensing.
- B. All stored and installed lighting control components shall be adequately protected from dust and dirt.

1.5 WARRANTY

- A. The lighting control manufacturer shall warrant the system to be free from manufacturing defects for a period of 5 years from shipment.
- B. The warranty shall include replacement parts deemed necessary to restore the system to normal operation.
- C. The manufacturer shall provide telephone technical support and remote diagnostics where applicable during normal business hours excluding manufacturer holidays.
- D. Upon request, the manufacturer shall make available for purchase service contract option(s) which include on-site technician visits for service and repair.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide lighting control system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- B. System components shall be UL listed under the UL916 Energy Management Equipment standard.

2.2 DIGITAL ROOM LIGHTING CONTROLLER

- A. Unless a lighting relay panel schedule is indicated on project documents, install room controller(s) to control the lighting and plug loads as shown on project documents.
- B. The room controller shall provide 0 - 10 volt dimming capability for the required number of dimmable lighting loads and on/off control for receptacle loads.
- C. The room controller shall integrate the functionality of connected lighting control components including wall switch stations, occupancy sensors and daylight sensors to provide control as indicated on the sequence of operation for the space. When specified they shall communicate on a building wide control network. Controls shall include, but not be limited to,
- D. Enclosed Offices shall be provided with multilevel control system to allow occupants to dim task lighting separately from ambient lighting.

- E. Multi-occupant Spaces shall be provided with multilevel control systems that allow each lighting type to be dimmed separately.
- F. Mechanical:
 - 1. The room controller housing approved for use in a return air plenum.
 - 2. The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
 - 3. Four RJ45 Smart Port connectors shall be accessible on the side of the enclosure for connection of room control devices.
 - 4. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, set-up and testing functions.
- G. Electrical:
- H. The room controller shall have a single power feed and shall be capable of operation at voltages between 120 and 347 volts AC, 50/60 Hz.
 - 1. One or two output relays (model specific) shall provide a total combined power switching capacity of 20 amps per unit.
 - 2. Where indicated in sequence of operation provide independent 0 - 10 volt dimming channels for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.
 - 3. Each dimming output shall have a current sinking capacity of at least 30 mA.
 - 4. The room controller shall be capable of supplying 250 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's four RJ45 Smart Port connectors.
 - 5. Where indicated, room controllers shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.
 - 6. On loss of normal power the controller 0-10 volt dimming signal shall default to full light output.
- I. Functional:
- J. Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.
- K. The room controller shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the connectors.
- L. Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.
- M. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
- N. Provide the following set up and configuration functions without the need for additional devices or software:
 - a. Assign/reassign relays for control by wall switch station buttons
 - b. Configure relays for occupancy or vacancy operation
 - c. Assign/reassign dimmers to raise/lower switches
 - d. Assign dimming channels for response to daylight sensor control

- e. Auto calibrate default daylight sensor sequence of operation
- f. Save preset scenes
- g. Include or exclude loads from occupancy sensor control
- h. Configure up to 16 load groups per room
- i. Configure up to 16 preset scenes per room with independent fade times
- j. Set independent power up conditions for relays and dimmers
- k. Set independent occupied and unoccupied conditions for each relay and dimmer
- l. Adjust dimmer high and low trim points
- m. Manually control loads allowing use of the phone or tablet as a personal control for the room

2.3 NETWORK BRIDGE MODULE

- A. The network bridge module allows multiple room controller zones to be networked with other system devices for whole building administration of lighting control functions.
- B. The network bridge approved for use in a return air plenum.
- C. The bridge shall connect to the room controllers smart port via a standard Cat5 cable.
- D. The network bridge module shall provide a communication link between the room control devices and the area controller via an Ethernet based network. At a minimum, the network link shall provide the following functionality through a web browser user interface:
 - 1. Report the current occupancy status for each lighting control zone
 - 2. Indicate the status of each relay and dimming channel
 - 3. Allow reconfiguration of system device input and output parameters
 - 4. Report the real time power consumption for each Room Controller
 - 5. Set up daylight harvesting for zones equipped with photocells
 - 6. Configure and download schedules to panels and Room Controllers

2.4 LOW VOLTAGE SWITCH STATIONS

- A. Low voltage digital wall switch stations shall be of the programmable type using standard Cat5 cabling for connection to system smart port.
- B. Stations shall have one to six buttons and provide lighting control functions as called out and shown on the plans.
- C. All switches shall be single gang and be of the generic decorator style allowing easy ganging and use of a wide array of standard wall switch plate options.
- D. Provide two RJ-45 ports per switch to allow for daisy chain connection of up to eight switches to each smart port.
- E. Switch station color as specified under 26 27 26 Wiring Devices and switches labeled.

2.5 OCCUPANCY SENSORS

- A. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared).

- B. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.
- C. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.
- D. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.
- E. Up to four occupancy sensors may be connected to one room controller.

2.6 DAYLIGHT SENSORS

- A. The daylight sensor shall provide ambient light level information to the room controller allowing daylight responsive lighting control.
- B. The system shall operate in an open loop sequence of operation reducing the amount of electric light as the quantity of daylight entering the room increases.
- C. It shall be possible to configure up to six daylight zones in a room. Each zone shall be programmable to proportionally respond to the light level provided by the daylight sensor.
- D. The daylight sensor shall be mounted and positioned to provide an unobstructed view of the windows per the manufacturer's directions.

2.7 MASTER CONTROLLER

- A. Web browser based system programming, monitoring and administration shall be provided by the master controller.
- B. The Master Controller shall have the ability to communicate by means of TCP/IP over Ethernet allowing enterprise connectivity between the Distributed Lighting Control System and external LAN or WAN networks.
- C. Provide integral capability to communicate with the Building Automation System via BACnet IP protocol.
- D. Mechanical:
 - 1. The Area Controller electronics shall be housed in a NEMA 1 industrial grade enclosure suitable for surface wall mounting in an electrical/mechanical room.
 - 2. The enclosure shall a screw on cover with a hinged locking door.
 - 3. Provide standard knock outs eliminating the need for field drilling or cutting of the enclosure which could damage the electronics.
- E. Electrical:
 - 1. Then Area Controller shall have a 120VAC, 60Hz hard wired supply connection. Servers or controllers using plug-in type power sources shall not be acceptable.

F. Functional:

1. The Area Controller shall function as a web server allowing the user interface to be accessible through a standard web browser.
2. The installation of software shall not be required. At a minimum, the user interface shall provide the following functions:
 - a. Automatic discovery of system devices
 - b. Commissioning of devices into logical areas and zones as shown on project documents.
 - c. Display the entire system in a logical navigation tree view
 - d. Allow the user to name Zones, Groups, Presets, Schedules and individual loads
 - e. Set up control functions for system inputs and outputs
 - f. Monitor status and override individual relays and dimmers
 - g. Set up and download schedules to panels and room controllers
 - h. Monitor real-time power use at each room controller

2.8 EMERGENCY LIGHTING INTERFACE

- A. Where emergency lighting is to be controlled by the lighting control system, provide UL924 listed load control relays as necessary to insure that emergency lights are automatically turned full on upon loss of normal power to the area.

2.9 SOFTWARE

- A. The system shall be capable of automatically modifying the sequence of operation for selected devices in response to any of the following: a time-of-day schedule, contact closure input state, RS-232/RS-485 command, BACnet input command, and/or demand response signal. Global profiles may be scheduled with the following capabilities:
 1. Global Profiles shall be stored within and executed from the system controller (via internal timeclock) such that a dedicated software host or server is not required to be online to support automatic scheduling and/or operation of Global Profiles.
 2. Global Profile time of day schedules shall be capable of being given the following recurrence settings: daily, specific days of week, every "n" number of days, weekly, monthly, and yearly. Lighting control profile schedules shall support definition of start date, end date, end after "n" recurrences, or never ending. Daylight savings time adjustments shall be capable of being performed automatically, if desired.
 3. Global Profiles shall be capable of being scheduled to run according to timed offsets relative to sunrise or sunset. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
 4. Blink warning and timed extension capabilities. At the end of a scheduled period, the system shall be capable of providing a visible "blink warning" 5 minutes prior to the end of the schedule. Wall stations may be programmed to provide timed overrides that turn the lights on for an additional period of time. Timed override duration shall be programmable for each individual device, zone of devices, or customized group of devices, ranging from 5 minutes to 12 hours.
 5. Software management interface shall be capable of displaying a graphic calendar view of profile schedules for each control zone.
 6. System Global Profiles shall have the following additional capabilities:
 7. Global Profiles shall be capable of being manually activated directly from the system controller, specially programmed input devices, and software management interface.

8. Global Profiles shall be selectable to apply to a single device, zone of devices, or customized group of devices.
9. Parameters that shall be configurable and assigned to a Global Profile include light level, response to occupancy sensors (including enabling/disabling response), response to daylight sensors (including enabling/disabling response), and enabling/disabling of wall stations.
10. A backup of Local and Global Profiles shall be stored on the software's host server such that the Profile backup can be applied to a replacement system controller or wall station.
11. Automated demand response capabilities. Profiles created for automated demand response events shall support automatic reduction of light level to programmable values. At least four levels of demand response profiles shall be supported by the system.

2.10 SOFTWARE INTERFACES

A. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules. Be password protectable
2. Management interface shall be able to read the live status of a networked luminaire or intelligent control device and shall be capable of displaying luminaire on/off status, dim level, power measurement, device temperature, PIR occupancy sensor status, microphonic occupancy sensor status, remaining occupancy time delay, photocell reading, and active Scenes or Profiles.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 PRE-INSTALLATION MEETINGS

- A. Prior to commencing work of this section, contractor shall arrange a pre-installation meeting to be attended by authorized manufactures representative, contractor, and owner's representative.

- B. Review installation procedures and coordination required with related work and the following:
 - 1. Confirm location and mounting of all devices with attention to placement of switches, dimmers, and any sensors.
 - 2. Review the specifications for low voltage control wiring and termination procedure.
 - 3. Discuss the sequence of operation while reviewing lighting control plans and manufactures wiring schematics. Ensure project requirements are met.
 - 4. Discuss requirement for integration with other trades

3.4 INSTALLATION

- A. Install all equipment in accordance with manufacturer's installation instructions.
- B. The lighting controls shall be installed in accordance with specifications and specific guidelines and submittal documents provided by the lighting control manufacturer. Where these conflicts, the more stringent requirements govern.
- C. Where variations from the general specifications or drawings exist, the contractor shall request a clarification prior to rough in or installation.
- D. The contractor shall verify all wire type and routing requirements with the lighting controls manufacturer prior to installation. Not part of this section are requirements for work including, but not limited to, raceways, electrical boxes, junction boxes, circuit protection, wiring, and fittings required for installation of the lighting control equipment.
- E. Installation Assistance: During the installation process, the manufacturer shall provide, at no cost, technical support and provide two pre-installation meetings prior to rough-in.

3.5 STARTUP, PROGRAMMING, COMMISSIONING, TESTING AND TRAINING

- A. The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.
- B. The factory field service engineer shall provide an on-site walkthrough to demonstrate system functionality to a Commissioning Agent. During this visit, the manufacturer's field service engineer will perform tasks, at the request of the commissioning agent, such as to demonstrate wall control functions, explain or describe occupancy and/or daylight sensor functionality.
- C. Allow for up to 4 hours of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.
- D. Comply with requirements of 26 08 00 and 26 08 10.

- E. Provide training video on lighting controls functions and settings. See Div 01.

3.6 FIELD QUALITY CONTROL

- A. System Startup: Manufacturer's authorized technician shall confirm proper installation and operation of system components. Start-up requirement shall verify:
 - 1. Occupancy and daylighting sensors are located, installed, and adjusted as required by the factory, the Contract Documents, and the Washington State Energy Code.
 - 2. Occupancy sensors and daylighting sensors are operating within manufacturers specifications.
 - 3. Sensors, room controllers and relay panels interact as a complete and operational system to meet requirements of the Contract Documents.
- B. Manufacturer shall submit written statement verifying that system meets above requirements. Include copy of test reports in the Operation and Maintenance Manual.
- C. Commission photocells with no daylight component present. Adjust photocells as required to set initial foot-candle level to 40 foot-candle average throughout the respective daylight zone.

3.7 TECHNICAL SUPPORT

- A. The lighting controls manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and Section 26 05 00 apply to Work in this section.
- B. Related Sections:
 - 1. 26 05 00 – General Electrical Provisions
 - 2. 26 05 32 – Outlet Boxes for Electrical Systems
 - 3. 26 05 33 – Raceway Systems

1.2 SUMMARY

- A. Provide a telecommunications system and other relevant components and accessories as required to provide a complete operating system as specified herein.

1.3 DEFINITIONS

- A. Accessible ceiling: An area above acoustical ceiling tile grid or lay-in type ceiling with a readily accessible space. Hard-lid type ceilings with access hatches or open to structure spaces shall not be considered accessible ceilings.
- B. Administration: Methodology defining the documentation requirements of a cabling system and its containment, the labeling of functional elements, and the process by which moves, additions, and changes are recorded.
- C. Bonding: Permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to safely conduct current likely to be imposed.
- D. Cable: An assembly of one or more insulated copper conductors or optical fiber strands within an enveloping sheath.
- E. Cable run: Length of installed media, which may include other components along its pathway.
- F. Cabling: System of cables, cords, and connecting hardware.
- G. Channel: End-to-end transmission path between two points at which equipment is connected including test cords and patch cords for a maximum total distance of 328 feet (100 meters).
- H. Connecting hardware: Device, or combination of devices, used to connect cables.
- I. Consolidation point: Location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture, floor box or other pathways.
- J. Cross-connection: Connection scheme between cabling runs, subsystems, and equipment using patch cords or jumpers that attach to connecting hardware on each end.

- K. Demarcation point: Point where operational control or ownership change, such as from a service provider to a customer facility.
- L. Equipment room: Environmentally controlled space for telecommunications equipment that usually houses a main or intermediate cross-connect.
- M. Ground: Conducting connection between an electrical circuit or equipment and the earth, or to a conducting body that serves in place of earth.
- N. Horizontal cabling: cabling that connects the telecommunications outlet or connector at the work area to the connecting hardware in the horizontal cross-connect.
- O. Horizontal cross-connect: Group of connectors that allows equipment and backbone cabling to be cross-connected with patch cords or jumpers. (Floor distributor)
- P. IDF: Intermediate Distribution Frame, reference to the Horizontal cross-connect or Intermediate cross-connect that is not the Main cross-connect (MDF).
- Q. Infrastructure (telecommunications): A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of information within a building or campus.
- R. Intermediate cross-connect: Connection point between a backbone cable and that extends from the main cross-connect and the backbone cable from the horizontal cross-connect. (Building distributor)
- S. Local area network (LAN): A geographically limited data communications system for a specific user group consisting of a group of interconnected computers sharing applications, data and peripheral devices intended for the local transport of data, voice and video.
- T. Main cross-connect: Cross-connect normally located in the (main) equipment room for cross-connection and interconnection of entrance cables, first-level backbone cables, and equipment cables. (Campus distributor)
- U. Metropolitan area network (MAN): Data communications network that covers an area larger than a campus and smaller than a wide area network. Typically interconnects two or more LAN's and usually covers an entire metropolitan area.
- V. MDF: Main Distribution Frame, reference to the Main Cross-Connect.
- W. Modular jack: Female telecommunications connector that may be keyed or unkeyed and may have six or eight contact positions, but not all positions need be equipped with jack contacts.
- X. Outlet/ connector (telecommunications): Connecting device in the work area on which a horizontal cable or outlet cable terminates.
- Y. Outside plant (OSP): Telecommunications infrastructure designed for installation exterior to buildings.
- Z. Patch cord: Length of cable with a plug or connector on both ends.

- AA. Patch panel: Connecting hardware system that facilitates cable terminations and cabling administration using patch cords. A facility enabling the terminating cable elements on insulation displacement connector modules and their connections by means of a patch cord.
- BB. Pathway: Sequence of connections that provides connectivity between devices on a network or between networks; the vertical and horizontal route of the telecommunications cable; a facility for the placement of telecommunications cabling.
- CC. Permanent link: Test configuration for cabling between two mated interfaces, excluding test cords and patch cords and cross-connections, but including the connecting hardware at each end for maximum total distance of 295 feet (90 meters).
- DD. Plenum: Compartment or chamber to which one or more air ducts are connected and that form part of the air distribution system.
- EE. Rack unit (RU): A unit of measure of vertical space in an equipment rack or enclosure. One rack unit is equal to 1.75in (45mm).
- FF. Registered Communications Distribution Designer (RCDD): A designation for individuals who demonstrate expertise in the design, integration and implementation of telecommunications (voice, data, video, audio, and other low voltage control) transport systems and their related infrastructure components.
- GG. Star topology: Network topology in which services are distributed from a central point.
- HH. Storage area network (SAN): Specialized high-speed network dedicated to the transport of data between storage devices and servers.
- II. Telecommunications: Transmission, emission, and reception of signs, signals, writings, images, and sounds, that is information of any nature by cable, radio, optical, or other electromagnetic systems.
- JJ. Telecommunications Room (TR): An enclosed architectural space for housing telecommunications equipment, cable terminations, and cross-connect cabling.
- KK. Unshielded twisted pair (UTP): Cable made up of one or more pairs of twisted copper conductors without metallic shielding. The entire assembly is covered with an insulating sheath/ cable jacket.
- LL. Wireless access point (WAP): A stand-alone hardware device on a local area network (LAN) that allows wireless capable devices and wired networks to connect through a wireless standard (802.11). The access point usually connects to a router or ethernet switch via a wired network. The wireless access point can also be an integral component of the router itself in smaller networks such as in residential applications.
- MM. Wide area network (WAN): Data communications system that uses telecommunications links to connect geographically distant networks.
- NN. Wireless local area network (WLAN): Data communications system that uses radio frequency technology allowing networks to transmit and receive data over the air, minimizing the need for wired connections to combine data connectivity with user mobility.
- OO. Work area (workstation): Building space where occupants interact with telecommunications terminal equipment.

- PP. Work area cable (cord): Cable connecting the telecommunications outlet/ connector to the terminal equipment.

1.4 SUBMITTALS

- A. Comply with requirements in Division 01 and Section 26 05 00.
- B. Submittal for this section shall be complete with all required information. Partial submittals are not acceptable and will be returned not reviewed.
- C. Submittal shall be arranged under categories such as, labels, products, certifications, personnel training, manufacturer warranty, test equipment and calibration, and similar items. Include index and product summary with the submittals.
- D. Pre-Construction Submittal:
1. Labeling
 - a. Include sample labeling for each of the following telecommunications infrastructure components:
 - 1) Workstation device faceplate identification labeling.
 - 2) 110 cross-connect block wall fields.
 - 3) Rack mount fiber cabinets for optical fiber backbone terminations.
 - 4) Multi-pair copper backbone cabling identification tags.
 2. Product Data:
 - a. Organize by specification infrastructure components described in Part 2 of this section.
 - b. Submit Product Data information sheets for coordination with item and model number. Where more than one product is indicated on a page, mark product with arrow or by other means to identify exact product or products being submitted by specific part number.
 3. Qualifications:
 - a. Submit resumes and certifications of technicians and project manager who will support this project. Certifications shall include:
 - 1) Manufacturer's certification to provide warranty
 - 2) Registered Communications Distribution Designer (RCDD) certification
 - 3) Copper and optical fiber installation certification
 - 4) Successful completion of approved manufacturer classes
 4. Test Equipment:
 - a. Submit network test equipment proof of calibration by manufacturer.
 5. Shop Drawings:
 - a. Submit Shop Drawings of telecommunications cabling systems.
 - b. Coordinate with other trades prior to submittal and start of installation.

- c. Show exact routing of horizontal cabling for workstation distribution throughout building, and optical fiber WAN cabling.
 - d. Label workstation devices to identify cabling being terminated in telecommunications rooms and spaces, where not provided on the Contract Drawings.
 - e. Prepare telecommunication system shop drawings using AutoCAD software or as approved by the Owner and or A/E. Shop drawings shall be submitted as full size, in PDF format.
- E. Record Drawing Submittal:
1. Keep complete set of telecommunications drawings in job-site office updated to identify actual installation of cabling and equipment during construction for recording as-built conditions.
 2. Record drawings set shall indicate where material, equipment, and system component are installed differently than indicated on the Contract Drawings, clearly and neatly using red ink or indelible red pencil during construction.
 3. Prepare electronic set of Record Drawings incorporating changes during construction.
 4. Submit Record Drawings to the Owner's Representative for review and acceptance.
 5. Submit Record Drawings saved as AutoCAD version 2018 (.dwg) format and in PDF format. The contractor shall request final architectural AutoCAD background drawing files that incorporate all project floor plan modifications and numbering of spaces.
 - a. AutoCAD drawings shall utilize the e-transmit capability to include all drawing backgrounds, title block and other associated files.
 6. Submit electronic copy of Record Drawings in full-size PDF and AutoCAD format, on CD-ROM or USB thumb drive where requested by the Owner's Representative.
 7. Prepare full size, laminated hard copy of telecommunications floor plan drawings, telecommunications room layouts, and equipment rack elevations. Install in the MDF room.
- F. Test Report Submittal:
1. Prepare test reports and submit to the Owner's Representative an electronic copy of the detailed test results, including overall test summary report.
 2. Include a copy of the detailed test reports on CD-ROM in each Operation and Maintenance Manual.
 3. Include a hard copy of the summary test sheets in each Operation and Maintenance Manual.
 4. Submit electronic copies in PDF and LinkWare software formats, including LinkWare reader software.
- G. Closeout Submittal:
1. Submit closeout documentation to the Owner's Representative and Architect under provisions of Division 01, Section 26 05 00, and this section.
 2. Provide project closeout documentation including but not limited to; product data, patch cord delivery transmittal signed by GC and digital photographs, test result documentation (full page sheets and summary sheets), Record Drawings, manufacturer warranty certificates (provide letter from manufacturer where warranty certificate shall be provided separately by the manufacturer to the owner) and Operation and Maintenance manuals.

1.5 MANUFACTURER CERTIFICATION AND WARRANTY

- A. Contractor shall be a certified installer and pre-qualified by the manufacturer for the purpose of offering the warranty at the time of bid, as specified herein.
- B. The telecommunications structured cabling system shall be covered by an Extended Product and Application Assurance Warranty.
 - 1. Warranty shall cover the passive telecommunications infrastructure copper connectivity and cabling products, performance from the date of installation registration and will support existing or future applications.
 - 2. Manufacturer solution partners for the Extended Product and Application Assurance Warranty are:
 - a. Ortronics/ Superior Essex (nCompass) – Limited Lifetime warranty
 - b. Ortronics/ Berk-Tek (OASIS) – 15 or 25 year warranty
 - 3. Installation practices shall follow the installation guidelines and procedures specified in the manufacturer certified installer training course, BICSI and current TIA standards.
 - 4. Submit closeout documentation in accordance with the manufacturer warranty requirements to comply for acceptance of the Extended Product and Application Assurance Warranty.
- C. Provide the original hard copy certificate for the Extended Product and Application Assurance Warranty to the Owner. This certificate may be issued directly to the Owner from the Manufacturer. Contractor to verify and communicate method of delivery with Owner and Architect/ Engineer.

1.6 QUALITY ASSURANCE

- A. UL listed material shall be visibly labeled as such.
- B. Equipment shall be manufacture's regularly catalogued items and shall be supplied as a complete unit in accordance with manufacturer's standard specifications and any optional items required for proper installation for equipment unless otherwise noted. Equipment and materials shall be installed in accordance with the manufacturer's recommendations and best trade practices.
- C. Products shall be new unless indicated otherwise in the Contract Documents.
- D. Telecommunications connectivity and cabling shall be independently tested to meet current TIA standards.
- E. Comply with applicable city, county, and state codes and ordinances.
- F. Codes and Standards:
 - 1. Comply with following standards for cable and equipment installations. Publications shall be latest issue and addenda:
 - a. NEC, National Electric Code.
 - b. NESC, National Electric Safety Code.

- c. TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises.
- d. TIA-568.1-D, Commercial Building Telecommunications Cabling Standard.
- e. TIA-568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
- f. TIA-569-D, Commercial Building Standard for Telecommunications Pathways and Spaces.
- g. TIA-606-C, Administration Standard for the Telecommunications Infrastructure of Commercial Building.
- h. TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises.
- i. TIA-758-B, Customer Owned Outside Plant Telecommunications Cabling Standard.
- j. TIA-862-B, Building Automation Systems cabling Standard.
- k. IEEE 802.3, Ethernet Standard.
- l. BICSI Information Transport Systems Installation Methods Manual.
- m. BICSI Telecommunications Distribution Methods Manual.
- n. BICSI Information Transport Systems Design Standard for K-12 Educational Institutions.

G. Qualifications:

- 1. Contractor shall have all required special skills and qualifications obtained by education and or experience.
- 2. Contractor shall have a minimum of (5) five years of experience in the construction, testing, and servicing of systems of the type and magnitude specified in this section.
- 3. Contractor shall be a certified installer of the telecommunications system and pre-qualified by the manufacturer for the purpose of offering the Extended Product and Applications Assurance warranty at the time of bid.
- 4. Contractor shall have access to and or own the tools and test equipment required to complete the project scope at the time of bid.
- 5. The Project Manager and Superintendent shall have a minimum of (5) five years of experience at project manager and superintendent levels, respectively, on completed telecommunications projects of the type and scale as this project.
 - a. Project manager shall be certified as a Registered Communications Distribution Designer (RCDD) through Building Industry Consulting Service International (BICSI) and directly employed by the company bidding the project.
- 6. Field technicians who will work at any given time during the project on the copper structured cabling system shall have a minimum of (3) three years of experience on completed telecommunications projects of the type and scale as this project.
 - a. Field technicians working at job site installing copper structured cabling shall have completed copper installation training class(es) conducted by the warranting manufacturer and or Building Industry Consulting Service International (BICSI).

1.7 PRE-CONSTRUCTION MEETINGS

- A. The Telecommunications subcontractor shall attend the pre-construction meeting as required by the Contractor or the Owner's Representative.

- B. Provide a schedule, indicating installation tasks, time duration for each task and coordination items to be discussed 5 days prior to the meeting, to the Contractor and to the Owner's Representative. Where the project includes multiple sites, include schedule for each site.

PART 2 - PRODUCT

2.1 MANUFACTURER SUBSTITUTIONS

- A. The substitution of products shall be allowed per the requirements defined in Division 01, Section 01 77 00 – Substitution and this section.
1. Submit requests for substitutions a minimum of 10 days prior to Bid date. Request submitted less than 10 days prior to, shall not be accepted.
 2. The basis of design for manufacturer partners are Berk-Tek cabling and Ortronics connectivity as specified herein.
 3. Copper connectivity shall be Augmented Category 6:
 - a. Pre-approved acceptable alternate manufacturer partners and connectivity are:
 - 1) Berk-Tek Cabling with Ortronics Connectivity.
 - a) Copper: LANmark-10G2 cabling with TracJack modular jacks and Clarity patch panels.
 - 2) Superior Essex Cabling with Ortronics Connectivity.
 - a) Copper: Category 6A 10Gain cabling with Ortronics as specified.

2.2 COPPER HORIZONTAL CABLING

- A. Augmented Category 6 UTP cabling for interior spaces:
1. Horizontal cables shall be constructed from 23 AWG solid bare copper conductors, insulated with polyethylene and cellular polyethylene, with four individually twisted pairs with three monofilaments.
 2. Conductors shall have an impedance of $100\Omega \pm 10\%$ / 100m.
 3. Cables shall meet the most current technical characteristics of TIA-568-D standard.
 - a. Wire map
 - b. Length
 - c. Insertion loss (Attenuation) 31.1dB/100m @ 250MHz, 45.3dB/100m @500MHz
 - d. Near-end crosstalk (NEXT) loss 38.3dB/100m @ 250MHz, 33.8dB/100m @500MHz
 - e. Attenuation to crosstalk ratio far-end (ACRF) 19.8dB/100m @ 250 MHz, 13.8dB/100m @500MHz
 - f. Minimum power sum near-end crosstalk (PSNEXT) loss 36.3dB/100m @250MHz, 31.8dB/100m @500MHz
 - g. Minimum power sum alien near end crosstalk (PSANEXT) loss 56.5dB/100m @ 250MHz, 52.0dB/10m @500MHz
 - h. Minimum power sum attenuation to alien crosstalk ratio far-end (PSAACRF) Loss 30.2dB/100m @ 250MHz, 24.0dB/100m @500MHz

- i. Return loss (RL) 17.3dB/100m @ 250MHz
 - j. Propagation delay (PD) 66% nom (CMR), 67% nom (CMP)
 - k. Delay skew (DS) 45ns/100m max
4. Cables shall be NFPA 262 CMP (plenum) rated unless otherwise noted with a maximum cable diameter 0.30 inches.
- a. Manufacturer Berk-Tek LANmark-10G2 series:
 - 1) Yellow plenum rated, Part No. 10137385

2.3 INTRABUILDING BACKBONE CABLING

A. Multi-pair Category 5e:

1. Category 5e 25-pair cables for voice intrabuilding backbone infrastructure in the quantities identified on the Contract Drawings for voice cross-connects. Cable shall be constructed of 24 AWG unshielded twisted pair solid copper conductors and shall meet the electrical requirements of 100-ohm, Category 5e, backbone UTP cables as specified in TIA-568-D
2. Cable shall be NFPA 262 CMP (plenum) rated as specified herein.
 - a. Manufacturer Superior Essex, Plenum rated, Part No. 51-478-48

B. Multi-pair Category 3:

1. Multi-pair Category 3 cabling for voice intrabuilding backbone infrastructure in the quantities identified on the Contract Drawings for voice cross-connects. Cable shall be constructed of 24 AWG unshielded twisted pair solid copper conductors and shall meet the electrical requirements of 100-ohm, Category 3, backbone UTP cables as specified in TIA-568-D.
2. Cable shall be NFPA 262 CMP (plenum) rated as specified herein, in color gray.
 - a. Manufacturer Superior Essex:
 - 1) 25-pair plenum rated, Part No.18-499-36

2.4 INNERDUCT AND CABLE IDENTIFICATION TAGS

A. Flexible Plastic Raceway/ Innerduct:

1. The nonmetallic flexible raceway/ innerduct shall be UL Listed and manufactured from High Density Polyethylene (HDPE) with smooth wall and provided with pull tape for placement inside outdoor underground conduit. Color shall be gray.
 - a. Manufacturer Carlon: (or Pyramid equal)
 - 1) 1" Sch.40, 250'-0", Part No. U5C4N1ENNB250
 - 2) 1" Sch.40, 500'-0", Part No. U5C4N1ENNB500
 - 3) 1" Sch.40, 1800'-0", Part No. U5C4N1ENNB1800

2. Duct plugs shall be provided in each outside plant conduit at the last maintenance hole or vault that routes to either the associated telecommunications room or the exterior junction box on the building. Blank plugs shall be provided at all unused U.G. conduit.
 - a. Manufacturer Carlon: (or Pyramid equal)
 - 1) 2" Blank, Part No. MAEPG5
 - 2) 4" Blank, Part No. MAEPG7
 - 3) 4" 3-hole, for 1" Sch. 40, Part No. MATPG2

B. Copper Identification Tags:

1. Identification tags shall be self-sealing, write-on, non-adhesive, measuring 3.50" x 2.00", and vinyl. Attach the tags to the associated innerduct or directly to the cabling utilizing specified cable ties. The tag for optical fiber cabling shall read "CAUTION: FIBER OPTIC CABLE" and for copper cabling the tag shall read "CAUTION: TELEPHONE CABLE". Each tag shall have lines for "TYPE" and "COUNT" which cable information shall be provided in permanent ink.
2. Tags shall be located where cable identification is needed, such as maintenance holes, vaults, risers, U.G. conduit entrance, and at cable termination location.
 - a. Manufacturer ACP International:
 - 1) Copper cable tags, Part No. VCT-201 (orange)

2.5 OPEN CABLING SUPPORTS

- A.** Mounting hardware and other accessories shall be provided for securing supports to structure for open cabling supports. Supports shall comply with TIA requirements for structured cabling systems and pathway supports. Follow manufacturer's recommendations for quantity of cables supported.

B. Hook & Loop Fasteners:

1. Hook and loop fastener rolls shall be offered in 15 and 75-foot lengths and be 0.5-inch in width. Shear strength; for plenum rated product shall be 29 PSI and non-plenum rated product shall be 23 PSI. Hook and loop fasteners installed in plenum air spaces shall be UL Listed (plenum).
 - a. Manufacturer Leviton or equal:
 - 1) Non-plenum 15' roll, Part No. 43115-15 (black)
 - 2) Non-plenum 75' roll, Part No. 43115-75 (black)
 - 3) Non-plenum 600' roll, Part No. 43115-600 (black)
 - 4) Plenum 15' roll, Part No. 43115-15P (maroon)
 - 5) Plenum 75' roll, Part No. 43115-75P (maroon)

C. J-Hooks:

1. J-hooks shall have a Galvanized finish with rounded edges for smoother cable pull and greater corrosion resistance. Compliant with UL2043 for use in plenum spaces. Cable capacity noted per manufacturer.

- a. Manufacturer Erico nVent Caddy:
 - 1) 1" Dia., Part No. CAT16HP
 - 2) 1-5/16" Dia., Part No. CAT21HP
 - 3) 2" Dia., Part No. CAT32HP
 - 4) 3" Dia., Part No. CAT48HP
 - 5) 4" Dia., Part No. CAT64HP

D. Adjustable Cable Support:

- 1. Adjustable cable support shall be of steel and polyethylene materials, plenum rated, with unlocking and locking bar allowing additional cables to be added easily after installation. Cable capacity noted per manufacturer.
 - a. Manufacturer Erico nVent Caddy, Part No. CAT425

2.6 CABLE PROTECTIVE DEVICES

A. Braided Expandable Sleeving:

- 1. Fray-resistant braided expandable sleeving shall be black, polyethylene terephthalate (PET), rated for use from -94°F to 257°F. Provide for telecommunications cabling transitions from wall pass-through plate to modular furniture system panel and dressing cables in telecommunications rooms.
 - a. Manufacturer Panduit:
 - 1) 1.25" I.D., Part No. SE125PSC-LR0 (per 50'-0" roll)
 - 2) 1.50", I.D., Part No. SE150PSC-LR0 (per 50'-0" roll)

2.7 FIRE-RATED PATHWAYS

- A. Fire-rated pathway device shall consist of a heavy gauge galvanized steel raceway lined with intumescent firestopping material. The intumescent firestopping material shall automatically adjust to the size of the cabling bundle and shall permit cabling to be added or removed without the need to remove the firestopping material. Provide the necessary quantity of wall plates to support the pathway device. The pathway device shall be UL tested and classified in accordance with ASTM E814 (UL1479).
 - 1. Series 22 pathway devices are provided as a complete kit. For Series 33 pathway devices, provide radius control modules at the end of each pathway through wall transition and penetration.
 - a. Manufacturer Specified Technologies, Inc. EZ Path:
 - 1) Series 22 mini fire-rated pathway device, Part No. EZD22
 - 2) Series 33 fire-rated pathway device, Part. No. EZD33FWS
 - 3) Series 33 radius control module, Part No. RCM33
 - 4) Series 33 extension module, Part No. EZD33E
 - 5) Series 33 circular wall plate kit (4" round opening), Part No. EZDP133CWK

- 6) Series 33 square wall plate (3" x 3" square opening), Part No. EZDP33FWS
 - 7) Series 33 two-gang fire-rated pathway kit, Part No. EZDP233GK
 - 8) Series 33 three-gang fire-rated pathway kit, Part No. EZDP333GK
 - 9) Series 33 four-gang fire-rated pathway kit, Part No. EZDP433GK
- B. Firestopping putty shall be a one-part, two-stage intumescent, non-hardening compound. The putty, when exposed to high heat or flame shall be capable of expanding a minimum of five times. Range of continuing expansion shall be from 230°F to >1,000°F (110°C to >538°C). The putty shall be soft and pliable with aggressive adhesion and shall not contain any water-soluble intumescent ingredients. The putty shall be UL Classified and/or FM Systems Approved and tested to the requirements of ASTM E814 (UL1479).
1. Manufacturer Specified Technologies, Inc.:
 - a. SpecSeal 24" putty bar, Part No. SSP28
 - b. SpecSeal 36" putty bar, Part No. SSP100

2.8 TELECOMMUNICATIONS WORKSTATION DEVICES

A. Augmented Category 6 Modules:

1. 8-Position 8-Conductor modules shall be Augmented Category 6, dual reactance technology, non-keyed, universal T568A/B pin configuration standard and used to terminate Augmented Category 6 UTP cabling as specified herein. Module shall be high impact thermoplastic housing, flame retardant UL 94V-O, modular contacts shall be beryllium copper, nickel plating under 50 micro-inches gold plating in contact area. IDC contacts shall be phosphor bronze, nickel under plating with tin lead over plate serving 22 through 24 AWG.
 - a. Manufacturer Ortronics:
 - 1) Augmented Category 6 module:
 - a) Cloud white, Part No. OR-TJ6A-88

B. Blank Modules:

1. Blank module shall be high impact thermoplastic housing, flame retardant UL 94V-O to secure unused module openings and provide protection from dust and debris. Blank modules are provided in packs of 10.
 - a. Manufacturer Ortronics:
 - 1) Cloud white, Part No. OR-42100002-88

C. Wall Phone Faceplate with Studs:

1. Wall phone faceplates shall be stainless steel single gang plates with top and bottom phone studs for mounting of telephone. Provide Category 6 or Augmented Category 6, 8P8C module matching the infrastructure specified for the structured cabling system.

- a. Manufacturer Ortronics, Part No. OR-403STJ1WP

D. Faceplates:

- 1. Faceplate shall be thermoplastic manufactured to hold 8P8C modules with recessed designation strips with clear plastic covers in accordance with the TIA-606-C labeling standard. See drawings for select outlets requiring stainless steel faceplates.

- a. Manufacturer Ortronics:

- 1) 4-port:

- a) Cloud white, Part No. OR-40300546-88
- b) Stainless steel, Part No. OR-403STJ14

E. Surface Mount Boxes:

- 1. Surface mount boxes shall be high impact thermoplastic to hold 8P8C modules with recessed designation strips with clear plastic covers in accordance with the TIA-606-C labeling standard. Surface mount boxes shall meet UL2043 to be suitable installation in plenum applications.

- a. Manufacturer Ortronics:

- 1) 1-Port cloud white, Part No. OR-404TJ1-88
- 2) 2-Port cloud white, Part No. OR-404TJ2-88

F. Floor Box and Poke-Thru Pedestal Frame:

- 1. Frame shall be high impact thermoplastic to hold four 8P8C modules and shall utilize a Decora style configuration for mounting in the rectangular electrical mounting footprint of a GFCI outlet.

- a. Manufacturer Ortronics:

- 1) 4-port Decora bezel:

- a) Cloud white, Part No. OR-41900018-88

2.9 DIRECT CONNECT CONNECTIVITY

A. Direct Connect Connectivity and Terminations:

1. 8P8C Modular Plugs

- a. Pre-approved Augmented Category 6, 8-position, 8-conductor 8P8C plugs shall be provided based on the warranting manufacturer for the direct attach termination to solid conductor Augmented Category 6 cabling.
- b. 8P8C plugs shall be compatible to be terminated on both Category 6 and Augmented Category 6 cabling.
- c. 8P8C plugs shall be field terminated with manufacturer approved termination tool. No other termination tools shall be authorized for the termination of these direct attach terminations.

- d. Plugs with a plastic boot shall be plenum rated when used in an air-plenum environment.
- e. Adhere to manufacturer's plug installation guidelines and testing procedures to ensure proper performance and signal transmission.
 - 1) Augmented Category 6 8P8C plug approved manufacturers:
 - a) Bel Stewart, Part No. SS-39100-031
 - b) Allen Tel, Part No. AT8X8RC6A-10G
 - 2) 8P8C termination crimping tool approved manufacturers:
 - a) Bel Stewart, Part No. 2990003-01
 - b) Sentinel, Part No. 900005
 - c) Allen Tel, Part No. AT568

2.10 TELECOMMUNICATIONS ROOM CONNECTIVITY

A. Patch Panels:

1. Augmented Category 6 Patch Panels:

- a. Augmented Category 6, high density 110-type patch panels with six-port 8-Position 8-Conductor modules, non-keyed, with dual reactance technology, universal T568A/B pin configuration for termination of UTP cables as specified herein. Patch panels shall be aluminum and available with black or white powder coat finish. Modules shall be high impact thermoplastic plastic housing, flame-retardant UL 94V-O rated, and fully encased protected printed circuit board. Modular contacts shall be beryllium copper, nickel under plating, 50 micro-inches of gold in contact area with IDC contacts serving 22 through 25 AWG cable conductor size.
 - 1) Manufacturer Ortronics:
 - a) 24 port patch panel, black, Part No. OR-PHD6AU24
 - b) 48 port patch panel, black, Part No. OR-PHD6AU48

B. Wall Mount 110 Series Wiring Block:

- 1. 110 wiring blocks shall be constructed of high impact flame-retardant polycarbonate UL 94V-O rated and shall be provided with legs. IDC contacts shall be phosphor bronze, 90/10 tin lead plating. For backbone cabling terminations, utilize 5-pair 110C connecting clips only. The wiring blocks shall accommodate 22 through 26 AWG cable conductor size.
 - a. Manufacturer Ortronics:
 - 1) Category 3 100-pair, Part No. OR-30200145
 - 2) 110C5 connecting clips, package of 10, Part No. OR-30200110
- 2. Colored identification strips and clear holders for 110 wiring blocks shall be provided as indicated on the Contract Drawings. 110 Designation Kits shall be provided with (2) clear holders and designation strips.

- a. Manufacturer Ortronics:
 - 1) White strips, Part No. OR-70400272

2.11 TELECOMMUNICATIONS ROOM SUPPORT EQUIPMENT

A. Fire Retardant Plywood Backboards:

- 1. Plywood backboards shall be 3/4" fire retardant ACX plywood to cover the walls as indicated in the Contract Drawings.
- 2. Backboard shall bear a seal identifying the plywood is fire retardant.
- 3. Backboard shall be painted white with the seal left exposed for identification.

B. Ladder Rack:

- 1. Ladder rack as specified herein shall be installed within the telecommunications room only.
- 2. Ladder rack shall be prefabricated metal structure consisting of longitudinal stringer side rails with cross members welded at 12-inch intervals on center and supported every 5'-0" and be black in color.
- 3. Both stringer side rails and cross members shall be constructed of 3/8" x 1-1/2" x 0.065" wall rectangular steel tubing.
- 4. Mounting supports shall be based upon the building conditions of the space. Utilize wall or ceiling/structural support mounting methods only, ladder rack shall not be attached to or supported by the equipment rack. Provide seismic bracing of the ladder rack as required by the AHJ. Cable loading shall meet the loading requirements of NEMA 12C.
- 5. Additional hardware required to construct the designed ladder rack shall be those recommended by the manufacturer.

- a. Manufacturer CPI:

- 1) 18" W universal cable runway, Part No. 10250-718

C. Ladder Rack accessories:

- 1. Cable runway radius bends, in color black, shall be provided to match the universal cable runway width as indicated in the Contract Drawings.

- a. Manufacturer CPI:

- 1) 18" E-bend, Part No. 10822-712

- 2. Protective end caps shall be provided at all exposed cable runway ends to prevent damage to cable jackets and reduce risk of personal injury.

- a. Manufacturer CPI, 1-pair, Part No. 10642-001

- 3. Vertical wall brackets shall be provided to secure vertically mounted cable runway to the wall.

- a. Manufacturer CPI, Part No. 10608-701

4. Wall angle support kits shall be provided where the end of the cable runway terminates perpendicular to the wall. Wall angle support kits consist of one wall angle bracket, two j-bolts and attachment hardware. Provide in color black.
 - a. Manufacturer CPI:
 - 1) 18" wall angle kit, Part No. 11421-718
5. Triangular bracket support kits shall provide wall support for ladder tray. Supports shall be constructed of cold rolled steel and have a load rating of 400 lbs. Supports kits shall consist of one triangular bracket, j-bolts and attachment hardware. Provide in color black.
 - a. Manufacturer CPI:
 - 1) Ladder rack width 9"-18", Part No. 11746-718
6. Threaded ceiling kits shall be provided where cable runway runs parallel to the wall and above equipment racks at intervals not to exceed 5-feet. Ceiling kits consists of one ceiling support bracket, one 5/8-inch x 6-foot long threaded rod, one runway support bracket and four 5/8-inch hex nuts. Provide (2) kits at each support location.
 - a. Manufacturer CPI:
 - 1) Threaded ceiling kit, 1 kit, Part No. 11310-003
 - 2) For locations where the ceiling height exceeds the 6-foot threaded rod length, provide 5/8-inch threaded rod coupling kit and 5/8-inch threaded rod.
 - a) Threaded rod coupling kit, Part No. 10697-002
 - b) Threaded rod, 5/8-inch x 12", Part No. 11440-004
 - c) Threaded rod, 5/8-inch x 8", Part No. 11440-005
 - d) Threaded rod, 5/8-inch x 6", Part No. 11440-007
 - e) Threaded rod, 5/8-inch x 4", Part No. 11440-006
7. Radius drop out brackets shall be provided at all sections along the ladder rack where cabling enters and exits the horizontal pathway to maintain proper bend radius. Provide in color black.
 - a. Manufacturer CPI:
 - 1) 8" radius drop cross member, Part No. 12100-709
 - 2) 7.75" radius drop stringer, Part No. 12101-702
8. Movable cross members shall be provided for radius drops where fixed rungs are not positioned directly over the side channels of the equipment rack. Provide in color black.
 - 1) 18" Movable cross member cable runway, Part No. 12115-718
9. Splice kits shall be utilized to connect sections in accordance with manufacturer's recommendations. Provide in color black.
 - a. Manufacturer CPI:

- 1) Butt-splice kit, Part No. 11301-701
 - 2) Junction-splice kit, Part No. 11302-701
 - 3) 45° runway splice kit, Part No. 11313-701
10. Ground straps shall be provided to bond cable runway sections at butt and junction splice points. Ground strap kit consists of 8", #6AWG green insulated wire attached at both ends to two-hole compression lugs and attachment hardware. The cable runway shall be bonded to the telecommunications grounding and bonding system. Remove black paint from runway prior to installation to maintain continuity.
- a. Manufacturer CPI, Part No. 40164-001
- D. Wall Mounted Cable Management
1. 110 Jumper Troughs with legs shall be mounted above and below each 100-pair 110-wiring block kit.
 - a. Manufacturer Ortronics, Part No. OR-30200140
 2. Metal D-rings shall be provided for routing and managing cabling on backboards.
 - a. Manufacturer Garvin, 5" Part No. DST-500 or approved equal.

2.12 TELECOMMUNICATIONS ROOM GROUNDING AND BONDING

- A. Telecommunications Main Grounding Busbar (TMGB):
1. TMGB shall be a copper plate, 1/4" thick x 4" wide x 20" long conforming to BICSI and TIA standards.
 2. TMGB shall be pre-drilled for bolts to secure bar to insulating standoffs. Mounting holes shall be 3/8" diameter spaced 5.75" apart. TMGB shall include insulators to isolate busbars from the wall or other mounting surfaces.
 3. Busbar shall be pre-drilled with hole pattern to accommodate two-hole lugs as follows, (27) lugs with 5/8" hole centers and (3) lugs, 1" hole centers.
 - a. Manufacturer CPI, Part No. 40153-020
- B. Pipe Clamps:
1. Copper UL listed grounding connector with pre-drilled lug pad allowing 2-hole compression terminal; the size of connector will be dictated by pipe size.
 - a. Manufacturer Burndy, T&B, Thermoweld or approved equal.
- C. Exothermic Welding:
1. Manufacturer Erico Cadweld or Thermoweld, appropriate fittings as required.
- D. C-type Compression Taps:
1. Bonding together two or more bonding backbones.
 - a. Manufacturer Burndy, T&B, Thermoweld or approved equal.

E. Cable Terminals:

1. Cable terminal shall be two-hole, non-insulated copper compression long barrel terminal, requiring 3/8" bolts on 1" and 5/8" centers.
 - a. Manufacturer Burndy, T&B, Thermoweld or approved equal.

2.13 EQUIPMENT RACKS AND CABLE MANAGEMENT

A. 2-Post Free-Standing Equipment Racks:

1. Standard Channel Equipment Racks
 - a. Equipment racks shall have a load capacity of 1,500 lbs., with 3" channel with standard EIA mounting hole pattern and masked mounting location for ground lug with (2) 1/4-20 threaded studs spaced 5/8" apart is provided inside the side channel.
 - b. Equipment racks shall be 7'-0" high with 45 rack units of mounting space accommodating 19" wide equipment.
 - c. Equipment rack side rails shall have manufacturer rack unit labeling.
 - 1) Manufacturer CPI,
 - a) 3" channel, Part No. 46353-703

B. Peripheral Devices for Equipment Racks:

1. Equipment racks shall be equipped with the following. Quantities shall be provided as indicated on the Contract Drawings.
 - a. Manufacturer CPI:
 - 1) Equipment mounting screws, package of 50, Part No. 40605-005
 - 2) Grounding kit, Part No. OR-40159-008
2. Equipment racks shall be anchored with 1/2" anchors designed for concrete. Kit shall include (4) 1/2" anchors, (4) 3-3/4" long bolts, (4) washers and (4) nuts.
 - a. Manufacturer CPI, Part No. 40604-003 or approved equal

C. Rack Mounted Cable Management:

1. Horizontal cable management panels shall have distribution rings or other means to secure copper and/ or optical fiber patch cords.
 - a. Manufacturer CPI:
 - 1) 2RU panel, fingers w/ cover, Part 30130-719
2. Vertical cable management panels shall be 7'-0" high and have latches spaced 12" apart for securing cabling and patch cords to be provided in between and at the end of each equipment rack as indicated on the Contract Drawings.

- a. Manufacturer CPI:
 - 1) 6" wide double-sided, Part No. 11729-703

2.14 POWER DISTRIBUTION

- A. Vertical Power Strip:
 - 1. Vertical power strip shall be 33" vertically mounted power strip with (14) NEMA 5-20 receptacles and NEMA 5-20 plug. Quantities shall be provided as indicated on the Contract Drawings.
 - a. Manufacturer CPI:
 - 1) 1.9kW Power strip, Part No. 12850-705 (w/ 9"D mounting brackets)

2.15 MATERIAL PROVISIONS

- A. Materials shall be provided to the Owner as specified herein. Deliver to the Owner Representative or General Contractor, as coordinated, 14 days prior to Substantial Completion. Include a signed transmittal to the Owner or Owner's Representative and General Contractor for each type of patch cord provided. Provide digital photographs of patch cords separated into groups identified by patch cord colors or lengths. Transmittal and digital photographs shall be included as part of the O&M manuals.
 - 1. Copper Patch Cords
 - a. Augmented Category 6 Patch Cords
 - 1) Patch cords shall be constructed from Augmented Category 6 4-pair 23 AWG, stranded patch cable material, UL[®] listed and shall meet FCC Part 65 plug and termination.
 - a) Manufacturer Ortronics: (See table)

Item	Part No.	Length	Color	Qty.	Description
1	OR-MC6A03-04	3'-0"	Yellow	12	Data
2	OR-MC6A05-04	5'-0"	Yellow	12	Data
3	OR-MC6A07-04	7'-0"	Yellow	24	Data
4	OR-MC6A09-04	9'-0"	Yellow	38	Data
5	OR-MC6A03-05	3'-0"	Green	14	Wireless
6	OR-MC6A05-03	5'-0"	Green	7	Wireless
7	OR-MC6A07-03	7'-0"	Green	7	Wireless
8	OR-MC6A09-03	9'-0"	Green	7	Wireless

PART 3 - EXECUTION

3.1 GENERAL

- A. Include labor, materials, tools, equipment, and services for installation as indicated in the Contract Documents. Install Work as specified and in accordance with the Contract Drawings and manufacturer's instructions.
- B. Coordinate Work with other trades for complete and operational system.
- C. Include supplementary and miscellaneous items, appurtenances, and devices incidental to and necessary for a complete installation, whether or not specifically indicated in the Contract Documents.
- D. Protect surrounding areas and surfaces to prevent damage as work is installed. Provide suitable barriers and take any other safety precautions required by applicable codes.
- E. Work area shall be kept free from debris of all types and remove all rubbish resulting from their work on the premises. Upon completion, vacuum and clean room floors, equipment racks, enclosures, and cable management where work has been performed.
- F. Contractor shall be responsible for any building repairs made necessary by their work or caused by negligence of their employees. No cutting, notching, drilling, or altering of any kind shall be done to the building without first obtaining permission from the Owner.
- G. Owner may have other Contractors in connection with this work for the installation of software and equipment. Contractor shall provide the Owner's Contractors reasonable opportunity for the execution of their work and shall properly coordinate other trade's work with theirs as required.
- H. Provide patch panels and termination blocks as indicated on the Contract Drawings regardless of if they are fully populated with cables.
- I. Provide cables, devices and equipment racking systems as indicated on the Contract Drawings.

3.2 ADDITIONAL CABLING

- A. Provide an additional (12) Category 6A cables to be located during construction by the Owner. Workstation devices shall be as specified herein including but not limited to; cabling, faceplates, modules, blank modules, open cabling supports, labeling and testing.
- B. Assume an installed cable length of 295'.
- C. Note all additional cables and device locations on the as-built drawings in the field office for inclusion in the Record Drawings.

3.3 TELECOMMUNICATIONS ROOM EQUIPMENT INSTALLATION

- A. Primary function of a telecommunications room is the termination of horizontal, backbone and service entrance cabling to compatible connecting hardware.

- B. A telecommunications room provides a controlled environment to house telecommunications equipment, connecting hardware, and splice enclosures serving a portion of the building.
- C. Coordinate layout and installation of telecommunications devices and equipment with Owner's telecommunications equipment.
- D. Coordinate location of power raceways and receptacles with locations of telecommunications equipment requiring electrical power to operate.
- E. Install fire retardant plywood backboard vertically at 6" AFF, painted with latex paint, on walls indicated on the drawings, leaving the fire seal exposed. See Contract Drawings for location of backboards in the telecommunications rooms and spaces.
- F. Provide equipment including the following, but not limited to the following, and shall be installed according to the Contract Drawings:
 - 1. Equipment racks and or equipment enclosures with vertical and horizontal cable management systems and or devices
 - 2. Patch panels and termination blocks
 - 3. Telecommunications workstation devices
 - 4. Cable tray and/ or ladder rack
- G. Where applicable, each freestanding equipment rack and/or server enclosure shall be seismically braced from the top to a structural component beam, column, bearing wall, etc. of the building. Coordinate with the AHJ to determine if seismic bracing is required and if structural engineering services are required.
- H. Equipment rack shall be secured to the concrete floor with a concrete floor mounting kit.
- I. 110-blocks shall be securely fastened to the backboards in the telecommunications room. Provide all required D-rings or other approved cable management devices for cable support and management as identified on the Contract Drawings.

3.4 TELECOMMUNICATIONS ROOM LADDER RACK INSTALLATION

- A. Install ladder rack/ cable runway at locations indicated on the Contract Drawings. Installation shall be in accordance with manufacturer's instructions and with recognized industry practices to ensure that ladder rack equipment comply with requirements of NEC and applicable portions of NFPA 70B. Reference NEMA-VE2 for general cable tray installation guidelines.
- B. Support the ladder rack on 5'-0" centers for a total of 2 supports for every 10' span when the ladder rack is supported from the ceiling. Support ladder rack at every transition. Support ladder rack utilizing wall mount brackets or c-channel hangers.
- C. Provide additional support brackets on ends, and two additional support brackets at tees and corners. Securely fasten ladder rack to brackets and supports using clamps manufactured for the purpose. Provide all required hardware and supports.
- D. Fitting supports shall be located such that they meet the strength requirements of straight sections. Install fitting supports per NEMA VE-2 guidelines, or in accordance with manufacturer's instructions.

- E. Place supports so that spans do not exceed maximum spans and provide clearances shown on Contract Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the ladder rack.
- F. Make changes in direction and elevation using manufacturer's recommended fittings.
- G. Make connections using manufacturer's recommended fittings.
- H. Remove burrs and sharp edges from ladder rack.

3.5 OPEN CABLING SUPPORT INSTALLATION

- A. Cabling shall be run exposed as "open cabling" in ceiling spaces and ceiling plenums, unless otherwise noted.
- B. Provide all hanger supports and cable supports for cabling specified in this section. All support structures shall adhere to the requirements in the National Electrical Code.
- C. Cabling supports shall be spaced no further than 60" apart and a minimum of 8" above ceilings.
- D. Cabling bundles shall not sag a maximum of two inches from the bottom of the cable support.
- E. Provide all additional cable management products as required to protect exposed cabling and complete the installation of cabling in a neat professional manner.
- F. Floor penetrations shall be at columns, exterior walls unless otherwise specified.
- G. Cabling supports shall be installed on their own support system. The use of ceiling grid supports shall be prohibited.
- H. Do not support cables from ductwork, sprinkler piping, water piping, waste piping, conduit or other system supports. Cabling shall never come in physical contact with these mechanical, fire protection and electrical systems and raceways.
- I. Cabling bundles and supports changing pathway direction shall maintain proper bend radius as to not impact the physical jacket construction of the cabling. Cabling that becomes damaged during this transition shall be replaced in its entirety.
- J. Follow manufacturer's recommendations for quantity of cables supported in J-hooks and adjustable cable supports.
- K. Installers shall observe the applicable requirements and recommended good practices contained within TIA-568-D standard for cabling installation requirements.

3.6 CABLING INSTALLATION

- A. Telecommunications devices shall be connected to the horizontal cross-connect in a telecommunications room with horizontal cabling installed in star topology.

- B. Horizontal cabling shall be installed in continuous runs from the telecommunications rooms to telecommunications device locations. Splices are not permitted.
- C. Maximum length of horizontal cables shall be 295 feet (90 m) including all service loops.
- D. Cabling shall be installed in accordance with manufacturer's recommendations, including but not limited to maximum tensile loading and maximum bend radius.
- E. Cabling shall be organized and identified to facilitate locating and handling individual sheaths for maintenance functions.
- F. Bundles shall be neatly secured without cinching or stressing the cabling, using hook and loop fasteners in open cabling installations and in the telecommunications room. Hook and loop fasteners shall be loose enough so that the fastener can be easily rotated around the cabling bundle and does not impact the physical construction of the cabling.
- G. Provide machine typed label on both ends of the horizontal cabling jacket no more than 4-inches from each termination point.
- H. Protect all cabling from physical damage beneath floors, above ceilings or elsewhere. Cabling shall not be exposed to any forces or handling factors that will degrade performance, such as crushing, pull stressing, twisting, or damaging sheathing materials. When left unattended, all cabling shall be secured and protected to avoid damage.
- I. Hook and loops fasteners shall be utilized in the telecommunications room for all cabling bundles. Tie wraps are prohibited in the telecommunications rooms.
- J. Horizontal and backbone cabling shall be bundled and routed separately in dedicated cabling supports in a neat and organized fashion for routing from the telecommunications rooms utilizing cable trays and open cabling pathways to the telecommunications devices.
- K. Route cabling runs from workstations parallel to building grid lines and directly to open cabling pathways without passing over adjacent office spaces or cubicles.
- L. Provide 5'-0" of slack in neatly suspended loops above each workstation and 10'-0" of slack neatly coiled in the ladder rack, cable runway or cable tray in the telecommunications room unless indicated otherwise on Contract Drawings. Service loops in the telecommunications room shall not be located above the equipment racks.
- M. Cables shall contact only dedicated and properly protected cable accesses and support mechanisms.
- N. Telecommunications unshielded twisted pair cabling supported utilizing open cabling methods shall maintain a minimum separation of 3" from fire alarm, intercom/paging, clock and security cabling. Cabling supports shall maintain increased separation requirements when attaching to the same hanger rod to ensure cabling sag maintains the minimum 3" separation.
- O. Maintain the following distances between cabling and other building systems:
 - 1. One foot from fluorescent lights.
 - 2. Six feet from motors and transformers.
 - 3. Three feet from water piping or other mechanical equipment.
 - 4. One foot from electrical conduits or other electrical equipment.

- P. Fasten cables on vertical runs to ladder rack and/ or cable trays every 18”.

3.7 CONNECTIVITY AND CABLING INSTALLATION

- A. Cabling shall be dressed and terminated in accordance with the cabling installation requirements identified in TIA-568-D, BICSI Telecommunication Cabling Installation Manual, and the manufacturer’s documentation.
- B. Cabling entering the telecommunications room and routing on the ladder rack or cable tray pathway shall be separated into cabling bundles specific to the patch panel in which it will be terminated to. Cable bundles shall be in increments of 24 cables.
- C. Cabling shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the equipment rack.
- D. Cabling transitioning from ladder rack or cable tray pathway shall maintain proper bend radius utilizing waterfall device brackets for transitioning vertically down the side rail of an equipment rack as to not impact the physical jacket construction of the cable. Waterfall device brackets shall also be utilized for transitioning cabling to blocks mounted on plywood. Cabling that become damaged during this transition shall be replaced in their entirety.
- E. Cables shall be clearly labeled on the cable jacket behind the patch panel at a location that can be viewed without removing the bundle support straps. Cables labeled within the bundle, where the label is obscured from view shall not be acceptable.
- F. Installation of 8-position 8-conductor modular jacks into faceplates and attaching of the faceplates to the wall shall ensure that the faceplates are flush. The faceplate shall be secured to the wall but shall not be secured to the wall with such force as to bow the faceplate.

3.8 WORK AREA

- A. 4-pair UTP horizontal cabling shall be terminated on an 8-position 8-conductor modular jack or plug at each telecommunications device as indicated on the applicable Contract Drawings.
- B. Telecommunications devices shall be provided with 8-position 8-conductor modular jacks or plugs in the quantity as indicated on the applicable Contract Drawings.

3.9 CABLING TERMINATIONS

- A. Provide all necessary installation materials, tools, and equipment to perform insulation displacement type terminations at all the telecommunications outlets, patch panels and 110 cross-connect blocks.
- B. Cabling shall be terminated on a 110-block, modular patch panel or telecommunications modules in accordance with this specification.
- C. Cabling shall be terminated in accordance with the T568B pin configuration standard.

- D. Remove only as much of the cable sheath as is necessary to terminate the cabling on the connecting hardware.
- E. A maximum of 0.25" of cable pair twists shall be removed from a 4-pair UTP cable. Cable terminations that exceed this dimension shall be re-terminated.
- F. At the horizontal patch panel, the cabling shall terminate from the center of the 110 IDC termination.
- G. Terminate cabling in accordance with connecting hardware manufacturer's recommendations. All cabling shall terminate in numerical sequence.

3.10 FIRESTOPPING

- A. Firestop systems shall be installed in accordance with the NEC and the manufacturer's recommendations and shall be accomplished in a manner acceptable to the local fire and building authorities having jurisdiction over this work.
- B. Cabling running through rated floors and walls shall be firestopped in accordance with the requirements within this Section.
- C. Penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system. This requirement applies to through penetrations (complete penetration) and membrane penetrations (through one side of a hollow fire rated structure).
- D. Penetrations created by or for the contractor and left unused shall also be sealed as part of the contractor's scope of work.
- E. Firestop putty or pillows shall be used inside conduits to provide a re-enterable system allowing telecommunications cables to be easily removed or added in the future. Firestop putty shall not be water soluble.
- F. Firestop systems shall be UL Classified to ASTM E814 (UL 1479).
- G. Firestopping sleeved devices shall be installed according to the manufacturer's recommendations including, but not limited to;
 - 1. Wiring devices shall be installed in locations where indicated on the Contract Drawings, arranged in a single or multiple sleeve formation at the height specified. Sleeves shall be installed a minimum of 6" above the accessible ceiling grid.
 - 2. Install the devices in accordance with the approved shop drawings and the manufacturer's recommendations.
 - 3. Apply the factory supplied gasket material prior to the installation of the wall plates.
 - 4. Secure wall plates to devices per the equipment manufacturer's recommendations.

3.11 TELECOMMUNICATIONS GROUNDING AND BONDING

- A. Grounding and bonding connections to the building's structural steel, electrical service main building ground and telecommunications bonding backbone shall be terminated on the left side of the busbar to facilitate access for other grounding sources within the space to be terminated within the center and right side of the busbar.

- B. Bonding backbone shall route along the shortest and straightest pathway as possible with minimal bends. Any bend shall be sweeping. The conductors shall be continuous and shall not contain splices.
- C. Telecommunications bonding backbone shall connect the main telecommunications grounding busbar to each other telecommunications grounding busbar within the facility.
- D. Grounding and bonding conductor distances shall meet the distance requirements described within TIA-607-D.
- E. Grounding and bonding connections shall be a stranded, insulated copper conductor with a minimum size of #6 AWG.
- F. Grounding and bonding connectors shall be 2-hole and made with a crimp or other non-reversible termination method.
- G. Provide a coupled bonding conductor for outside plant copper shielded cabling routing between buildings and ground to the busbar.
- H. Provide a dedicated grounding connection for the below floor and overhead ladder rack and/or cable tray pathways.
- I. Ladder rack, cable runway and/ or cable tray shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers
- J. Equipment racks shall have a dedicated grounding connection.
- K. Provide grounding and bonding of all telecommunications pathways including conduit raceway systems and ladder rack pathways.
- L. Ensure that all grounding and bonding connections break through and/or remove the paint to the bare metallic surface of all painted metallic hardware.

3.12 LABELING

- A. General:
 - 1. Labeling shall be in accordance with TIA-606-C, Administration Standard for Commercial Telecommunications Infrastructure.
 - 2. Labels shall be permanent typewritten labels produced by a labeling machine.
 - 3. Labels shall be installed on all cabling at each end. Ensure labels are securely fastened.
 - 4. Labels shall be located within 4"-6" of a cable termination and placed so they can be easily read.
 - 5. Font type for each type of label shall be Arial with maximum size font allowed.
 - 6. Labeling information will be reviewed at the Pre-Construction Meeting.
 - 7. Labeling shall be completed prior to the Substantial Completion date of the project.
- B. Telecommunications Device Labeling:
 - 1. Label shall be produced to fit into the recess provided and covered with a clear plastic cover.

- a. TR-2-03-04 where:
 - 1) TR = Telecommunications Room (MDF or as indicated on the Contract Drawings)
 - 2) 2 = Equipment rack number
 - 3) 03 = Patch panel number
 - 4) 04 = Port number
2. Above Ceiling Device Labeling
 - a. A label on the ceiling grid shall be provided at each location where a network device is located above the ceiling.
 - b. The label shall be machine generated. The text shall be in bold white letters on black background printed on 1" tape with the maximum font size allowable.
 - c. Labeling shall be as follows:
 - 1) *WAP* - TR-2-03-04 where:
 - a) *WAP*= Device type as indicated on the Contract Drawings
 - b) TR-2-03-04=Cable I.D. Label
- C. Equipment Rack Labeling:
 1. Plastic lamacoid nameplate shall be provided for each equipment rack and/or server enclosure in the telecommunications room.
 2. Plastic lamacoid nameplate shall be black with white letters. The nameplate shall be machine engraved with a size 36 font.
 3. Mount the name plate at the top of each equipment rack, server enclosure or wall mount enclosure.
 4. Labeling scheme shall be as indicated on the Contract Drawings.
- D. Patch Panel Labeling:
 1. Station Patch Panel
 - a. 48-port modular patch panels shall be labeled with sequential numbering starting with "01" for the topmost patch panel and moving downward to the bottom of the rack. Patch panel labels shall be affixed to the left hand side of the patch panel.
- E. 110 Wiring Block Labeling:
 1. Color coded 110 designation strips shall be clearly labeled to identify the voice cabling terminated on each wiring block.
 2. In a horizontal cross-connect, the wall mounted 110 white fields on which terminates the voice backbone cable terminates shall have labels showing at a minimum the pairs at the beginning, end of each row, and at 5 pair increments.
 3. In the MDF/ MC, the white field labels shall show the pairs at the beginning, end of each row, and at 5 pair increments, as well as the IDF/ HC in which the voice backbone cables terminate.
- F. Cable Identification Tag Labeling:

1. Copper backbone cabling shall be clearly and visibly identified by the contractor in all maintenance holes, pull boxes, riser room pull points, building entrance points, service entrance and 36" before entering a free standing rack, wall mounted enclosure, rack mount fiber cabinet or surface mount fiber cabinet utilizing an optical fiber cable identification tag.
2. Copper backbone cable identification tags shall contain the following information at a minimum.
 - a. Cable manufacturer and part number
 - b. Extent of cable run (i.e. "From: MDF- To: Vault #XXX")
 - c. Cable type and description (i.e. "CMP, Cat5e 25-pair")

3.13 TESTING

- A. Test procedures shall be as prescribed by the TIA, Insulated Cable Engineers Association and the National Electrical Testing Association.
- B. Test Equipment:
 1. Network testing equipment shall be a Fluke Networks DSX-5000 Cable Analyzer or equal and shall have a certified calibration from the manufacturer within the past 12 months at the time of testing. Proof of calibration shall be provided with the product submittal. Test equipment shall be utilized to test horizontal and backbone cabling.
 2. Field tester and adapters shall be certified by an independent laboratory as meeting or exceeding current level as defined in TIA-1152 Level IIIe.
 3. 8P8C test plug for the network testing equipment adapters shall be in range of values defined in TIA-568-D for Near-end Crosstalk, Far-end Crosstalk and Return Loss.
 4. Test equipment shall support the complete suite of Resistance Unbalanced standards for PoE per IEEE 802.3af, IEEE 802.3at and TIA-568.2-D.
 5. Test equipment shall be able to test up to a 1000 MHz frequency range.
 6. Test equipment shall be ISO 9001 certified.
 7. An electronic copy of the manufacturer's testing procedures shall be kept in the job site office.
 8. Test equipment batteries shall be charged daily.
 9. Test equipment shall be calibrated daily before the start of testing.
- C. Horizontal Cabling:
 1. Horizontal cabling shall be certified to meet or exceed the permanent link performance specifications for Augmented Category 6 horizontal cabling tested with a frequency range from 1MHz to 500 MHz as defined in TIA-568-D.
 2. Certifications shall include the following parameters for each pair of each cable installed:
 - a. Building identification
 - b. Cable identification
 - c. Date of test
 - d. Test equipment manufacturer and model number
 - e. Wire map
 - 1) Continuity to the remote end.
 - 2) Shorts between any two or more conductors
 - 3) Reversed pairs
 - 4) Split pairs

- 5) Transposed pairs
 - 6) Any other miswiring
- f. Length
 - g. Near-end crosstalk (NEXT)
 - h. Attenuation to crosstalk ratio far-end (ACRF)
 - i. Power sum Attenuation to crosstalk ratio far-end (PSACRF)
 - j. Power sum-near-end crosstalk (PS-NEXT)
 - k. Return loss (RL)
 - l. Propagation delay (PD)
 - m. Delay skew (DS)
3. Horizontal cabling shall be tested using a Permanent Link configuration as defined in TIA-568-D.
 4. Test reports with an asterisk (*) or fails, shall be documented identifying the reason for the test failure and a corrective action plan developed.
 5. After corrective action has been completed, the permanent link shall be retested.
 6. It is the Telecommunications Contractor's responsibility to ensure 100 percent of the network horizontal cabling system links pass all tests.
 7. Test results shall be organized by building identification and cable identification number. The test results shall contain the date and time of when each test was saved in the memory of the tester. The test results shall be recorded on a CD-ROM in both PDF and LinkWare software formats.
- D. Backbone 100-ohm UTP Cabling:
1. Continuity tests shall be performed on all backbone cabling pairs and/or conductors.
 2. Testing procedures shall include the following parameters for each pair of each cable installed:
 - a. Wire map
 - 1) Continuity to the remote end.
 - 2) Shorts between any two or more conductors
 - 3) Reversed pairs
 - 4) Split pairs
 - 5) Transposed pairs
 - 6) Any other miswiring
 - b. Length
 3. Tests shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures and referenced to the appropriate cable identification number and circuit or pair number.
 4. Cabling links that fail the testing will be documented, identifying the reason for test failure and a corrective action plan.
 5. After corrective action has been completed, the link shall be retested.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section describes a Fire Station Alerting System known as FAST Alerting System.
- B. Work in this section is supported by all Fire Station Alerting drawings.
- C. Provide all labor, equipment, programming, associated interfaces and options required to provide a turnkey alerting System as described in these specifications and shown on associated drawings.
- D. Provide all testing and commissioning required to certify the system as meeting the minimum required operation and functionality described herein.
 - 1. Systems in this section include:
 - a. Station Wide Paging System
 - b. Audio Alerting System
 - c. Visual Alerting System
 - d. Dorm Room Isolation System
 - e. Triggered Events
 - f. Custom Programming
 - g. Code Notification
- E. Related Sections:
 - 1. Section 26 05 32 - Outlet Boxes for Electrical Systems
 - 2. Section 26 05 33 - Raceways Systems

1.2 REFERENCES

- A. Reference Standards: Current edition at date of Bid, except as otherwise specified.
 - 1. AES Audio Engineering Society
 - 2. EIA Electrical Industries Associations of America
 - 3. ICIA International Communications Industry and Association
 - 4. NSCA National Systems Contractors Association
 - 5. FCC Federal Communications Commission
 - 6. NAB National Association of Broadcasters
 - 7. NEC National Electrical Code
 - 8. NFPA National Fire Protection Association
 - 9. SMPTE Society of Motion Picture and Television Engineers
 - 10. UBC Uniform Building Codes
 - 11. UL Underwriters Laboratories

1.3 DEFINITIONS

- A. The "Owner" shall refer to Kirkland Fire Department.

- B. The "AVC" shall refer to the Audio Video Contractor submitting a bid on this specification and taking full responsibility for completion of project as required.
- C. The term "shall" is mandatory; the term "will" is informative; the term "should" is advisory; the term "provide" means furnish and install.
- D. The term "OFE" refers to Owner Furnished Equipment. The contractor shall install this equipment and integrate into the system as outlined in these documents. Contractor shall provide all required mounting hardware, rack panels, cable, connectors, etc. to ensure proper operation of the OFE systems as specified. All accessories necessary to fully provide intended functionality is the responsibility of the AV Contractor, unless otherwise noted.
- E. The term "BO" refers to By Others. Coordinate integration of existing components or new components provided by others into the system.
- F. The term "A/R" indicates components quantities "as required". The AVC shall provide the quantities necessary in order meet the full specifications of these systems.
- G. The term "NIC" refers to Not in Contract. These products and or services are not part of the overall contract, but information may be provided for the contractors benefit in determining a system's overall intent.
- H. The term "By EC" refers to equipment and/or services provided by the Electrical Contractor engaged on this project. The AVC shall coordinate with the EC to make sure all products and/or services listed conform to the needs of the Station Alerting System.

1.4 SYSTEM DESCRIPTION

- A. Station Wide Paging System- Provide ample coverage in all areas designated as paging zones, to provide a signal at least 20 db above ambient noise at 2kHz. The entire area covered must not vary by more than 6 db from the highest area of coverage to the lowest area. In any area where the ambient noise level may vary more than 10 db; provide an ambient noise sensing system where the paging level will automatically adjust according to the current ambient noise level. This ambient noise correction system shall be active in at least the following locations: Apparatus Bays; Kitchen; Dining Room; and Fitness Room. Contractor shall identify any other room on the plans as needing ambient noise control and provide all necessary equipment to provide as specified.
- B. Audio Alerting System- Provide an audible alert tone over the station wide paging system that will activate when the station is called by the local emergency dispatch for service. The alerting tone will activate and generate upon call notification and permeate through the entire audio system. The tone shall be followed by a human voice (dispatcher) describing the emergency situation. The Audio Alerting system shall remain on and active for at least 90 seconds; or programmed to a specific time constraint as determined by the local fire station personnel. There shall be no minimum or maximum time duration constraint on the alerting system.
- C. Visual Alerting System- Provide a visual alerting panel at all locations shown on the drawings. The alerting panel shall be visible from at least 20 feet away. The alerting panel shall provide at least 4 colored light illuminations. Each color shall be associated to specific call level; i.e. Red- Engine; Blue- Aid Car; Amber- Battalion Chief; Green- Rescue. The exact apparatus reference shall be provided prior to installation.
- D. Dorm Room Isolation System- Each Dorm room shall be equipped with an alerting system that is isolated from all other alerting zones in the building. Each room shall be able to be

programmed to be on a designated zone as determined by the member residing in the room. The member shall be able to check into or out of the alerting system on an ongoing basis with simple touch panels that provide immediate feedback in plain English as to what that room's current status is. The dorm room alerting system is used primarily for evening notification and is intended to alert the member within each room that their particular code level has been called. When activated- each dorm room shall provide at minimum the following:

1. Audio Alert- All functions of the Audio Alerting System shall be active in that room, and no other room, unless the other rooms are programmed to receive the current code level.
 2. Visual Alert- All functions of the Visual Alerting System shall be active in that room, and no other room, unless the other rooms are programmed to receive the current code level.
 3. Night Light- Provide a low-level illumination in the room that will come on when the alerting system has been activated. The light shall be different than the standard lighting provided as part of the electrical lighting package and shall not be integrated in any fashion. The Night Light will only come on in those rooms that have been programmed to receive the associated code call.
 4. Dorm Check In- There shall be a touch sensitive graphic panel located in each dorm room. The panel shall provide the resident the ability to check in or out of their room on an ongoing basis. The panel shall provide simple to use instructions to the resident on how to operate, and it shall provide visual confirmation of the current code status of their dorm room. The current code level of each dorm room shall be transmitted to the master control panel and shall automatically update the master panel immediately upon any code level change. The code level that the resident checks in as will determine which code level alert they will receive while in that room.
 5. The Dorm Remote shall automatically be reset to accept ALL INCOMING ALERTS every morning at a designated time. The Dorm Resident shall "Check OUT" of the undesired apparatus. i.e. If the Dorm Resident only is involved with the Ladder Truck, they would check out of all apparatus EXCEPT the Ladder truck. This way when a call comes in for Ladder truck, their bunk room receives the signaling.
- E. Triggered Events-The Alerting system shall provide the capability of triggering specific events each time an alarm is sounded. These events shall be programmable, but must include at minimum the following:
1. Lighting Zones On/ Off (See drawings for zone quantity)
 2. Gas Barbecue On/Off
 3. Gas Range On/Off
 4. Designated Appliances On/Off
 5. Provide for up to 3 additional triggered events On and Off
- F. Custom Programming- the Alerting system control software shall provide flexibility in the control system parameters as determined by the local fire station. The details of the control system operations shall be determined via a post-award interview with the user's group. The custom programming MUST be written in a platform that is readily available to an authorized service agency. NO CUSTOM PLATFORMS will be acceptable. In general, the programming shall provide at minimum the following functions:
1. Provide audio system adjustments in each audio zone (Each Dorm Room is considered a zone, as well as each living space as identified on the drawings):
 - a. Volume Up/Down/Mute
 - b. 1/3 Octave Equalization
 - c. Automatic Gain Control

- d. Automatic Level Control
 - e. Telco Interface for Paging System from Telephone System (Telephone System is specified elsewhere)
 - f. Fully adjustable Pre- Alert Tone
2. Provide programming on Triggered events that can be timed to turn on or off specific devices as determined by client.
 3. Provide programming of the Dorm Check In panels as described above.
- G. Code Notification- The alerting system shall be notified of a code call situation by various methods. The primary alerting shall be done via radio band notification compatible with the current emergency dispatch center's radio dispatch frequency. There shall be a secondary alerting done via IP, TELCO or other means as determined by the local emergency dispatch center. The contractor shall research the local dispatch centers methods of notification and provide redundant notification in order to satisfy NFPA #70. Initially the Code Notification system shall be triggered by Interface with the existing LOCUTION transmission methods. The Fire Department shall provide the local LOCUTION Computer with programmed CODE DECODER interface for the designated station. There shall be a minimum of 4 specific codes available to the system. Both the codes and audio dispatch shall be received via the LOCUTION computer.
- H. The AVC must provide a programming directive and detailed outline to the owner for review prior to implementation of the project. The programming directive must have at a minimum:
1. What the 4 Apparatus / Alarm Calls are to be called.
 - a. i.e. ENGINE, MEDIC, BATTALION CHIEF, LADDER
 2. What events occur on alert, i.e:
 - a. Lighting Zone 1 turns on.
 - b. Gas Stove turns off,
 - c. Etc.
 3. What the process is for resetting the alert.
 4. What time do the dorm rooms re-set
 5. Etc.

1.5 DESIGN REQUIREMENTS

- A. Coordination: Coordinate the work of this specification with the work of all sections being provided within the General Construction Contract.
- B. Verification: All documents, including supplied drawings have been put together with the greatest of care to insure accuracy. It is up to the bidding contractor to verify dimensions, conduits and/or any other critical information for accuracy before submitting a bid. Any unforeseen discrepancy must be presented to the owner/architect in a timely manner for resolution.

1.6 INSTALLATION REQUIREMENTS

1.7 GENERAL

- A. Perform the work of this specification in accordance with acknowledged industry and professional standards and practices, and the procedures specified herein.

1.8 WIRE AND CABLE INSTALLATION

- A. Provide permanent identification of run destination at all raceway terminations.
- B. All cables shall be continuous and splice-free for the entire length of run between designated connections and terminations.
- C. All shielded cable shall be insulated. Do not permit shields to contact conduit, raceway, boxes, panels or equipment enclosures.
- D. Within buildings- make splices only in designated terminal cabinets and/or on designated equipment backboards. Outside buildings-make splices only in designated manholes and/or hand holes. Protect splices outside of buildings with splicing kits equivalent to Scotchcast Re-enterable. Make splices only with connectors or terminal devices specified herein. Document all splices on Record Drawings.
- E. Verify that all raceway has been de-burred and properly joined, coupled, and terminated prior to installation of cables.
- F. Verify that all raceway is clear of foreign matter and substances prior to installation of wire or cable.
- G. Inspect all conduit bends to verify proper radius. Comply with code for minimum permissible radius and maximum permissible deformation.
- H. Apply a chemically inert lubricant to all wire and cable prior to pulling in conduit. Do not subject wire and cable to tension greater than that recommended by the manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
- I. Provide a box loop for all wire and cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, hand holes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.
- J. Secure all wire and cable run vertically for continuous distances greater than three (3) feet. Secure robust non-coaxial cables with screw flange nylon cable ties or similar approved devices appropriate to weight of cable. For all other cables, provide symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.
- K. All exposed multi-cable bundles are to be sleeved with expandable plastic mesh screen tubing, Alpha or equal.
- L. Signal polarity convention:

1. Maintain consistent absolute signal polarity at all connectors, patch points and connection points accessible in the system. Where applicable, a positive polarity electrical signal shall yield positive acoustic pressure from the loudspeakers.
2. Audio signal connector convention: AES14-1992 (ANSI S4,48-1992) AES standard for professional audio equipment:

1.9 ELECTRICAL CONNECTIONS

- A. Contractor is to use UL rated 3 conductor AC plugs whenever connecting to the house AC power system. All concealed power connections shall conform to local code and NEC.

1.10 WIRING PRACTICE

- A. Identify all wire and cable clearly with permanent labels wrapped about the full circumference within one (1) inch of each connection. Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate splices.
- B. Provide the following:
 1. Adhesive strip machine-printed labels with a clear over-wrap, equivalent to Panduit, Brady or Thomas and Betts. Labels must be sized so that the clear over-wrap, is wrapped a minimum of the full circumference of the wire and fully protects the printed portion of the label.
 2. Label information: provide the following on each label:
 - a. Cable Type
 - b. Cable Number
 - c. Source ID
 - d. Source Connection Point
- C. Strip all cable only with manufacturers recommended type tooling. Apply all crimp connectors only with manufacturers recommended ratchet type tooling and correct crimp dies for connector and wire size. Pliers' type crimp tooling shall not be acceptable.
- D. Coordinate insulation displacement (quick connect) terminal devices with wire size and type. Comply with manufacturer's recommendations. Make connections with automatic impact type tooling set to recommended force.
- E. Make all connections to screw-type barrier blocks with insulated crimp-type spade lugs. Lugs are not required at captive compression terminal type blocks. Provide permanent designation strips designed for use with the terminal blocks provided.
- F. Tin terminate shield drain wires and insulate with heat shrinkable tubing.
- G. Use only rosin core 60/40 tin/lead solder for all solder connection.
- H. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire shall be supported by a connection point. Provide service loops where harnesses of different classes cross, or where hinged panels are to be interconnected.

- I. Termination and build out resistors and rated circuit correction components shall be visible. Do not install in connection shells or internally modify equipment. Show location on Record Drawings.
- J. Correct any of the following unacceptable wiring conditions:
 - 1. Deformed, brittle or cracked insulation.
 - 2. Insulation shrunken or stripped further than 1/8-inch away from the actual point of connection within a connector, or on a punch block.
 - 3. Cold solder joints.
 - 4. Flux joints.
 - 5. Solder splatter.
 - 6. Un-grommet, un-bushed, or un-insulated wire or cable entries.
 - 7. Deformation or improper radius of wire or cable.

1.11 SIGNAL GROUNDING PROCEDURES

- A. Comply with the National Electrical Code.
- B. Unless you can verify that both ends of the associated cable ties to the same electrical ground plane, only connect the signal ground conductor of active levels at the source side of the audio chain.

1.12 EQUIPMENT ENCLOSURE (RACK) AND EQUIPMENT BACKBOARD FABRICATION

- A. Combustible material, other than incidental trim of indicated equipment, is prohibited within equipment racks.
- B. Within each equipment enclosure, provide a full-height multi-circuit ISOLATED GROUND outlet strip with branch circuit count as shown on drawings; located on the left side of the equipment enclosure, as viewed from the rear. In each enclosure provide number of receptacles required by present and future equipment indicated on drawings, plus at least two spare receptacles. Provide flexible steel raceway and junction box for connection of power service. Bond internal raceway to rack frame.
- C. Provide a permanent label on the front of each equipment rack including the rack designation, and the circuit breaker number and associated electrical distribution panel designation servicing same.
- D. Maintain separation of wiring classifications as specified herein. Separately dress, rout and land microphone, line and control cables and related on the right side of the equipment enclosure, as viewed from the rear; dress, route, and land loudspeaker level cables on the left side of the equipment enclosure, as viewed from the rear.
- E. Access shall not require demounting or de-energizing of equipment. Install access covers, hinged panels, or pull-out drawers to insure complete access to terminals and interior components.
- F. Fasten removable covers containing any wired component with a continuous hinge along one side, with associated wiring secured and dressed to provide an adequate service loop. Provide an appropriate stop locks to hold all hinged panels and drawers in a serviceable position.

- G. Provide permanent labels for all equipment and devices. Where possible, fasten such labels to the rack frame or to blank or vent panels, which will remain in place when active equipment is removed for possible service. Permanent labels to be either:
 - 1. Engraved plastic labels, minimum of 3/8" high with minimum 1/8" engraved letters, black with white contrasting letters, self-adhesive or mechanically fastened
 - 2. Professional printed Mylar tape labels, equivalent to Brother "P-Touch", minimum of 3/8" high with minimum 1/8" letters:
 - a. Black/dark gray equipment: black or matching background with white letters.
 - b. Silver, white or light gray equipment: white or matching background with black letters.
- H. Coordinate the design and execution of wire harnessing of multi-bay rack ensembles with conditions of delivery to installation locations at Project Site, and with the requirement herein for test of the completely wired system in the shop prior to delivery to the Project Site. Organize the wiring harnesses such that they will fold within one shippable unit without risk of damage or provide polarized multi-pin connectors and related interconnect systems as specified elsewhere herein.
- I. At each equipment backboard, provide UL Listed surge suppressing multi-outlet assembly with at least four spare receptacles.

1.13 EQUIPMENT RACK AND EQUIPMENT BACKBOARD TESTING AND ADJUSTING PROCEDURES:

- A. Conduct procedures in fabrication shop. Verify safe and proper operation of all components, devices, or equipment; establish nominal signal levels within the systems and verify the absence of extraneous or degrading signals. Make all preliminary adjustment and document the setting of all controls, parameters of all corrective networks, and voltages at key system interconnection points, gain and losses, as applicable. Submit test report. Request and coordinate verification of submitted test data by the representative of the Owner. Correct all non-conforming conditions prior to shipment to Project Site. Perform at least the following procedures:
 - 1. Preliminary: Verify:
 - a. Grounding of devices and equipment.
 - b. Integrity of signal and electrical system ground connections.
 - c. Proper provision of power to devices and equipment.
 - d. Integrity of all insulation, shield terminations and connections.
 - e. Integrity of soldered connections. Absence of solder splatter, solder bridges.
 - f. Absence of debris of any kind, tools, etc.
 - g. Routing and dressing of wire and cable- All wiring, including polarity and continuity, including conformance with wire designations on running sheets, field and shop drawings.
 - h. Mechanical integrity of all supports provisions
 - 2. Determine the proper sequence of energizing systems to minimize the risk of damage. Energize. Burn in for at least 72 hours.
 - 3. Gain control settings: Establish tentative normal settings for all gain controls. Set all equalizers flat. Set all automatic gain control devices to bypass. Terminate power amplifier outputs with power load resistors with resistance value within 10% the nominal output impedance of the respective amplifier. Adjust all gain controls on equipment for

optimum signal-to-noise ratio and signal balance and, unless they are sub-panel mounted, cap them to prevent tampering. Unless specified or directed otherwise, adjust gains such that in a given system the "front end" operates at unity gain and maintains 10dB of clip margin referenced to the first onset of clipping of the associated power amplifier(s). Measure and document system gains at 1 kHz. Settings may require further adjustment by the Contractor, and result of testing by the representative the Owner.

4. Freedom from parasitic oscillation and radio frequency pickup: Maintain previous setup. Set up for each mode of operation specified in the functional requirements; verify that all systems are free from spurious oscillation and radio frequency pickup using broadband oscilloscope. Correct any such defects.
5. Hum and noise level/signal to noise level/signal to cross talk level: Maintain previous setup. Terminate microphone and line-level inputs with shielded resistors of 150 and 600 ohms, respectively. Set available variable gain controls such that full power amplifier output would be achieved with -40 dB input level at microphone input and +12 dB at a line-level input. Measure and document the specified parameters of the systems overall for each microphone input channel and line-level input channel. Compare with nominal signal level.
6. Total Harmonic Distortion: Maintain previous setup. Measure at reference operation level at least 63 Hz, 125 Hz, 1 kHz, and 10 kHz.

1.14 LOUDSPEAKER ASSEMBLY INSTALLATION

A. Loudspeakers, general:

1. Verify proper installation of loudspeaker enclosures and related support.
2. Check all ceiling speaker/line transformer units for proper assembly polarity before assembly to the speaker grills using an appropriate DC test voltage and visual verification.
3. Connect loudspeaker assemblies to the appropriate 70-volt-line transformer tap as applies. Verify specified polarity. Use insulated crimp connectors or insulated "bobtail" splices applied with manufacturers recommended ratchet tooling. Wire nuts or "Scotch lock" connectors shall not be acceptable.
4. Verify that loudspeaker grille openings and loudspeaker components are clear of paint after finishing.
5. Perform preliminary loudspeaker tests specified herein. Correct non-conforming conditions.
6. Adjust 70 volt-line transformer taps as required to realize uniform sound pressure level as specified here in. Document final 70-volt-line transformer taps on the Record Drawings.
7. Correct all conditions giving rise to noise, rattle or other extraneous sound owing to operation of a loudspeaker assembly under any specified operating condition.

1.15 LOUDSPEAKER ASSEMBLY TESTING AND ADJUSTING PROCEDURES

A. Upon completion of the installation of all loudspeakers in an area, perform the following test and record results. Correct non-conforming conditions, unless the cause is clearly outside the work of this specification, in which case submit the apparent cause to the representative of the Owner.

B. Loudspeaker Line Impedance:

1. At terminal cabinets at equipment rooms, measure the modules of impedance of each loudspeaker line. Measure continuously over the range from at least 31 Hz to 16 kHz.

- C. Loudspeaker Polarity:
 - 1. Test the acoustic polarity of all loudspeakers using either an Acoustic Polarity Tester or an appropriate DC Voltage with visual confirmation of polarity.
- D. Freedom from Buzzes, Rattles and Objectionable Distortion:
 - 1. Individually apply to each loudspeaker line a slow sine wave sweep from 50 Hz to 5 kHz at a level of 6 dB below rated power amplifier output voltage. Listen carefully for buzzes, rattles and objectionable distortion.
- E. Uniformity of Coverage:
 - 1. Apply broadband Pink Noise. Adjust level to approximately 70-80 dB at measurement locations. Measure in 4 kHz octave band at ear level. Adjust loudspeaker aiming and amplifier level or 70 Volt loudspeakers tap as applies for uniformity of coverage.

1.16 VISUAL DEVICE ASSEMBLY AND INSTALLATION PROCEDURES:

- A. All Visual devices shall be securely mounted to structure using industry standard procedures.
- B. Apply appropriate voltages to devices and verify functionality for at least 24 hours continuous.

1.17 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B. Product Data / Shop Drawings:
 - 1. Recycled Content: Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.
 - 2. Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
 - 3. Submit product data for all materials for review arranged in same order as Specifications, individually referenced to specifications paragraph and/or Contract Drawing number.
 - 4. Submit four (4) copies of 8 1/2" x 11" material and four (4) prints. Submit all drawings on sheets of the same size. Drawings shall be no smaller than 11" x 17" and no larger than 36" x 48".
 - 5. Submittal data should include at minimum the following:
 - a. Table of contents of all equipment, listed in same order as shown in contract documents, along with specification section number and/or drawing number; along with quantity provided.
 - b. Deviations- Provide a list of any deviation made from the specification and explain the impact of the overall system.
 - c. Manufacturer's Technical data on all equipment to be installed and/or provided as part of this system.
 - d. Point to point diagrams showing the complete wiring of all systems. All point to point drawings shall show each conductor by conductor termination i.e. identify floating and/or terminated grounding; red conductor on + terminal; black conductor on - terminal; etc. A block drawing that does not identify EXACT termination points will be returned for re-submittal.

- e. A Scaled Drawing showing conduit layouts along with quantity and type(s) of cables installed therein.
 - f. Rack Layouts including vent, blanks and shelves provided.
 - g. Drawings shall show mounting heights and special installation procedures. Include in drawings, any custom fabrication, speaker cluster structures, projector bracketing, screen mounting, or any other specialty details.
 - h. Control Panel overlay layout drawings, along with text description of the function of each graphic element.
 - i. DSP Graphic layout and text description of any pre-set or macro operations.
- C. Samples:
- 1. If requested, the AVC shall provide sample products of any component specified in this section.
- D. Test Data and Calculations:
- 1. Sound systems:
 - a. Speaker Impedance
 - 1) Provide documented impedance level of each speaker zone in system.
 - b. Uniformity of coverage.
 - 1) Electronic and acoustic frequency response/one-third octave equalization. Measure at ear level. Provide documentation of even distribution of audio at 2 kHz in all speaker zones. Test at three locations in each area that is greater than 250 Square feet in size. Test at one centrally positioned location in areas that are less than 250 square feet in size.
 - 2. Visual Alerting Devices
 - a. Lamp Indications
 - 1) Activate each zone light separate and identify that each color is appropriately associated with the correct code alert. Once each lamp has been identified as appropriate- illuminate all lamps on the code circuit and document the current/voltage draw on the total load. Repeat for each code level.
 - 3. Dorm Check In Device
 - a. Visually check each Dorm Remote and verify that the GUI has been loaded and is fully functional.
 - b. Test each unit independently and verify that the appropriate code alert is activated; and not activated as selected.
 - c. Document this test and submit a check off tally for each location.
 - 4. Triggered Events
 - a. Test each triggered event and verify functionality.
 - b. Document each trigger on and off and submit a check off tally for each event.

5. Programming
 - a. Submit a complete programming description in plain English. Identify overall programmed functionality as well as individualized control parameters.
 - b. Submit a copy of all final software programs in appropriate format to match platform to which the code was written. Provide any passwords or special requirements for using the software in future service situations.
 - c. The code becomes the property of the owner at completion of the project.

1.18 ACCEPTANCE REVIEW AND TESTING PROCEDURES

- A. Complete all work of this specification. Submit Test Report. Submit review copies of Operating and Maintenance Manuals, and a reduced set of Record Drawings. Notify the representative of the Owner in writing that the work of this specification is complete and fully complies with the Contract Documents. Request Acceptance Review and Test. The representative of the Owner will conduct Verification of Submitted Test Data, and otherwise direct testing and adjustment of this work. These Procedures may be performed at any hour of the day or night as required by the representative of the Owner to comply with the Project Schedule and avoid conflict with these procedures from possible ongoing work of other Sections. Provide all specified personnel and equipment at any time without claim for additional cost or time.
- B. Personnel: Provide services of the designated supervisor and additional technicians familiar with work of the specification. Provide quantity of technicians as required to comply with Project Schedule.
- C. In Addition, Provide:
 1. Set of hand and power tools appropriate for performance of adjustment of and corrections to this work. Include spare wire and connectors and specified tooling for application.
 2. Ladders, scaffolding and/or lifts as required to access loudspeakers and other high devices.
 3. All test equipment.
 4. Complete set of latest stamped, action submittals of record for reference.
 5. Complete set of Shop and Project Site Test Reports.
 6. Complete set of manufacturer's original operation, instruction and service manuals for each equipment item or reference.
- D. Demonstrate: Complete operation of all systems and equipment, including Portable Equipment.
- E. Adjust: As directed by the representative of the Owner.
- F. Correct: In timely manner.

1.19 CLOSEOUT SUBMITTALS

- A. Prior to close out, the AV contractor shall provide O&M Manuals: Submit two (2) sets. Submit in electronic .pdf format with tabs. Include:
 1. Index
 2. Systems operating instruction, custom:

- a. Include custom written instruction to include
 - 1) Table of contents
 - 2) In Plain English, system description
 - 3) In Plain English, operation instruction including pictorials and descriptive text
 - 4) Submit rough draft of custom written instructions for approval by the Owner. Re-submit as required until approved
3. Reduced set of system Record Drawings
4. Maintenance information including local authorized repair stations, warranty information and normal replacement parts (i.e. light bulbs) availability.
5. Field Test Reports
6. Equipment Manuals: Collate alphabetically by manufacturer.
7. Provide manufacturer's original operation, instruction and service manuals for each equipment item.

1.20 QUALITY ASSURANCE

- A. Manufacturer: Company specializing in work of this Section with minimum Five (5) years documented manufacturing experience.
- B. Installer:
 1. Company:
 - a. Contractor MUST have successfully installed at least 5 Alerting Systems of same or similar scope as listed here.
 - b. Work of this specification shall be performed by an Audio Visual System Contractor who has at least five (5) years direct experience with the devices, equipment and systems of the type and scope specified herein, and who has a fully staffed and equipped maintenance and repair facility, and who is a Washington State licensed Low Voltage (06) Electrical Contractor.
 2. Personnel: Provide adequate numbers of electrical licensed journeymen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the AV systems installation work specified herein. Supervisors shall have at least five (5) years direct experience in similar work. Job to be staffed with at least one journeyman at all times and no more than two (2) apprentice electricians at any one time per journeyman.
 3. Certifications: There shall be at least one individual, who is a full-time employee of the AV contracting company who is CTS Certified.
 4. Custom Control System Programmer: Provide at least one (1) installer certified as a "MASTER CERTIFIED" programmer in the Crestron software platform. The programmer must have programmed at least 5 similar systems in the past 2 years and be a recognized factory authorized programmer for all software within the systems described. NO SUB CONTRACT PROGRAMMING ALLOWED ON THIS PROJECT.
 5. Designated Supervisor: Provide a designated supervisor responsible and in charge of the fabrication in-shop and on the Project Site during all phases of installation and testing of the work of this specification. This supervisor shall be the same individual through the execution of the work unless illness, loss of personnel, or other circumstances reasonably beyond the control of the Contractors intervene.

1.21 REGULATORY REQUIREMENTS

- A. Conform to provisions of Section 01 41 00.

1.22 MOCK-UP

- A. Provide under provisions of Section 01 43 00.

1.23 PRE-INSTALLATION CONFERENCE

- A. Arrange, in accordance with Section 01 31 19 – Project Meetings.
- B. Attendance: Contractor, installer, Owner, Owner, manufacturer's representative, and those requested to attend.
- C. Meeting Time: As required by owner, general contractor, or Owner.
- D. Location: Project Site or as agreed.

1.24 DELIVERY, STORAGE, AND HANDLING

- A. Conform to provisions of Section 01 66 00 – Product Storage and Handling Requirements, and manufacturer's instructions.

1.25 FIELD MEASUREMENTS

- A. Verify field measurements before beginning fabrication.

1.26 SEQUENCING AND SCHEDULING

- A. Conform to Section 01 32 16 – Construction Progress Schedule for sequencing and scheduling to meet Progress Schedule Critical Path and long lead items.

1.27 COORDINATION

- A. Conform to Section 01 31 13 – Project Coordination for coordination with work of other Sections.

1.28 WARRANTY

- A. Conform to Warranty provisions specified Section 01 78 36 - Warranties.
- B. Manufacturer: During the warranty period the manufacturer shall repair or replace any product that is found to be defective.
- C. Contractor:
 - 1. During the warranty period the contractor shall provide site service for all products and workmanship that fails to conform to contract requirements.

2. Service work shall be performed during normal business hours, or as mutually agreed upon between owner and contractor.
3. The contractor shall respond to any request for service within one (1) business day, and the problem shall be corrected within 3 business days.

1.29 SYSTEM START-UP

- A. Facility Start-up and Adjusting: Conform to provisions of Section 01 75 00 – Starting and Adjusting.

1.30 COMMISSIONING

- A. Conform to Section 01 91 00 - Commissioning.

1.31 MAINTENANCE

- A. Extra Materials: Provide a list of recommended spare parts and consumables.
- B. Maintenance Service: There is no maintenance provided in this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. FAST (Fire Alerting System Technology)

2.2 EQUIPMENT

- A. ALL EQUIPMENT MUST BE UL LISTED.
- B. Head End

1. Rack
 - a. Type: 19-inch stand-alone equipment rack.
 - b. Compliance: IA/TIA 310D.
 - c. Seismic Certified: Seismic certified to 1997 UBC and 2001 CBC Seismic Zone 4 and 2000 IBC, 2003 IBC, 2002 ASCE Standard 7, and 2003 NFPA 5000 Seismic Use Group III lateral force requirements for protecting 900 pounds of essential equipment in upper floor installations when used with optional MRK-Z4 seismic floor anchor brackets with Ip value of 1.5.
 - d. UL Listed: US and Canada.
 - e. Overall Dimensions:
 - f. Height: 83 1/8 inches.
 - g. Width: 24 1/4 inches.
 - h. Depth: 32 1/20 inches.
 - i. Useable Dimensions:
 - j. Height: 44 rack spaces.
 - k. Depth: 30 inches.
 - l. Construction: Fully welded.
 - m. Weight Capacity: 2,500 pounds.

- n. Materials:
 - o. Top and Bottom: 14-gauge steel.
 - p. Horizontal Braces: 16-gauge steel welded to integral structural side panels of 16-gauge steel giving 1/8-inch thick structure.
 - q. Rear Door: 18-gauge steel.
 - r. Finish of Structural Elements: Black textured powder coat.
 - s. Rack rail:
 - t. Two pairs of fully adjustable, 11-gauge steel rack rail with tapped 10-32 mounting holes in universal EIA spacing.
 - u. Finish: Black e-coat.
 - v. Rackspace's: Numbered.
 - w. Top and Bottom: Vertical slotted vent pattern.
 - x. Sides: Fully welded. Vertical vent pattern at top and bottom.
 - y. Rear Door: Solid, key locked, selectively vented with two 3-space knockouts for optional vent panels, fan panels, solid panels, and filter kits.
 - z. Removable Rear Knockout Panel:
 - aa. 1/2-inch, 3/4-inch, 1-inch, and 1-1/2-inch electrical knockouts installed in top and bottom.
 - bb. 5/8-inch BNC knockouts for UHF/VHF antennas installed in top.
 - cc. Grounding and Bonding Stud: 1/4-20 by 1-inch threaded, installed in base, allows installation to conform to NEC.
 - dd. Top Panels: 16-gauge steel with 3-1/2-inch service plate, accepts four 4-1/2-inch fans.
 - ee. Fans: Four 4-1/2-inch, 50 cfm quiet fans.
 - ff. Seismic compliancy floor anchor kit.
 - gg. The Rack shall be a Middle Atlantic SR40-28 plus associated hardware as listed. Provide at minimum: Side Panels, Rear Rack Rails, Solid top, Blanks, Vents, Shelves as necessary to fill the entire rack space.
2. Central Control Processor
- a. Utilize a real time, event driven, multi-tasking, multi-threaded operating system with dual bus architecture.
 - b. Utilize a Motorola Coldfire processor at no less than 257 MIPS.
 - c. High speed processor shall communicate directly with Ethernet, control ports and proprietary control network utilizing high-speed, parallel bus infrastructure.
 - d. Control processors that communicate via a serial bus shall not be accepted.
 - e. Control processor shall contain 36 MB of memory, with expansion up to 4GB supported via compact flash plug in cards (externally accessible/hot swappable).
 - f. Control processor shall accept industry standard compact flash cards or IBM Microdrive plug-in cards, for program, web-page, or miscellaneous file memory expansion, via a built-in compact flash card slot.
 - g. Master processor with all available cards is listed in this specification. The AVC must provide enough control for what processes are needed.
 - h. Control processor shall utilize a FAT32 file structure.
 - i. Support internal communications speed via two, independent communications busses. The first control bus speed shall be at least 40 mb/s. The second control bus speed shall be at least 300 mb/s.
 - j. Control system shall be capable of firing all internal IR ports simultaneously.
 - k. Control System shall support the option of add-on single or dual Port 10/100 BaseT Ethernet Modules, via a direct processor 300 mb/s communications bus/card-slot, that supports all of the following features:
 - 1) TCP/IP Communications
 - 2) DHCP and DNS Support

- 3) 802.11b and Bluetooth Compatibility
 - 4) Native Email Client
 - 5) Remote Diagnostics
 - 6) Remote Program Loading and Administration
 - 7) Built-In Web Server
 - 8) FAT32 File System for easy data management
 - 9) SSL security plug in
 - 10) Native NAT/Fire-Wall/Router w/dual port option
 - 11) PDA Integration and Control, XPanel PDA - Pocket PC 2002
 - 12) WebTablet Integration and Control – Microsoft Tablet PC
 - 13) Self-Generating Executable GUI, XPanel EXE – Microsoft Family of OS
 - 14) Self-Generating ActiveX powered IE Integration and Control
 - 15) Self-Generating Java powered Web Integration and Control
- l. Support user assigned or dynamic IP address.
 - m. Full API (Applications Interface) directly to control system via TCP/IP for integration with Visual Basic, C++, Java, etc. applications.
 - n. Control system shall support the optional add-on of an integrated three slot card cage to support any mix of control cards for IR, RS-232/422/485, relay, digital I/O, analog input, volume, MIDI, and more.
 - o. Internal 75W 110/220V 24VDC power supply.
 - p. Front and rear programming ports.
 - q. Support RS-485 token passing network with data communication for a minimum distance of 5000 feet.
 - r. Allow proprietary network expansion via 4 RS-232 ports or Ethernet Port that allow high-speed network acceleration
 - s. Support a minimum of 253 proprietary network devices simultaneously.
 - t. Support direct communication to LAN based thin servers by same manufacturer
 - u. Control system shall support object-oriented logic-based programming language and a C-like language programming language. Both programming types are supported to run simultaneously and integral to each other.
 - v. Control system manufacture shall supply Windows-based graphical programming software for drag and drop object-oriented programming for the control system operation.
 - w. Control system manufacture shall provide Windows-based graphical programming software, which is self-documenting in that it generates a symbolic flow diagram printout from the system program.
 - x. The control system shall support a variety of wireless communication modes, including one-way and two-way radio frequency and infrared transmission.
3. DSP Audio Processor
- a. The Digital Audio Platform shall be available in various I/O configurations. Inputs/outputs shall be specified in pairs, up to a total of 24.
 - 1) Mic/line Input
 - 2) Acoustic Echo Cancellation
 - 3) Telephone Interface
 - 4) Mic/Line Output
 - 5) Amplifier Output
 - b. Input/output options shall be available.
 - c. Inputs/outputs shall be analog, with internal 24-bit A/D & D/A converters operating at a sample rate of 48kHz.
 - d. All internal processing shall be digital (DSP).

- e. Electronically balanced inputs and outputs shall be provided on plug-in barrier-strip connectors.
 - f. Inputs and outputs shall be individually programmable for either microphone or line level signal.
 - g. Each hardware configuration shall include six 60MHz 32-bit floating point DSPs.
 - h. Software shall be provided for creating/connecting DSP system components within each hardware unit.
 - i. Available system components shall include (but not be limited to) various forms of: mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, and diagnostics.
 - j. Ethernet communications shall be utilized for software control, configuration, and DSP distribution.
 - k. After initial programming, systems may be controlled using either TCP/IP or RS-232 serial communication by third party control systems (such as AMX® and Crestron®), by PC computer, and/or by dedicated remote control devices.
 - l. Software shall operate on a PC computer, with network card installed, running Windows® XP Professional/Vista.
 - m. The Digital Audio Platform shall be CE marked; UL/C-UL listed, and shall incorporate AES48-2005 Grounding & EMC practices. The Digital Audio Platform shall be compliant with EU Directive 2002/95/EC, the RoHS directive.
 - n. Warranty shall be 5 years.
4. Amplifiers
- a. The power amplifier shall be a solid-state eight-channel model employing Multi-Mode® (AB+B) output circuitry.
 - b. The AMPLIFIER shall be the QSC CX108V.
5. Code Decoder
- a. The Code Decoder shall be compatible with the existing 911 Emergency Dispatch System in the local as to which this system is being installed. Verify frequency with local authority prior to ordering product.
 - b. There shall be capabilities of receiving up to seven separate capcodes within the designated frequency.
 - c. Upon receipt of the associated capcode the Code Decoder shall provide communication to the Control Processor by a suitable means, RS-232, Contact Closure, or IP.
 - d. There shall be the capability of providing a serial or RS-232 digital stream of information received on the Code Decoder.
 - e. The system shall be connected to a receiving device: RF Antenna, PC, or IP Port and configured for reception of the appropriate transmitting methods i.e. Provide an RF antenna the height necessary to be compatible with a full wavelength of the transmitted frequency.
 - f. The decoder shall be programmable via manufacturers' proprietary software. Programming shall be done via a standard Windows-based computer.
 - g. There shall be a printer port provided such that information received can be printed on a standard okidata microline printer.
 - h. The Code Decoder shall be a FAST-1000/8 Decoder Switch
6. Battery Back UP
- a. The system shall use Pure Sine Wave technology which provides optimum waveform for sensitive AV components
 - b. Line interactive with Automatic Voltage Regulation

- c. Compact rack mount chassis only 19" deep
- d. Easily integrates with control systems using RS-232 and analog I/O
- e. Total of 8 surge protected outlets
- f. Load shedding extends runtime for critical loads
- g. Expansion Battery Pack Option- Connect up to 10 to a single UPS for extended half-load runtimes of up to 20 hours
- h. Energy Saver circuitry- reduces power consumption by up to 75% when compared with traditional UPS designs
- i. Hot swappable primary battery for easy service

7. SOFTWARE

- a. Crestron- Provide programming of the Crestron Control Unit by a FACTORY AUTHORIZED AND CERTIFIED "MASTER" programmer who works FULL TIME for the AVC. No sub-contracted programming will be allowed on this project.
- b. BIAMP- Provide programming of the BIAMP Audia/Nexia and Tesira system by a FACTORY AUTHORIZED AND CERTIFIED programmer who works FULL TIME for the AVC. No sub-contracted programming will be allowed on this project.
- c. Programming shall provide at a minimum:
 - 1) Code Level status of each dorm room as signified by user input at each dorm remote.
 - 2) Activate Signal Alerting System upon receipt of signal from 911 Dispatch via Code Decoder.
 - 3) Designate Active Areas as all speakers in common areas as well as speakers in those dorm rooms that have been activated by the dorm remote.
 - 4) Generate Pre-Alert Tone to all speakers in the active areas.
 - 5) Pass Radio Dispatch Audio to all speakers in the active areas.
 - 6) Turn On all common areas lighting as designated on the electrical prints as triggered lights.
 - 7) Turn Off all appliances as designated on the electrical prints as triggered appliances.
 - 8) Illuminate the Visual Display Unit (Indicating Light) with the appropriate color for the level of code. i.e Red for Engine, Blue for Aid, Amber for Rescue, White for Battalion chief.
 - 9) Illuminate Visual Indicator when call received.
 - 10) Provide visual feedback on the master control panel, that a call has been received and identify its level.
 - 11) Illuminate Dorm Lights in the Active Door Rooms.
 - 12) Set up the system for Time Critical Events: All Dorm Rooms become active for all levels of call at 7:00 AM every day.
 - 13) Provide a system reset on the master panel.
 - 14) Provide for audio level adjustment in each dorm room. The programming shall set a maximum and minimum level attainable, but the dorm remote panel shall be able to adjust the speaker level within the constraints set. Each dorm room speaker shall have an individual level control, and that level shall be adjustable from the Dorm remote and/or the master panel. Do not use passive volume controls.
 - 15) Provide for automatic gain control in the following areas: Bays; Kitchen; and Exercise. Install a sensing microphone in these rooms and program the system to automatically adjust to 10db above ambient noise level or 75db; whichever is higher.

- 16) Provide an allowance for additional custom programming not listed in these specifications. Include up to 40 hours of additional programming for no additional compensation.
- 17) UNDER NO CIRCUMSTANCES can the speakers be adjusted via a volume control to the point there is no audio emanating, except in the front offices and lobby, where there shall be an isolated volume control for those areas to allow the occupants to not receive the alerting signals.

The Above Items listed under paragraphs 2.2A and 2.2B when assembled together and cabled as shown on the drawings shall constitute the Head End

C. Audio Speaker (Paging Horn)- Apparatus Bays Wall Mount

1. The horn shall be of the folded sectoral type featuring two separate air columns within the single assembly. It shall produce a horizontal beam width of 100 degrees and a vertical beam width of 60 degrees at 2.0 kHz. In addition, it shall provide useful acoustic loading at all frequencies above 250 Hz.
2. The horn shall be constructed from a non-resonant glass fiber reinforced polyester and self-finished in an ultraviolet-inhibiting gray.
3. A serrated, positive-lock "U" mounting bracket shall be affixed to the bell by self-locking nuts and shall provide orientation adjustment in all three planes. The horn shall possess a throat of 2.54-cm (1.00 in.) diameter and shall be provided with a 1 3/8"-18 thread for the mounting of a compression driver. The horn shall be 36.8 cm (14.5 in.) high, 69.9 cm (27.5 in.) wide and 38.1 cm (15.0 in.) deep. It shall weight no more than 3.2 kg (7.0 lb).
4. The horn shall be the Electrovoice Cobreflex III folded sectoral horn. Provide with Electrovoice ID30T Driver.

D. Audio Speaker (Ceiling Mounted)

1. The loudspeaker shall be of in-ceiling design, consisting of a 114 mm (4.5 in) low frequency transducer, a 12 mm (0.5 in) tweeter, and frequency dividing network installed in an integral ported enclosure. The low frequency voice coil shall be 24 mm (1 in) in diameter and the cone shall be of lightweight injection molded graphite.
2. Performance specification of a typical production unit shall be as follows: Measured sensitivity (SPL at 1m [3.3 ft] with 2.83V input, averaged from 100 Hz to 10 kHz) shall be at least 86 dB-SPL. Usable frequency response shall extend from 85 Hz to 25 kHz (10 dB below rated sensitivity) with no external equalization. Rated power for 8-ohm unit shall be at least 15 watts continuous pink noise power, defined as conforming to international standard IEC 268-5 (shaped pink noise with peak-to-average ratio of 6 dB) for a period of 100 continuous hours.
3. The speaker shall have a nominal conical polar coverage pattern of 150 degrees (at -6 dB point), averaged 500 Hz to 10 kHz, and shall hold the same consistent polar coverage pattern when averaged in the intelligibility frequency band from 1 kHz to 4 kHz.
4. The back can shall be constructed of formed steel and the baffle of UL94V-O fire rated medium impact polystyrene. An agency-rated enclosed-terminal wiring block shall be provided on the side of the back can to allow positive screw-down connection of wiring.
5. The system shall include a support backing plate to reinforce the ceiling material and tile support rails for use on either 2 ft. or 600 mm suspended ceiling tiles, and which can be installed from beneath the ceiling tile. Overall front face diameter shall not exceed 195 mm (7.7 in) and overall depth from the bottom of the ceiling shall not exceed 105 mm (4.1 in).
6. The Control 24C Micro: Nominal impedance shall be 8 ohms. The loudspeaker shall weight no more than 1.6 kg (3.6 lb.).

7. The Control 24CT Micro: The loudspeaker shall be equipped with transformer for use in either 70.7V or 100V distributed-line speaker systems, with taps selectable by connecting the input wire to the selected enclosed wiring block terminal. Taps shall be nominally 8W @ 70V, 4W @ 70V (8W @ 100V), 2W @ 70V (4W @ 100V), 1W @ 70V (2W @ 100V) and 0.5W @ 70V (1W @ 100V).
8. The loudspeaker shall weigh no more than 2.0 kg (4.4 lb.).

E. Audio Speaker (Wall Mounted or Surface Mounted)

1. The loudspeaker shall consist of a 90 mm (3-1/2 in) low frequency transducer, 13 mm (1/2 in) high frequency transducer, and frequency dividing network installed in a ported enclosure. The low frequency voice coil shall be 19 mm (3/4 in) in diameter.
2. Performance specifications of a typical production unit shall be as follows: Measured sensitivity (SPL at 1 m [3.3ft] with 2.83V input, averaged from 500 Hz to 1.5 kHz) shall be at least 86 dB-SPL. Usable frequency response shall extend from 85 Hz to 22 kHz (10 dB below rated sensitivity, in half-space, with no external equalization). Nominal impedance shall be 8 ohms. The frequency dividing network shall have a crossover frequency of 3.5 kHz. Rated power capacity shall be at least 50 watts continuous program power, defined as 3 dB above a test signal of filtered random noise conforming to international standard IEC268-5 (shaped pink noise with a peak-to-average ratio of 6 dB), for 100 continuous hours duration.
3. The system shall be protected against damage from occasional overpowering via full range series lamps that limits the power to the network and transducers. The high frequency transducer shall be horn loaded to more evenly cover a nominal 90° horizontal by 90° vertical area.
4. The enclosure shall be constructed of high-impact polystyrene for protection against the elements in outdoor applications..
5. The grille shall be completely zinc-coated for resistance against rusting, shall be bake-painted black, and shall be secured via screws to keep it in place when facing downward.
6. The low frequency transducer shall have a polypropylene cone and a butyl rubber surround which shall extend seamlessly over the edge of the speaker frame for protection against the elements.
7. The high frequency transducer shall be constructed of polycarbonate, reinforced with a titanium film for additional weather resistance. The system shall withstand Mil Spec 810 testing with specified time durations for exposure to the following environments with no effect on its acoustical performance or structural integrity: salt spray (method 509.3), temperature -19°C to 49°C (method 501.3 and 502.3), 95% humidity (method 507.3) and ultra-violet (method 505.3). The system shall have an IEC 529 splash proof rating of IP-X4. For theft deterrence, the installation access area shall be hidden behind a snap-out cover, and the access area shall be on the front of the loudspeaker for ease of installation and adjustment. The loudspeaker shall be rotatable over a minimum of ±35° in all directions via a ball type mounting system. The ball mechanism shall be internal to the cabinet to allow low-profile mounting and better stability via a short moment arm. The logo shall be rotatable for proper orientation when the loudspeaker is mounted horizontally or vertically.
8. The external wiring connectors shall be spring loaded, and gold plated, and shall accept bare wire, single or dual banana-type connectors with 19 mm (3/4 in) spacing. Overall cabinet dimensions shall be no greater than 193 mm (7.6 in) high by 140 mm (5.5 in) wide by 111 mm (4.4 in) deep and shall weigh no more than 1.8 kg (4 lbs.).
9. The finish shall be a paintable lightly textured black.
10. The system shall be the JBL Model Control 25-1 with included Invisiball® mounting system.

F. Loudspeakers (Pendant Mount)

1. The loudspeaker shall be a JBL Control 64 P/T
2. The color shall be either white or black as selected by architect
3. Suspension shall be via structural aircraft cable.
4. Use White or Black SJO 16-2 Cable between junction box on ceiling and loudspeaker

G. Volume Control

1. The volume control shall have a power rating of 25W (100 W for common areas) and attenuation per step of 3dB.
2. The Plate style shall be standard one-piece stainless steel.
3. The Plate color shall be brushed stainless.
4. The Controls shall be UL Listed (Standard UL813 and UL2043) and shall mount in an E.O. Box with a minimum inside dimension of 1.875"W x 2.688"H x 2.125"D.
5. The Volume control shall be Lowell Model LVC25 (LVC100 for common areas)

H. Dorm Light (Red LED Light)

1. Four - Gang Brushed Aluminum Panel
2. The devices shall consume no more than .1A ; 12VDC
3. The Dorm Light shall be a FAST- Night Light

I. Visual Indicator (Strobe Light)

1. The Visual Indicator is a weatherproof strobe light designed for easy attachment to a 2-Gang Panel
2. 12VDC; 310 mA draw
3. Available in Clear, Amber, Blue, and Red.
4. Verify Color with architect.
5. The Visual Indicator shall be an ELK-SL1. Include the ELK-WK1 for wall mounting.

J. AGC Sensing Microphone

1. The microphone shall be a Pressure Zone Microphone, electret-condenser type, with built-in electronics interface. The microphone capsule holder shall be mounted on a standard switch plate. The microphone shall be powered from 12-48V phantom power. The output shall be low impedance balanced. Frequency response shall be from 80 Hz to 20,000 Hz. Low frequencies below the voice range shall be rolled off. Open-circuit sensitivity shall be 5 mV/Pa (-46 dB re 1V/Pa).
2. The maximum SPL capability shall be 120 dB SPL at 3% THD. Equivalent noise shall be 26 dBA typical (0 dB = .0002 dyne/cm²).
3. The microphone shall be the Crown Model PZM-11

K. Visual Display Unit (Indicating Light)

1. Four lamps shall be under a single dome lens with barriers dividing the lens into four separate sections colored white, red, amber, and green.
2. All lamps shall have a standard bayonet base, shall operate on 12 volts, and consume no more than .01A.
3. All lamps shall be LED type lamps with life expectancy of 50,000 hours.
4. The lamp sockets shall be attached to a two-gang chassis constructed of nonconductive, high impact, flame-retardant ABS Cyclocac® plastic, rigidly reinforced to withstand breakage if attached to improperly installed backboxes.
5. All surfaces shall be protected against wear due to continual usage and cleaning solutions. A 4-1/2 inch (11.4 cm) square snap-on trimplate, of the same material as the chassis, shall be provided to cover any exposed mounting hardware.

6. The Indicating Light shall be a PATLITE WEP-402FB-RYGB

L. Dorm Touch Panel

1. The Dorm Touch panel is a compact wall mounted high-contrast 3.6" active matrix color touch screen with 16-bit color graphics and 10 backlit pushbuttons.
2. The panel shall be 100% compatible with the Central Processor; and be programmed together seamlessly.
3. Provide a customized WAV file loaded on the touch panel as part of the alerting system.
4. Connects to the Network via Ethernet or to the central controller via the proprietary data network.
5. The Dorm Touch Panel shall be a QSC TSW-560

M. Master Panel (Wireless)

1. Provide WEB PAGE control that could be emulated by a master panel.

N. Reset Switch

1. 1 Gang Panel on Stainless Steel
2. AML DPDT Momentary Switch to de-activate Alerting System.
3. Engraved Overlay "PUSH TO RESET ALERTING SYSTEM"
4. The Reset Switch shall be custom panel by Proco. Type A

O. Door Bell

1. 1 Gang Stainless Steel Panel
2. Momentary Push Button connected to Alerting system to trigger chime.
3. Proco Type A.

2.3 ACCESSORIES

- A. Provide all accessories necessary for a full turn-key system to meet all criteria presented herein.

2.4 CABLES

- A. Provide cables as CL2P Rated wherever the cables are not installed in conduit. Provide CL2 Rated Cables in all locations where the cables are installed 100% in conduit.
- B. Audio Cables – Provide Belden 9451 or 9451P
- C. Microphone Cables – Provide Belden 9451 or 9451P
- D. Speaker Cable (70V) – Provide Belden 5300UE or 6300 UE
- E. Speaker Cable (8 Ohm) – Provide Belden 5100UE or 6100UE
- F. Data Cable (CAT5E) – Provide Belden 1583A or 1585A
- G. Cresnet – Provide Belden 1502R or 1502P

PART 3 - EXECUTION

3.1 SPECIAL CONDITIONS:

- A. The Locution Interface will be connected into the new facility by the A/V contractor.
- B. Accepted Installers
 - 1. Jaymarc AV Tel (206)762-8903 X 104 Tyson@jaymarc-av.com
- C. Any other installers need to provide a qualifications statement to the architect to be listed as an accepted installer. All accepted installers will be listed by addenda. Request must be made prior to 10 days from initial bid date. Installers **MUST BE LOCUTION APPROVED** to install this system.

3.2 EXAMINATION

- A. Verify conditions as satisfactory to receive work of this Section before beginning.

3.3 PREPARATION

- A. Protection: Protect all products that are scheduled to be reinstalled in the systems.

3.4 CLEANING

- A. Leave installations clean and premises free from residue and debris from work of this Section.

3.5 TRAINING

- A. After final demonstration and acceptance of systems provide the following training:
 - 1. Alerting – Provide 2 hours of on-site training
 - 2. Paging – Provide 2 hours of on-site training
 - 3. Control System- Provide 2 hour of on-site training
- B. Set up the training sessions with the owner at a mutually agreeable time.
- C. Provide a hard copy; 2 pages maximum of SIMPLE easy to use operation guide specific to each system provided. This is intended to be used as a basic operating guide and should not be used in place of the Owners and Maintenance manuals required elsewhere in this specification.
- D. The training session shall be performed by a person who is familiar with the systems and has experience presenting and instructing personnel on system usage.
 - 1. Provide video of training sessions per Division 01.

3.6 DELIVERY OF LOOSE ITEMS

- A. Deliver to the owner all loose items and obtain a written receipt for all product delivered.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 and Section 26 05 00 apply to Work in this section.
- B. Related Sections:
 - 1. 26 05 00 – General Electrical Provisions
 - 2. 26 05 10 – Basic Electrical Materials and Methods
 - 3. 26 05 32 – Outlet Boxes
 - 4. 26 05 33 – Raceway Systems

1.2 SUMMARY

- A. Provide cabling and other relevant components and accessories required for an Owner provided, Genetec based, electronic access control system. See also Sheet Notes 7 and 8 on Drawings E5.1 and E5.2 for additional information.
- B. Provide an emergency call box with audio communications. Provide programming of built-in dialer.

1.3 SUBMITTALS

- A. Provide submittals in accordance with Division 01 and Section 26 05 00.
- B. Submittal for this section shall be complete with all required information. Partial submittals are not acceptable and will be returned not reviewed.
- C. Submittal shall be arranged under categories such as, products, certifications, personnel training, manufacturer warranty, and similar items. Include index and product summary with the submittals.
- D. Pre-Construction Submittal:
 - 1. Product Data:
 - a. Organize by specification infrastructure components described in Part 2 of this section.
 - b. Submit Product Data information sheets for coordination with item and model number. Where more than one product is shown on a page, mark product with arrow or by other means to identify exact product or products being submitted by specific part number.
 - 2. Qualifications:
 - a. Submit resumes and certifications of technicians and project manager who will support this project. Certifications shall include:
 - 1) Manufacturer's certification to provide warranty

- 2) Successful completion of approved manufacturer classes
3. Shop Drawings:
 - a. Drawings shall provide details of proposed system and the equipment and work to be provided. Drawings shall include point-to-point drawings of systems and wiring diagrams of individual devices. Include voltage drop calculations and other calculations as required.
 - b. Drawings shall identify connections to other equipment/ systems not specified herein.
 - c. Prepare access control system and emergency call box shop drawings using AutoCAD software or as approved by the Owner and or A/E. Shop drawings shall be submitted as full size, in PDF format.
- E. Record Drawing Submittal:
 1. Keep complete set of access control and emergency call box drawings in job-site office updated to identify actual installation of cabling and equipment during construction for recording as-built conditions.
 2. Record drawings set shall indicate where material, equipment, and system component are installed differently than indicated on the Contract Drawings, clearly and neatly using red ink or indelible red pencil during construction.
 3. Prepare electronic set of Record Drawings, incorporating changes during construction.
 4. Submit Record Drawings to the Owner's Representative for review and acceptance.
 5. Submit Record Drawings saved as AutoCAD version 2018 (.dwg) format and in PDF format. The contractor shall request final architectural AutoCAD background drawing files that incorporate all project floor plan modifications and numbering of spaces.
 - a. AutoCAD drawings shall utilize the e-transmit capability to include all drawing backgrounds, title block and other associated files.
 6. Submit electronic copy of Record Drawings in full-size PDF and AutoCAD format, on CD-ROM or USB thumb drive where requested by the Owner's Representative.
- F. Closeout Submittal:
 1. Submit closeout documentation to the Owner's Representative and Architect under provisions of Division 01, Section 26 05 00 and this section.
 2. Provide all project closeout documentation including but not limited to; test acceptance documentation, material transmittals, Record Drawings, product data, manufacturer warranty and Operation and Maintenance Manuals.

1.4 QUALITY ASSURANCE

- A. The system and its components shall be Underwriters Laboratories, Inc., listed under the appropriate UL testing standard as listed herein for security access control applications.
- B. Equipment shall be manufacture's regularly catalogued items and shall be supplied as a complete unit in accordance with manufacturer's standard specifications and any optional items required for proper installation for equipment unless otherwise noted. Equipment and materials shall be installed in accordance with the manufacturer's recommendations and best trade practices.

- C. Products shall be new unless indicated otherwise in the Contract Documents.
- D. Comply with applicable city, county, and state codes and ordinances.
- E. Codes and Standards:
 - 1. American National Standards Institute (ANSI):
 - a. ANSI C63.4 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
 - 2. Federal Communications Commission (FCC):
 - a. Title 47 CFR – Part 15; Class B – Radiated and Conducted Emissions.
 - b. Title 47 CFR – Part 68; rules governing the connection of Terminal Equipment (TE) to the Public Switched Telephone Network (PSTN).
 - 3. The National Institute of Standards and Technology of the United States of America (NIST):
 - a. Federal Information Processing Standards Publications 197 (FIPS 197) - Advanced Encryption Standard (AES).
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. UL 50 – Enclosures for Electrical Equipment.
 - b. UL 294 – Access Control System Units.
 - c. UL 60950-1 – Information Technology Equipment - Safety.
 - 5. International Organization for Standardization (ISO):
 - a. 9001 – Quality System
 - 6. National Electric Code (NEC): Latest Version
 - 7. Provide all wiring in accordance with Article 725 of the National Electrical Code and local ordinances, and other sections of these specifications.
- F. Qualifications:
 - 1. Contractor shall be a certified reseller/ dealer, installer, and pre-qualified by the manufacturer for the purpose of offering the services as specified herein, at the time of bid.
 - 2. Contractors shall have a minimum of five years of experience in the construction, testing, and servicing of systems of the type and magnitude specified herein.
 - 3. Contractor shall have completed at least five projects of equal or larger in size to this project within the past five years.
 - 4. Contractor shall have direct access to the tools and test equipment required to complete the work as defined herein.
 - 5. Contractor shall employ certified technicians skilled in the maintenance of the access control system and shall be located within 50 miles of the project site.

1.5 PRE-CONSTRUCTION MEETINGS

- A. The subcontractor shall attend the pre-construction meeting as required by the Contractor or the Owner's Representative.
- B. Provide a schedule, indicating installation tasks, and coordination items to be discussed 5 days prior to the meeting, to the Contractor and to the Owner's Representative. Where the project includes multiple sites, include schedule for each site. Include milestone dates for field device installation and panel installation and programming durations.

1.6 WARRANTY AND SERVICE

- A. Contractor shall provide a parts and labor guarantee on all Work. Contractor's guarantee shall be for a period of one (1) year from Date of Acceptance, except where warranty coverage from a supplier or equipment manufacturer extends for a longer period of time.
- B. Contractor's guarantee shall cover all costs associated with troubleshooting, repair, and replacement of defective Work, including but not limited to costs for labor, transportation, lodging, materials, and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURER SUBSTITUTIONS

- A. Substitutions: The substitution of products shall adhere to the requirements defined in Division 01. Section 01 77 00 – Substitutions.
 - 1. Access control panels and equipment shall be from a manufacturer with at least 5 years of experience in the manufacturing of equipment.
 - a. Approved manufacturers:
 - 1) Access Control System 4-Element Cabling: Windy City, or equal
 - 2) Access Control System Cabling: Windy City, Belden, West Penn or equal
 - 3) Emergency Call Box Cabling: by Division 27 11 00
 - 4) Emergency Call Box: Rath Microtech

2.2 MONITORING DEVICES

- A. Request-to-exit (REX):
 - 1. Doors with electronic door hardware shall contain an internal micro switch REX device provided by Division 08. Coordinate cabling and wiring harnesses installation at door frame and sequencing of connectivity with Division 08 installer and the Electrical Contractor prior to rough-in.
- B. Magnetic Door Position Switches:
 - 1. Door position switches shall be provided by the Owner.

2.3 ELECTRONIC LOCKING HARDWARE

- A. Electronic Locking Hardware and wiring harnesses shall be provided by Division 08.

2.4 EMERGENCY CALL BOX

- A. Call box shall be surface mounted, NEMA 4 watertight enclosure, exterior rated and vandal resistant.
1. Power: Analog telephone line powered.
 2. Pushbutton: Hands-free push button activation.
 3. Visual LED indication that a call box has been activated and call answered.
 4. Built-in automatic dialer that dials programmed number when door is opened, and button is pushed.
 5. Labeling: Engraved labeling indicating "Emergency Phone", international phone symbol, raised Braille lettering and/or as required by AHJ.
 - a. Manufacturer Rath Microtech:
 - 1) Surface mount, Part No. 2400-970RD

2.5 OPEN CABLING SUPPORTS

- A. Mounting hardware and other accessories shall be provided for securing supports to structure for open cabling supports. Follow manufacturer's recommendations for quantity of cables supported.
- B. Hook & Loop Fasteners:
1. Hook and loop fastener rolls shall be offered in 15 and 75-foot lengths and be 0.5-inch in width. Shear strength for plenum rated product shall be 29 PSI and non-plenum rated product shall be 23 PSI. Hook and loop fasteners installed in plenum air spaces shall be UL Listed (plenum).
 - a. Manufacturer Leviton or equal:
 - 1) Plenum 15' roll, Part No. 43115-15P (maroon)
 - 2) Plenum 75' roll, Part No. 43115-75P (maroon)
- C. J-Hooks:
1. J-hooks shall have a Galvanized finish with rounded edges for smoother cable pull and greater corrosion resistance.
 - a. Manufacturer Erico Caddy:
 - 1) 1" Dia., Part No. CAT16HP
 - 2) 1-5/16" Dia., Part No. CAT21HP
 - 3) 2" Dia., Part No. CAT32HP

2.6 CABLING

- A. Category 6A cabling supporting emergency call box/ telephone call functions shall be provided under Section 27 11 00. All other cabling and connections required shall be provided under this section.
- B. Cabling shall be sized to provide minimum resistance and minimum voltage drop to the devices being supplied. Voltages delivered to all devices shall be within the tolerances specified by the device manufacturer.
 - 1. Cabling shall be a minimum 18 AWG solid copper conductors for power connectivity.
 - 2. Twisted pair cable shall be used to prevent EMI/RFI interference with the proper operation of the circuits.
- C. Cable shall be NFPA 262, CMP (plenum) rated unless otherwise noted.
 - 1. Cables installed in underground applications shall be rated for wet environments.
- D. Provide cables consistent with the manufacturer's recommendations. The following general guidelines shall be followed for wiring installation:
 - 1. Wiring shall be appropriately color-coded with permanent wire markers.
 - 2. Cabling shall have stranded copper conductors.
 - a. ACS 4-element cable: Windy City #446100
 - b. Card readers: 18 AWG-6C with overall shield.
 - c. Door position switch: 22 AWG-2C
 - d. Lockdown buttons, keyed switch: 18 AWG-4C
 - e. Request to exit: 18 AWG-4C
 - f. Electrified lock/exit device: 16 AWG-6C
 - 1) Refer to manufacturer requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide all labor, tools, supplies, software, hardware, materials, and equipment required for the design, installation, configuration/ programming and testing of a complete and operational system.
- B. Install all equipment in accordance with manufacturer's instructions, approved Shop Drawings and as indicated on the Contract Documents.
- C. Cabling shall be installed in conduit at non accessible locations. Cabling shall be installed in cable tray or open cabling supports in accessible ceiling spaces.
- D. Where subject to mechanical damage, wiring shall be enclosed in metallic conduit and/ or surface metallic raceway.
- E. Cabling shall not be enclosed in conduit or raceways containing AC power.
- F. All devices shall be securely mounted. Provide necessary backing in walls or ceilings.

- G. Properly ground the system per NEC requirements to the building safety grounding system to prevent electrostatic charges and other transient electrical surges from damaging the control panel.
- H. ADA operator motor (ADA button): provide relays and cabling for card reader operation with ADA operators. Coordinate requirements with the electrical and door hardware contractors.

3.2 OPEN CABLING SUPPORT INSTALLATION

- A. All cabling shall be run exposed as “open cabling” in ceiling spaces and ceiling plenums, unless otherwise noted.
- B. Provide all hanger supports and cable supports for cabling specified in this section. All support structures shall adhere to the requirements in the National Electrical Code.
- C. Cabling supports shall be spaced no further than 5'-0” apart.
- D. Provide all additional cable management products as required to protect exposed cabling and complete the installation of cabling in a neat professional manner.
- E. Cabling supports shall be installed on their own support system. The use of ceiling grid supports shall be prohibited.
- F. Do not support cables from ductwork, sprinkler piping, water piping, waste piping, conduit or other system supports. Cabling shall never come in physical contact with these mechanical, fire protection and electrical systems and raceways.
- G. Cabling bundles and supports changing pathway direction shall maintain proper bend radius as to not impact the physical jacket construction of the cabling. Cabling that becomes damaged during this transition shall be replaced in its entirety.
- H. Follow manufacturer’s recommendations for quantity of cables supported in J-hooks and adjustable cable supports.

3.3 LABELING

- A. Provide computer generated wrap around label on both ends of the cabling jacket no more than 4-inches from each termination point. Font type for each type of label shall be Arial with maximum size font allowed.
- B. Labels shall identify door and device connection point, where “xxx” is the door number, i.e. CR-XXX, EL-XXX, REX-XXX, AUX-1, LD-1, etc. 4-element cables shall read “ACS-XXX”
- C. Labeling scheme shall be as indicated on the Contract Drawings or as coordinated with the Owner and Engineer prior in pre-construction meeting.

3.4 PROGRAMMING

- A. Programming of the system shall include, but not limited to:
 - 1. Program backup call numbers to be called if no answer occurs at the base station. Coordinate with Owner for phone numbers and order of calls to be placed.
 - 2. Setup and record recorded message of where the call box was placed.

3.5 TESTING

- A. After Work is completed, Contractor shall conduct a final inspection, and an operational test of all equipment and system features of the Emergency Call Box and cabling for the Access control System. Contractor shall correct any deficiencies discovered as the result of the inspection and operational pre-test. Final labeling shall be completed, and temporary non-conforming labeling methods shall be removed prior to testing.
- B. Submit written notification to the Owner's Representative and the A/E that systems have been tested, are operating properly, and are ready for Acceptance at least 14-days prior to the requested test date.

3.6 TRAINING

- A. The Owner shall receive 2 hours of instruction in (1) 2-hour segment covering all aspects of operating the Emergency Call Box.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDES

- A. Description: Work includes an automatic, non-coded, Class 'B', addressable type fire alarm and detection system. System shall be bidder designed and provided.
- B. General Requirements: Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01, and Sections 26 05 00 apply to Work in this section.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with applicable city, county, and state codes and ordinances.
- B. Codes and Standards:
 - 1. NFPA 70, National Electrical Code (NEC).
 - 2. NFPA 72, National Fire Alarm Code.
 - 3. NFPA 101, Life Safety Code
 - 4. UL 268, Standard for Smoke Detectors for Fire Alarm Signaling Systems.
 - 5. Underwriters Laboratories, Inc.
 - 6. Americans with Disabilities Act (ADA)
- C. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Components and systems UL listed and labeled for fire alarm systems and fire alarm and detection systems and accessories and FM approved. Comply with applicable State and local requirements.
- D. Comply with applicable provisions of current NFPA 72, local building codes, and requirements of AHJs.
- E. Fire Alarm and Detection System Support:
 - 1. Contractor's factory trained technical representative shall respond to job site within 4 hour period for emergencies relating to system.
 - 2. Emergency response is defined as having a technician actively troubleshoot and correct problem at job site.

1.3 SUBMITTALS

- A. Comply with requirements in Division 1 and Section 26 05 00.
- B. Product Data: Submit manufacturer's technical product data for fire alarm and detection systems components including, but not limited to, roughing-in diagrams and instructions for installation, operation, and maintenance, suitable for inclusion in the Maintenance and Operation Manuals. Include riser and wiring diagrams for panel and system components.

- C. Shop Drawings: Indicate equipment and device locations and connecting wiring of entire fire alarm and detection system. Include layout wiring and riser diagrams, point-to-point diagrams, floor plans with device addresses and strobe candela ratings shown, battery calculations and notification appliance circuit calculations.
- D. Coordinate all submittal requirements with each AHJ and provide complete.
 - 1. Submit to A/E after approval from AHJ has been achieved.
- E. Test Reports:
 - 1. Field test reports.
 - 2. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.
- F. Obtain from each AHJ written certification that the permanent installation has been inspected and that it complies with AHJs' published regulations and requirements. Submit prior to Substantial Completion.
- G. Operation and Maintenance Data: Comply with requirements in Section 26 05 00. In addition, include the following:
 - 1. Prepare complete, simple, understandable, step-by-step, testing instructions with recommended and required testing frequency of equipment with methods for testing equipment. Include trouble-shooting manual.
 - 2. Prepare complete, easy-to-read, understandable maintenance instructions including the following information:
 - a. Instruction on replacing components of system including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.
 - b. List of equipment and components with address and phone number of both manufacturer and local supplier of each item.
 - 3. Submit minimum one week prior to system training.

1.4 SYSTEM DESIGN CRITERIA

- A. Design, furnish, and install complete operable fire alarm and detection systems in accordance with the latest adopted editions of IBC, IFC, NFPA 72, and applicable city, county, and state laws, codes, and standards.
- B. The Contractor's scope of work shall include but not limited to the following:
 - 1. Complete fire alarm system based on the available architectural, civil, structural, mechanical and electrical drawings. Devices shown on drawings do not reflect complete system. Provide additional devices, conduit, wire and programming for a complete and operable system as required by AHJ.
 - 2. Wiring systems associated with fire alarm system.
 - 3. Providing additional smoke detectors, heat detectors, manual alarm stations, horns, visual evacuation alarm devices, bells, door closers and holder controls, panels, power supplies, batteries, AES radio and control graphic annunciators associated with fire alarm system.

4. Providing auxiliary controls and switches including interposing control, monitor relays, and interconnection coordination for monitoring of fire sprinkler system, tamper, flow and air pressure switches mechanical equipment shutdown and smoke and combination fire/smoke damper controls.
 5. Power circuits required for all fire alarm equipment including, but not limited to, the main control panel, annunciator panels and power supplies.
- C. Owner's Minimum Requirements:
1. In addition to Code requirements, provide complete smoke detection coverage in the following rooms:
 - a. Server Room
 - b. Electrical Room
 - c. Any room with an electrical panel in it.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fire Alarm and Detection System: Subject to compliance with requirements, Silent Knight IFP-300. No substitutions.

2.2 FIRE ALARM AND DETECTION SYSTEMS

- A. General: Electrically operated, electrically supervised, fire alarm and detection system as described herein. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings, and accessories required for a complete operating system.
- B. Comply with requirements in Section 26 05 33 for raceways, Section 26 05 19 for conductors, Section 26 05 32 for outlet boxes, and Section 26 05 29 for supports. Minimum wire size No. 16 AWG for initiating circuits and No. 14 AWG for indicating circuits.
- C. Enclose entire fire alarm system wiring in raceways.

2.3 SYSTEM TYPE

- A. Low voltage, point identification fire management system. Fire alarm and detection system shall monitor intelligent (analog) and addressable (digital) devices, traditional initiating devices, point identify alarm location, and transmit signals to monitoring agency.
- B. Fire alarm control panel shall allow for loading or editing special instructions and operating sequences. System capable of on-site programming to accommodate and facilitate expansion, building parameter changes, and changes as required by AHJs. Software operations stored in non-volatile programmable memory within fire alarm control panel. Loss of primary and secondary power shall not erase instructions stored in memory.

2.4 SYSTEM OPERATION

- A. Alarm displayed on an 80 character alphanumeric display and on remote printer. Top line of characters shall be point label and second line shall be device type identifier. System alarm red LED shall flash on control panel and remote annunciator shall indicate specific device in alarm. Subsequent alarm received from another zone after being acknowledged shall flash system alarm LED on control panel and remote annunciator. LCD display and printer shall show new alarm information. Alarm tone shall occur within control panel and remote annunciator until acknowledged.
- B. Alarm indicating devices silenced by entering locked control cabinet and operating alarm silence switch. Subsequent alarm condition shall reactivate signals.
- C. Activation of any system smoke detector shall initiate an alarm verification operation whereby control panel shall reset activated detector and wait for second alarm activation. If, within 1 minute after resetting, second alarm is reported from same or any other smoke detector, system shall process alarm as described previously. Time period for alarm verification reset programmable from 0 to 60 seconds. If no second alarm occurs within alarm verification time window, system shall resume normal operation. Alarm verification shall operate only on smoke detector alarms. Other activated initiating devices processed immediately. Alarm verification operation selectable by device, not just by zone. Control panel with capability to display number of times zone or detector has gone into verification mode. Information displayed on control panel and transmitted to remote printer and remote annunciator.
- D. Control panel shall have a dedicated supervisory trouble condition indicator and acknowledge switch.
 - 1. Activation of any standpipe or sprinkler valve tamper switch shall activate system supervisory service audible signal and illuminate LED at control panel and remote annunciator. Include differentiation between valve tamper activation and open circuits or ground conditions.
 - 2. Activating acknowledge switch shall silence audible signal while supervisory service LED.
 - 3. Restoring valve to normal position shall cause supervisory service LED to extinguish thus indicating restoration to normal position.
- E. Include manual evacuation switch at control panel to operate systems alarm indicating devices. Other control circuits not activated. True alarm processed as described previously.
- F. Alarm and trouble conditions displayed on control panel from alphanumeric display, at remote printer, and at remote annunciator. If more than one alarm or trouble is initiated, operator may scroll to display new alarms.
- G. Control panel capable of supplying minimum 6 Amps at 24 VDC, filtered and regulated. Power supply expandable to total ampacity required by system. Initial system shall include a minimum of 25% spare capacity.
- H. Functions of control panel field programmable.
- I. Include connection to fire sprinkler system tamper switches, flow switches, and high/low air pressure alarm switches. Include connection to tamper switches in exterior vaults, and post indicator valves as required.
- J. Include elevator fire alarm control.

- K. Include connection to kitchen hood fire suppression system and fan shutdown.
- L. Include connection from duct smoke detectors to fan starter control circuit. Fans shut down on local detection only. Include interface relay to control system.
- M. Include connection to smoke dampers and combination fire/smoke dampers. Dampers close upon activation of smoke detectors in adjacent corridor area and adjacent duct detection. Include interface relay.
- N. Include fire alarm system power and fire closure signal connection to fire shutters in corridors. Shutters powered from fire alarm panel. Shutters close on local detection only. Coordinate requirements with shutter supplier.
- O. Include fire alarm system power and general alarm release signal for magnetic door holders. Coordinate requirements with door hardware supplier.
- P. Include signal wires to fire control communicator specified in paragraph 2.7, L., this section.

2.5 POWER REQUIREMENTS

- A. Include 120 VAC power from dedicated optional standby generator circuit for control panel.
- B. Include sufficient battery capacity to operate entire system upon loss of normal 120 VAC power in normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at end of this period. System shall automatically transfer to standby batteries upon power failure. Battery charging and recharging operations shall be automatic.
- C. Circuits requiring system operating power shall be 24 VDC. Include individual fuses at control panel.

2.6 EQUIPMENT

- A. Fire Alarm Control Panel: Modular construction with solid state microprocessor based electronics with a minimum of 25 percent spare point capacity. Include minimum 80 character minimum alphanumeric display to indicate alarms, supervisory service conditions, and troubles.
 - 1. The FACP shall a Jumpstart feature that can automatically enroll all properly connected accessories into a functional system within 60 seconds of powering up the panel.
 - 2. The FACP shall be capable of automatically generating textual service reminder on the main and remote annunciator LCD's to inform the user of required testing or service. The service reminder shall not interfere with the normal operation of the FACP.
- B. Control panel shall include the following:
 - 1. 80 character LCD display.
 - 2. Minimum of 2 indicating appliance circuits.
 - 3. Non-volatile EEPROM memory.
 - 4. Multiple password levels.
 - 5. RS232 port for programming and printer and video display unit input/output.

- C. Programming:
 - 1. Programming accomplished using a standard IBM compatible computer, either desk or laptop.
 - 2. Resident program stored in non-volatile EEPROM memory.
 - 3. System with capability to store system program on a hard disk for future changes, upgrades, and replacement.
 - 4. Software to allow user to reprogram system points, add system points, add or change point descriptions, and update data file. System output functions field programmable to allow custom operation.
- D. Printer: Black and white laser printer to record trouble and alarm signals and program changes. Coordinate location with Owner prior to rough-in. Provide dedicated duplex receptacle and data jack at this location. Utilize spare circuit from branch circuit panel serving this area of the building. Record on as-built drawings.

2.7 PERIPHERAL DEVICES

- A. Manual Stations: Constructed of red die cast metal with raised white lettering. When station is operated, handle shall lock in protruding manner to facilitate quick visual identification of activated station. Station capable of being reset using a key. Stations which require only a screwdriver for operation not acceptable. Model IDP-Pull
- B. Manual Station Guards: Plastic guards with built-in independent local alarm. Stopper Two or approved. Provide on all manual pull stations unless otherwise noted.
- C. Smoke Detectors: UL 268 listed and documented compatible with control equipment to which it is connected. Photoelectric type with a plug-in base and LED indication of detector actuation. Detectors addressable and with capability of alarm verification, sensitivity adjustment by detector, and "maintenance alert" circuitry. Model IDP-Photo with IDP-6AB base.
- D. Duct Smoke Detectors:
 - 1. Photoelectric type capable of operating in air velocity range of 300 to 2000 feet per minute.
 - 2. Detectors with approved duct housing for mounting exterior to duct with perforated sampling tubes extending across width of duct and end support.
 - 3. Integral filter system air flow monitor to indicate presence and direction of air flow through detector.
 - 4. Addressable monitor module for individual identification at control panel.
 - 5. Control modules and relays required for equipment shutdown circuit [and connection to control system].
 - 6. Where duct detector is installed above a ceiling, include remote indicator lamp mounted on ceiling below unit.
 - 7. Provide Silent Knight Model SSDNR housing with Model IDP-Photo Smoke detectors.
- E. Heat Detectors: Addressable, analog thermal detectors. Rate of rise feature accomplished with electronic, dual thermistors. Include built-in test switch and LEDs to indicate alarm condition and polling. Thermal head shall plug-in to base. Heat detector rated for the environment in which it is to be installed (135° typical). Model IDP-Heat with IDP-6AB base

- F. Primary Notification Appliances: Provide flush mounted combination horn/strobe Audio/Visual signaling appliances where required. Specific audible and visual characteristics shall be as follows:
1. Visual Signals: Furnish and install xenon strobes, synchronized in accordance with NFPA 72 chapter 4 and rated to UL 1971 standards. Strobes shall have a fixed candela rating, as follows: provide 15 candela in corridors and other areas up to 20' x 20', 75 candela in areas up to 40' x 40', and 110 candela in areas up to 50' x 50'.
 2. Audible Signals: Provide audible signal appliances designed to produce a minimum sound output of 85dbA at 10', or 15dbA above ambient; whichever is greater.
- G. Multiple strobes visible in a single room coordinated to flash simultaneously.
- H. Water Flow Switches: Provided by Division 21 and wired by Division 28. Coordinate requirements.
- I. Sprinkler Valve Tamper Switches: Provided by Division 21 and wired by Division 28. Coordinate requirements.
- J. Magnetic Door Holders: Provide by General and wired by Division 28. Holders shall be powered from the fire alarm system. Coordinate requirements.
- K. Provide Remote LCD Annunciators. The Remote Annunciator shall be an 80 character LCD type with key activated controls to allow silencing, resetting and activating of alarms. Provide an adjacent building map to direct fire fighters to source of alarm. Wording on map shall reflect information on digital readout. Communication between the main fire alarm control panel and the remote annunciator shall be via an RS232 link. A graphic map shall be provided adjacent to the remote LCD annunciator and shall be a full color image printed on the reverse side of 10 mil. Polycarbonate Lexan. The printed image shall be laminated to a 1/8" rigid backing with a removable adhesive for future replacement. The graphic map shall be secured in a black (standard) anodized aluminum frame and mounted with a concealed security hanging system to prevent any unauthorized removal. The location of the FACP, main graphic map and other graphic maps shall be shown in red with "YOU ARE HERE" printed in red. Detection devices, nomenclature, building detail shall be color coded as specified by the engineer. See drawings for location.
- L. Automatic Communicator: Conveyance of alarm signals shall be by AES Radio only. The AES Radio shall be provided by the Owners alarm monitoring company, Washington Alarm. Coordinate all requirements with Owner and with Washington Alarm and provide. Washington Alarm and fire alarm system successful bidder designer shall be present during AES Radio programming. Washington Alarm shall provide all AES programming hardware, software and services as requested by the Owner and AHJ.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Verify installation conditions as satisfactory to receive work of this section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of conditions as satisfactory.

3.2 PREPARATION

- A. Field Measurements: Field verify locations of new and existing work prior to commencing work of this section.
- B. Protection: Protect surrounding areas and surfaces to preclude damage from work of this section.

3.3 INSTALLATION, APPLICATION, ERECTION, AND PERFORMANCE

- A. General: Install, apply, erect, and perform the work in accordance with Article "Quality Assurance" provisions, specifications, and manufacturer's installation instructions and directions. Where these may be in conflict, the more stringent requirements govern.

3.4 FIRE ALARM AND DETECTION SYSTEM INSTALLATION

- A. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 3 feet from air-supply diffusers or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- B. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- C. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- D. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- E. Mounting Heights:
 - 1. Manual Station: Operating handle approximately 48 inches above floor.
 - 2. Alarm Signal Devices: Approximately 80 inches above floor to centerline.
 - 3. Magnetic Door Holders: 78 inches to center line except as noted.
- F. Wire:
 - 1. Per manufacturer's recommendations and as per NEC. Comply with requirements in Section 26 05 19.

2. Where required, provide wiring in metallic conduit. Comply with requirements in Section 26 05 33.
- G. Make conduit and wiring connections to sprinkler flow switches, sprinkler valve tamper switches, and appropriate air handling equipment.
- H. Label junction boxes for fire alarm with minimum 1/4 inch letters: "FIRE ALARM."
- I. Test conductors for ground conditions before making final wiring connections. Comply with requirements in Section 26 05 26.
- J. Maintain wiring color code throughout installation. Include color code identification in the Operation and Maintenance Manual.
- K. Coordinate with appropriate subcontractors for installation of equipment and devices that pertain to other work in the contract.
- L. Clean dirt and debris from inside and outside of the fire alarm equipment after completion of installation.
- M. Coordinate installation of duct smoke detectors with Division 23 work.
- N. Install remote annunciators as indicated on the Drawings and as required by AHJ.

3.5 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 2. Alarm-initiating connection to elevator recall system and components.
 3. Supervisory connections at valve supervisory switches.
 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 5. Supervisory connections at elevator shunt trip breaker.

3.6 WARRANTY

- A. Warranty all materials, installation and workmanship for a period of one (1) year from Substantial Completion. A copy of the manufacturer warranty shall be provided with the close out documentation for inclusion in the O&M manual.

3.7 MANUFACTURER'S FIELD SERVICES

- A. Include services of certified technician to supervise installation, adjustments, final connections, and system testing.

- B. Include operations and maintenance instructions for the Owner's representative of devices including trouble shooting procedures.

3.8 FIELD QUALITY CONTROL

- A. Check out of and final connections to fire alarm control panel by factory trained technicians in employ of factory authorized franchised dealer for products installed.
- B. System, upon completion of installation, checked out, final connections made, and tested to initiating and indicating devices by factory trained technicians in employ of factory franchised dealer for products installed.
- C. Comply with requirements of Section 26 08 00 for field inspection and testing.
- D. Test completed fire alarm and detection system in accordance with NFPA 72 in presence of the Owner's representative and the AHJ. Upon completion of successful test, certify in writing to the Owner and general contractor that system has been successfully tested and accepted by the AHJ. Include field test results in the Operation and Maintenance Manual.

3.9 TRAINING

- A. In addition, factory trained technicians shall demonstrate operation of the complete system and each major component to the Owner, including location of all equipment. Provide hardware, software, and training to allow Owner to view and change panel programming on site and to view programming remotely.
- B. A factory trained representative shall provide (1) 2 hour session to fully instruct the Owner's personnel as to correct operating testing, maintenance and troubleshooting procedures. Video tape this training session and provide copy to Owner for future reference. Schedule training with Owner in writing as least 7 working days in advance of the training date.

3.10 RECORD DRAWINGS

- A. See Section 26 05 00 for record drawing information. Accurately identify the final location, addresses and type of each device on drawings. Division 26, 27, and 28 Subcontractor shall keep a set of record drawings on site during construction and programming and shall mark-up changes made on these drawings. Transfer the mark-up information to an AutoCAD format CAD file at the close of the project. Provide the Owner with the mark-up drawings, a CAD plot and CAD file on disk.
- B. Provide a complete printout hard copy of the system program and an electronic backup copy or the site specific software for all future programming needs by authorized manufacturer/distributor per NFPA 72 4,5,2,3.(3).

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Construct and maintain erosion and sedimentation control in accordance with contract documents and City of Kirkland requirements. Clear and grub site as indicated and as necessary to construct improvements. Save and protect from harm any trees, vegetation, or other objects selected to remain. Remove from area to be cleared all other growth unless otherwise indicated or directed.
- B. Work includes, but is not limited, to the following:
 - 1. Establish clearing limits and vegetation to remain.
 - 2. Protect from harm any trees, vegetation, existing structures, utilities, pavements, sidewalks, curbs, or other objects selected to remain.
 - 3. Installation and maintenance of erosion control facilities through project completion.
 - 4. Clearing site of trees, shrubs, root masses, and other vegetation.
 - 5. Salvage and stockpiling of landscape materials for future use.
 - 6. Removal of structures, slabs, foundations, pavements and other improvements.
 - 7. Removal and disposal of materials from site per regulatory requirements.
- C. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
 - 1. Section 01 57 00 "Erosion Control"
 - 2. Section 31 20 00 "Earth Moving"

1.3 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of each of the following documents at the job site. The bidder in submitting a bid acknowledges that he is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.
 - 1. Standard Specifications: WSDOT-APWA: Standard Specifications for Road, Bridge, and Municipal Construction, 2022
 - 2. Standard Plans: WSDOT/APWA Standard Plans for Road, Bridge, and Municipal Construction

3. City of Kirkland Public Works Pre-Approved Plans
4. Hydraulic Project Approval (HPA)
5. Geotechnical Report:
Geotechnical Engineering Services
Fire Station 27, Kirkland WA
December 13, 2021
6. Technical Memorandum – Fire Station 27 Vault and Signal Poles
Geotechnical Engineering Services
Dated January 19, 2002

1.4 SUBMITTALS

- A. General: Comply with Section 013300.
- B. Submit demolition procedures and operational sequence for review and acceptance by Owner.
- C. Permits for transport and disposal of debris as required.

1.5 EXISTING CONDITIONS

- A. Protection of Existing Improvements:
 1. Provide, erect, and maintain barricades, coverings, or other types of protection necessary to prevent damage to existing improvements.
 2. Restore any existing improvements damaged by this work to their original condition, as acceptable to Owner.
- B. Objectionable Noises: Conform to City of Kirkland requirements regarding Noise Control.
- C. Maintain vehicular and pedestrian traffic routes:
 1. Ensure minimum interference with roads, streets and adjacent facilities.
 2. Do not close or obstruct streets, fire lanes, sidewalks, passageways, or emergency exits without permission from authorities having jurisdiction.
- D. If required by City of Kirkland, provide alternate routes around closed or obstructed traffic ways.
- E. The Contractor is to notify the Owner's Representative immediately if underground utilities not shown on the project documents are encountered.

1.6 HYDRAULIC PROJECT APPROVAL

- A. See Section 31 20 00 "Earth Moving"

1.7 DIMENSIONS AND LAYOUTS

- A. The Contractor will be responsible for furnishing, setting and marking all line and location stakes, including offsets and general construction staking. When work requiring control is being performed, all necessary related equipment, supplies and instruments shall be on site. A qualified layout professional must be assigned to the Contractor's crew for this work. This equipment and personnel must be available, at no additional cost to the Owner for the purpose of verifying layout, conformance of grading design, and certifying the accuracy of work on the site.
- B. The Contractor is responsible for preserving all benchmarks and stakes and the replacement of any that are displaced or missing.
- C. The Contractor is responsible for review of all utility purveyor, and City or State records relative to the existing underground utilities. The Contractor is responsible for avoiding damage to these facilities and shall restore all utilities at Contractor's own expense.

PART 2 - PRODUCTS

2.1 CONSTRUCTION FENCING

- A. Chain link fencing: minimum 6' height, line posts at 8' o.c. maximum. 2" chain link mesh fence.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify limits of clearing, grubbing, and site improvement removal with Owner prior to commencing work.
- B. Obtain required permits and permission from local governing authorities and Owner prior to commencing work.
- C. Prior to beginning site removals and clearing, meet with Owner's Representative and review all proposed utility layouts on site. Indicate all existing trees, shrubs and landscaping as well as site improvements that will be affected by construction. Coordinate removals of landscape materials with Owner.
- D. Identify existing rockery walls and fences near excavations. Verify excavation will not undermine or cause damage to structures.

3.2 CLEARING

- A. Clearing and Grubbing (Stripping) shall be in accordance with Section 2-01.3 of the Standard Specifications.
- B. Prior to site clearing and demolition, contact utility location service and have all underground utilities on the construction site and adjacent areas clearly marked. Locate, flag and protect existing underground utilities to remain.
- C. Approximate locations of existing utilities have been obtained from available records and are shown for convenience. The contractor shall be responsible for verification of the locations shown and for discovery of possible additional utilities not shown to avoid damage or disturbance. The Owner shall be contacted if a utility conflict exists.
- D. Unless otherwise noted, completely remove all roots, vegetation and all other organic debris within the clearing limits as required for new construction and as indicated. Remove all stumps completely from felled trees unless otherwise noted on the plans. Perform removal operations in a manner to protect property.
- E. Dispose of clearing debris off site in a legal manner.

3.3 UTILITY SERVICES

- A. Underground Utility Locations: Phone 1-800-424-5555 for location a minimum of 48 hours prior to excavation.
- B. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition.
 - 1. Do not interrupt existing utilities servicing occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
 - 2. Provide not less than 72 hours notice to Owner if shutdown of service is required during changeover.
 - a. Utility requirements: Locate, identify, disconnect and seal or cap off indicated utility services to be removed that serve existing buildings.
 - 3. Arrange to shut off utilities with utility company and/or Owner as required.
 - 4. Where utility services are required to be removed, relocated or abandoned, provide bypass connections to maintain continuity of service.

3.4 GRUBBING

- A. General: Grub or otherwise prepare areas where clearing has occurred to receive construction or other improvements.
- B. Excavate and remove all stumps to a minimum depth of at least 2 feet below grade.

- C. Excavate and remove roots larger than 2 inches in diameter, rocks, boulders, any remaining paving, and the like, as well as other unsuitable materials.
- D. Use only hand methods for grubbing inside the greater of a 10-foot radius or the drip line (whichever is greater) of trees indicated to remain.
- E. Abandoned piping shall be per Section 7-08.3(4) of the Standard Specifications.

3.5 SITE IMPROVEMENT REMOVALS

- A. Remove existing underground utilities, per City of Kirkland standards, below the future building structure, and as shown on plans.
- B. Sprinkle excavated material and access roads as necessary to limit dust to lowest practicable level. Do not use water to extent causing flooding, contaminated runoff or icing.

3.6 DRAINAGE

- A. Keep designated drainage ways open for drainage at all times. Maintain and/or adjust erosion control facilities as required to prevent sediment transport either downstream or off-site. All catch basins and conveyance ditches shall be cleaned prior to paving. Mud/sediment build-up shall be removed, and the cleaning operation shall not flush sediment-laden water into the downstream system.
- B. The Contractor is responsible to provide temporary and permanent control of surface water and subsurface seepage to allow for site access, grading, construction of underground utilities, and paving. The Contractor is solely responsible for protecting disturbed areas from inclement weather and surface runoff during construction process to provide a suitable working platform for all phases of the construction. Ground water from upgradient sources shall be intercepted and routed around work area. The Contractor shall be familiar with and shall follow the specifications concerning subgrade protection.
- C. Keep open pits and holes caused as a result of demolition work free of standing water.

3.7 DISPOSAL OF MATERIALS

- A. Refuse from clearing and grubbing shall be disposed of by the Contractor in a manner consistent with government regulations. In no case shall refuse material be left on the project site, placed onto abutting private properties, or buried in embankments or trenches on the project site. Debris shall not be deposited in a stream or body of water, any public right of way or upon private property except by written consent of the private property owner. On-site burning is not allowed. Maintain hauling routes clean and free of debris resulting from work of this Section.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

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

1.2 SUMMARY

- A. This Section includes the following:

1. Rough and final grading of the project area from existing condition to the lines and grades shown on the plans.
2. Excavation of unsuitable material.
3. Excavating and recompacting existing fill as indicated in the contract documents.
4. Preparing subgrades for future slab-on-grade and foundations.
5. Excavations and backfilling for utility trenches and vaults.
6. Placing and compacting aggregate and soil materials.
7. Protection and conditioning of on-site materials.
8. Removing groundwater from excavations.
9. Exporting and disposing of unsuitable and excess soil material.
10. Unit Price descriptions for unanticipated unsuitable soil and replacement imported structural fill.

- B. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:Section 00 12 70 "Unit Prices and Allowances"

1. Section 01 22 00 "Unit Prices"
2. Section 01 57 00 "Temporary Erosion Control"
3. Section 31 10 00 "Site Preparation"
4. Section 33 30 00 "Sanitary Sewer"
5. Section 33 10 00 "Water Utilities"
6. Section 33 41 00 "Storm Drainage"

1.3 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of each of the following documents at the job site. The bidder in submitting a bid acknowledges that he/she is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.

1. Standard Specifications: WSDOT-APWA: Standard Specifications for Road, Bridge, and Municipal Construction, 2022
2. Standard Plans: WSDOT/APWA Standard Plans for Road, Bridge, and Municipal Construction
3. Hydraulic Project Approval (HPA)
4. City of Kirkland Public Works Pre-Approved Plans
5. Geotechnical Report:
Geotechnical Engineering Services
Fire Station 27, Kirkland WA
December 13, 2021
6. Technical Memorandum – Fire Station 27 Vault and Signal Poles
Geotechnical Engineering Services
Dated January 19, 2002

1.4 DEFINITIONS

- A. Backfill: Soil materials used to fill a cut, trench, or other excavation placed at a specified degree of compaction.
- B. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- C. Concealed Condition: Conditions encountered that are subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent construction activities of the character provided for in the Contract Documents.
- D. Crushed Surfacing: Gravel layer placed between the compacted subgrade and final surfacing. Includes Top Course and Base Course.
- E. Excavation: Removal of material encountered above subgrade elevations, or as indicated on project documents.
- F. Fill: Soil materials placed at a specified degree of compaction used to obtain an indicated grade or elevation.
- G. Over-excavation: Excavation below subgrade elevations or below excavation elevations as indicated in project documentation or as identified by the Geotechnical Engineer.
- H. Pipe Bedding: Soil layer placed over the excavated subgrade in a trench before laying pipe.
- I. Structural Fill: Soil placed as fill and compacted to the specified maximum dry density per the project documents and as defined by ASTM D 1557.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below base, drainage fill, or topsoil materials. See Paragraph 1.7 for additional information.
- L. Trench Backfill: Soil layer placed within a trench between top of pipe or bedding material (whichever is higher) and the subgrade of the hard or soft surface wearing course.
- M. Unauthorized over-excavation: Excavation below subgrade elevations or beyond indicated dimensions without approval of the Geotechnical Engineer.
- N. Unsuitable soil shall be that material below the Subgrade elevation that does not meet bearing capacity requirements as defined in the field by the Geotechnical Engineer.
- O. Wet Weather Earthwork: Earthwork performed between dates of October 1 and April 30 or during wet weather regardless of the time of year.

1.5 PROJECT CONDITIONS

- A. Existing fill soil has been encountered within the project area and depths are expected to vary across the project area. See Geotechnical Report for approximate depths and locations of existing fill soils expected to be encountered.
- B. Existing Conditions: Existing on-site native and fill soils are above the optimum moisture content for compacting to specified maximum dry densities. Drying of on-site soil will be required for reuse as structural fill.
- C. Groundwater is anticipated in excavations exceeding 6 feet below existing ground level. Temporary construction dewatering will be required, and the Contractor shall be responsible to remove groundwater to a depth of 1 foot below the bottom of excavation. Groundwater shall be discharged from the site in

1.6 SUBMITTALS

- A. General: Comply with Section 01 33 00.
- B. Temporary construction dewatering plan.
- C. Samples: Submit minimum 50-pound samples sealed in airtight containers to Geotechnical Engineer for each material four business days prior to placing material.
- D. Test Reports: Sieve analysis for each material.
- E. Certificates: WSDOT pit certification for each pit.
- F. Products:

1. Crushed Surfacing Top Course
2. Crushed Surfacing Base Course
3. On-site Structural Fill
4. Imported Structural Fill
5. Common Fill
6. Gravel for Pipe Zone Bedding
7. Gas Service Pipe Bedding
8. Gravel Backfill for Drains
9. Gravel Backfill for Trenches
10. Geotextile Fabric
11. Controlled-Density Fill
12. Tracer Tape

1.7 BIDDING

- A. Contractor shall include in their base bid the cost of achieving the final grades shown on the Contract Documents beginning with the existing conditions as represented in the site survey included in the Contract Documents. The project Geotechnical Report shall be used as a reference. All excavation to suitable bearing soil, removal of unsuitable materials and debris, export, import, placement, and compaction required to achieve the final grades, as shown in the Contract Documents, shall be included in the base bid. Shoring, if necessary to protect existing structures and utilities, shall be included in the base bid.
- B. Sub Grade: For the purpose of the Contractor Bid, the following shall define the sub-grade elevations:
 1. Construction grade elevation as noted in the Civil Engineering Plans.
 2. Utility Trenches: The elevation of the bottom of the pipe bedding.
 3. Pavements: The elevation of the bottom of the paving section.
 4. Landscape Areas: The elevation below the stripping depth or the soil planting section, whichever is lower.
 5. Foundations: The elevation of the bottom of the footing or the bottom of excavation, whichever is lower, as shown on the Civil, Architectural and Structural Plans and as defined in the Contract Documents.
 6. Building Slabs: The elevation at the bottom of the capillary break or the bottom of excavation, whichever is lower, as shown on the Civil, Architectural and Structural Plans and as defined in the Contract Documents.
- C. Soil integrity will be influenced by the weather conditions and the Contractor's handling and protection of the material as it is removed and placed. It is the sole responsibility of the Contractor to protect soils from the elements. Material that is deemed unsuitable due to lack of protection will not be applied to the Unit Price. The Contractor will be responsible for removing such material and replacing with acceptable material at no additional cost to the owner.
- D. The Contractor shall not apply the Unit Price to material that was not defined as unsuitable material by the Geotechnical Engineer.

1.8 QUALITY ASSURANCE

- A. Comply with applicable provisions of the following specifications and documents:
1. Washington State Department of Transportation 2022 Standard Specifications for Road, Bridge, and Municipal Construction.
 2. City of Kirkland Public Works Pre-Approved Plans.
 3. ASTM C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate.
 4. ASTM D-422 Method for Particle Size Analysis of Soils
 5. ASTM D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/cu ft).
 6. ASTM D2922 Standard Test methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 7. ASTM D3017 Standard Test methods for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 8. ASTM D698 Standard Test method for Moisture-Density relations of soils and soil-aggregate mixture using 5.5-lb. Rammer and 12-inch Drop.
 9. AASTO T176 Plastic Fines in Graded Aggregates and Soils by use of the Sand Equivalent Test.
- B. Tests and Inspection: Provide sieve analysis per ASTM D422 for each material type. Tests and analysis of aggregate material will be performed in accordance with Standard Specifications. If tests indicate materials do not meet specified requirements, change material and retest. Costs associated with the modifying and retesting of non-conforming materials shall be the responsibility of the Contractor.

1.9 QUALIFICATIONS

- A. Crew Foreman: Minimum six years' working experience and four years' experience as foreman performing similar work.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Stockpiling: Stockpile materials on site within clearing limits or at locations approved by Owner. The Contractor shall be responsible for protecting the stockpiled material.
- B. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- C. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.
- D. Comply with Section 3-02 of the Standard Specifications. Contractor shall provide survey stakes for stockpiles.
1. Maintain toe of material at least a horizontal distance equal to the excavation depth from edges of trenches and excavations. Pile so surface water is prevented from flowing into excavations. Provide free access to fire hydrants, water valves, meters; private driveways; and leave clearance to enable the free flow of storm water in gutters, conduits, and natural water courses.

1.11 DIMENSIONS AND LAYOUTS

- A. See Section 31 10 00, "Site Preparation".

1.12 REGULATORY REQUIREMENTS

- A. Conform to Agency codes for dust control, runoff control, and disposal of demolished and cleared materials.
- B. The Contractor shall comply with the safety requirements of all government agencies, including OSHA.
- C. Notify affected utility providers before starting work and comply with their requirements.
- D. If any materials that appear to be hazardous are encountered during excavation, discontinue work and immediately notify both Owner and Architect.
- E. Conform to the requirements set forth in the Hydraulic Project Approval (HPA) Permit No. 2022-4-89+01.

1.13 HYDRAULIC PROJECT APPROVAL

- A. The HPA permit covers the following activities:
 - 1. Removal and Disposal of an existing 24-inch diameter outfall pipe to the existing Juanita Creek.
 - 2. Installation and replacement of a new stormwater outfall structure which includes a rock outfall pad between the outfall and Juanita Creek.
 - 3. Removal of invasive species
 - 4. Replacement of removed trees with newly planted native trees within 10 feet of the ordinary high water mark.
- B. The approved "FIRE STATION 27 HPA PLAN SET" dated January 18, 2022 must be onsite during construction activities and all supporting documents and communications uploaded to the Aquatic Protection Permitting System (APPS) project file; except as modified by this Hydraulic Project Approval. You must have a copy of these plans available on site during all phases of the project construction.
- C. Invasive Species Control: Follow Method 1 for low risk locations (i.e. clean/drain/dry). Thoroughly remove visible dirt and debris from all equipment and gear (including drive mechanisms, wheels, tires, tracks, buckets, and undercarriage) before arriving and leaving the job site to prevent the transport and introduction of invasive species. For contaminated or high risk sites please refer to the Method 2 Decontamination protocol. Properly dispose of any water and chemicals used to clean gear and equipment. You can find this and additional information in the Washington Department of Fish and Wildlife's "Invasive Species Management Protocols", available online at <https://wdfw.wa.gov/species-habitats/invasive/prevention>.

D. Notification Requirements

1. The Contractor shall contact the Washington Department of Fish and Wildlife at least three business days before starting work, and again within seven days after completing the work. The notification must include the permittee's name, project location, starting date for work or date the work was completed, and the permit number by one of the following methods:
 - a. e-mail at HPAapplications@dfw.wa.gov
 - b. mail to Post Office Box 43234, Olympia, Washington 98504-3234;
 - c. fax to (360) 902-2946
2. The Contractor shall photograph the job site before the work begins and after the work is completed. Photographs shall be uploaded to the "post-permit requirement" page in the Aquatic Protection Permitting System (APPS) or mailed to Washington Department of Fish and Wildlife at Post Office Box 43234, Olympia, Washington 98504-3234 within 30-days after the work is completed.
3. If a fish kill occurs or fish are observed in distress at the job site, immediately stop all activities causing harm. Immediately notify the Washington Department of Fish and Wildlife of the problem. If the likely cause of the fish kill or fish distress is related to water quality, also notify the Washington Military Department Emergency Management Division at 1-800-258-5990. Activities related to the fish kill or fish distress must not resume until the Washington Department of Fish and Wildlife gives approval. The Washington Department of Fish and Wildlife may require additional measures to mitigate impacts.

E. Staging, Job Site Access, And Equipment

1. Stage all equipment landward of the ordinary high water line (OHWL).
2. Equipment used for this project may operate waterward of the ordinary high water line, provided the drive mechanisms (wheels, tracks, tires, etc.) do not enter or operate waterward of the OHWL.
3. Check equipment daily for leaks and complete any required repairs in an upland location before using the equipment in or near the water.
4. Use environmentally acceptable lubricants composed of biodegradable base oils such as vegetable oils, synthetic esters, and polyalkylene glycols in equipment operated in or near the water.

F. Construction-Related Sediment, Erosion And Pollution Containment

1. Protect all disturbed areas from erosion. Maintain erosion and sediment control until all work and cleanup of the job site is complete.
2. Straw used for erosion and sediment control, must be certified free of noxious weeds and their seeds.
3. Stop all hydraulic project activities except those needed to control erosion and siltation, if flow conditions arise that will result in erosion or siltation of waters of the state.
4. Prevent project contaminants, such as petroleum products, hydraulic fluid, fresh concrete, sediments, sediment-laden water, chemicals, or any other toxic or harmful materials, from entering or leaching into waters of the state.
5. Route construction water (wastewater) from the project to an upland area above the limits of anticipated floodwater.
6. Remove fine sediment and other contaminants before discharging the construction water to waters of the state.

7. Deposit waste material from the project, such as construction debris, silt, excess dirt, or overburden, in an upland area above the limits of anticipated floodwater unless the material is approved by the Washington Department of Fish and Wildlife for reuse in the project.
8. Deposit all trash from the project at an appropriate upland disposal location.

G. Construction Materials

1. Store all construction and deconstruction material in a location and manner that will prevent contaminants such as petroleum products, hydraulic fluid, fresh cement, sediments, sediment-laden water, chemicals, or any other toxic or harmful materials from entering waters of the state.
2. Use only clean, suitable material as fill material (no trash, debris, car bodies, tires, asphalt, concrete, etc.).

H. Outfall

1. To prevent scouring, protect the watercourse bank and bed at the point of discharge using biotechnical techniques, including installation of an appropriately sized rock splash pad. Install native plantings adjacent to the splash pad area, such that the root system can grow and lock the rock splash pad in place. Examples of preferred native plant species include red-osier dogwood (*Cornus sericea*) and willow (*Salix* spp.).
2. The downstream end of the outfall structure must be located at least 4 feet landward of the OHWL, and a rock pad must be used to dissipate the energy of flowing water exiting the outfall.
3. The angular rock must be large enough and installed to withstand the 100-year peak flow.
4. To prevent the entry of adult or juvenile fish, construct the outfall structure according to the approved plans and specifications.
5. Isolate the excavation pit from the wetted perimeter.

I. Demobilization and Cleanup

1. Seed areas disturbed by construction activities with a native seed mix suitable for the site that has at least one quick-establishing plant species.
2. Replant the job site with the plant species composition and planting densities approved by the Washington Department of Fish and Wildlife.
3. Any existing woody shrubs or trees, which become either damaged or removed due to construction work must be replaced with native plantings approved by WDFW, to be planted within 10 feet of OHWL.
4. Complete replanting of riparian vegetation during the first dormant season (late fall through late winter) after project completion per the approved plan. Maintain plantings for at least three years to ensure at least 80% of the plantings survive. Failure to achieve the eighty percent survival in year three will require you to submit a plan with follow-up measures to achieve requirements or reasons to modify requirements.
5. Remove temporary erosion and sediment control methods after job site is stabilized or within three months of project completion, whichever is sooner.
6. Upon completion of the project, remove all materials or equipment from the site and dispose of all excess spoils and waste materials in an upland area above the limits of anticipated floodwater.

PART 2 - PRODUCTS

2.1 NEW MATERIALS

- A. Crushed Surfacing Top Course: shall be manufactured from ledge rock, talus or gravel and shall be 5/8" minus for top course. Crushed surfacing top course shall conform to the gradations of Section 9-03.9(3) of the Standard Specification.
- B. Crushed Surfacing Base Course: shall be manufactured from ledge rock, talus or gravel and shall be 1 1/4" minus for base course. Crushed surfacing base course shall conform to the gradations of Section 9-03.9(3) of the Standard Specification with the following revisions: the material passing the No. 40 sieve shall be 5.0% (maximum), and it shall have at least two mechanically fractured surfaces.
- C. Structural Fill: All fill placed under buildings, roadways, sidewalks, walkways, and all other paved areas, including fill used in utility trenches, shall be "Structural Fill" as defined herein, unless specified otherwise for specific applications.
 - 1. Imported materials that conforms to the grading requirements of Gravel Borrow, Section 9-03.14(1) of the Standard Specifications, except the material passing the #200 sieve shall be less than 5%.
 - 2. Onsite materials which are free of organic material and significant rubble greater than 3-inches in dimension and other debris, and moisture conditioned to within 2% of optimum moisture content to reach the specified compaction requirements AND meet the following criteria:
 - a. It shall be acceptable to the Geotechnical Engineer for use as Structural Fill.
 - b. Onsite materials may be used for Structural Fill only during the months of June, July, and August when the weather is dry and can be moisture conditioned.
 - c. Onsite materials may be used as Structural Fill only below pavements or as trench backfill. Onsite material is not acceptable as Structural Fill below building slabs or foundations.
 - 3. Structural Fill shall be acceptable to the Geotechnical Engineer.
- D. Common Fill: All fill placed under landscaped and vegetated areas to specified subgrade elevations shall be "common fill" as defined herein, unless specified otherwise for particular applications.
 - 1. Common Fill shall be granular material, either naturally occurring or processed. It shall be essentially free from various types of wood waste, concrete debris or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily. The maximum particle size shall not exceed 4 inches. On-site Common Fill shall conform to Section 9-03.14(3) of the Standard Specifications except that the percent by weight passing the U.S. No. 200 sieve shall be based on the portion passing the 3/4 inch sieve.
 - 2. On-site material used for common fill shall have an organic matter content of less than 20%.
- E. Capillary Break Material shall be AASHTO Grading No. 67 per Section 9.03(1)4C of the Standard Specifications.

- F. Gravel for Pipe Zone Bedding Material: shall be in accordance with Section 9-03.12(3) of the Standard Specifications unless otherwise specified in the following Sections:
 - 1. Section 33 30 00 "Sanitary Sewer"
 - 2. Section 33 10 00 "Water Utilities"
 - 3. Section 33 41 00 "Storm Drainage"

- G. Utility Trench Backfill: shall be Gravel Borrow in accordance with Section 9-03.14(1) of the Standard Specifications.

- H. Gravel Backfill for Drains: shall be 1" minus washed rock in accordance with Section 9-03.12(4) of the Standard Specifications. It shall be free of roots, organic matter, and other unsuitable materials.

- I. Gravel Backfill for Walls: shall be accordance with Section 9-03.12(2) of the Standard Specifications.

- J. Geotextile Fabric:
 - 1. Non-woven, needle punched, TenCate Mirafi #140N, or approved equal, shall be used unless otherwise noted.
 - 2. Separation Fabric shall be a woven fabric: TenCate Mirafi #500X, or approved equal.

2.2 APPROVAL OF FILL MATERIAL

- A. All fill placed below buildings, pavements, construction surfaces, and in utility trenches shall be "Structural Fill" as defined herein, unless specified otherwise for specific applications.

- B. Approvals of fill material:
 - 1. All material that is proposed to be used as fill and backfill shall meet specified gradation. Gradation test results shall be submitted for review and approved by the Geotechnical Engineer prior to placement.
 - 2. It is the sole responsibility of the Contractor to protect existing ground, prepared subgrade, and any stockpiled material from inclement weather, surface runoff, construction traffic and other conditions that may preclude the re-use of the material.
 - 3. The Contractor shall moisture condition on-site excavated fill for reuse as structural fill. Debris shall be removed from soils to be reused on site. The Contractor shall protect all existing soils to be reused as structural fill from precipitation. Soils exposed to precipitation and become unusable as structural fill due to excess moisture shall be exported and replaced at no expense to the Owner.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Section 31 10 00 "Site Preparation".

- B. Survey and stake limits of clearing per City of Kirkland Standards.
- C. Identify required lines, levels, contours, and datum. Should indicated figures conflict with actual conditions, notify Architect and await direction before proceeding.
- D. Verify existing grade elevations to be matched. Notify Architect where existing grades to be matched creates an adverse affect, such as blocking grading, abrupt change in grade, slopes steeper than allowed, and grades not conforming with ADA.
- E. Prepare for and execute a construction dewatering plan as required for excavations deeper than 6 feet below existing grade.

3.2 CONSTRUCTION

- A. Clearing and Grubbing (Stripping) shall be in accordance with Section 31 10 00, "Site Preparation".
- B. Strip topsoil, organics, and soft surficial soils to their full depth within the clearing limits.
 - 1. Do not strip more area than can be protected from moisture damage to underlying material.

3.3 EXCAVATION

- A. Contractor shall be responsible for, and make their own determination regarding, the import of fill materials and hauling off-site excess materials as necessary to attain the indicated elevations. Import of fill material and hauling off-site of excess material shall be included in the Base Bid. Removal and disposal of all displaced soil from utility trench and other excavations shall be included in the Base Bid.
- B. Excavate and remove all topsoil and existing fill containing organic materials within project area.
- C. Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered, including cobbles and boulders, soil materials, and obstructions.
 - 1. If excavated materials are encountered that include unsuitable material for fill and backfill including concrete, rock, and loose fill, over-excavate unsuitable material and replace with satisfactory soil materials in conformance with this Section and as approved by the Geotechnical Engineer.
 - 2. Excavated existing loose fill may be stockpiled on-site and re-used as Onsite Structural Fill if the criteria in this Section is fulfilled.
- D. Subgrade Preparation shall be in accordance with Section 31 10 00, "Site Preparation". See also Section 3.5 below.

- E. The Contractor shall arrange for the Geotechnical Engineer to observe excavation work. Obtain the Geotechnical Engineer's approval of subgrade prior to placement of any structural fill.
- F. Remove and dispose of groundwater found in excavations.
- G. Fill materials may be stockpiled in areas on-site that do not interfere with other portions of the work. Contractor shall protect stockpiled soils from wind or erosion by covering with plastic sheeting and securing, or other effective methods. Remove excavated soil that will not be reused from the site. Shortage of material caused by premature disposal of any material by the Contractor shall be replaced with suitable material by the Contractor at their own expense.
- H. Direct surface water away from excavation and stockpiles to prevent erosion or deterioration of materials.
- I. Remove material stockpiles when materials are no longer needed. Leave area in a clean and neat conditions. Grade site surface to prevent standing surface water.
- J. The Contractor shall condition the soil, drying or moistening, so that a dense unyielding condition results and the compaction criteria are met.
- K. Stabilization of Excavations and Trenches
 - 1. The Contractor shall exercise sound engineering and construction practices for excavations and trenches and maintain them so that no damage will occur to any foundation, structure, pole line, pipe line, or other facility because of sloughs or slopes, or from any other cause. If, as a result of the excavation or trenching, there is disturbance of the ground that may endanger other property or require repair, the Contractor shall take remedial action at no expense to the Owner.
 - 2. The contractor shall provide dewatering, shoring or other types of stabilization, in addition to the shoring required for safety by State codes, as required to maintain the integrity of the trenching or excavation and protect nearby existing utilities and structures. All earthwork activities shall conform to the Washington Administrative Code (WAC) 296-155 requirements for Excavation, Trenching, and Shoring. If the Contractor elects to provide stabilization by open pit excavation or flatter side slopes, no additional compensation will be made for the work including excavation, select backfill material, backfilling, and protection of existing facilities.

3.4 PROOFROLLING

- A. Before any fill material is placed, Contractor shall proof-roll or compact subgrade to a dense and unyielding condition with a loaded dump truck, large vibrating roller or equivalent to identify soft pockets and areas of excess yielding. Do not proof roll wet or saturated subgrades. Proofrolling shall extend at least 5 feet beyond the future building footprint.
- B. Proofrolling shall be observed the Geotechnical Engineer.

- C. When soft subgrade is identified by the Geotechnical Engineer, the contractor shall excavate the unsuitable soil and replace it with Structural Fill. Structural fill shall be compacted to meet the specified compaction criteria. Previously approved subgrade areas that subsequently deteriorate because of Contractor's activities shall be removed and replaced with Structural Fill at no expense to the Owner.

3.5 FILLING, BACKFILLING, AND COMPACTION

- A. All areas that are to receive compacted fill shall be field reviewed by the Geotechnical Engineer prior to the placement of new fill.
- B. Any areas of loose or soft soil exhibiting significant deflection, pumping, or weaving that cannot be adequately reworked and/or compacted shall be over-excavated per the Geotechnical Engineer's recommendations. Over-excavated material shall be replaced with structural fill unless otherwise directed.
- C. Filling, Backfilling, and Compaction
 - 1. Fill areas to contours and elevations indicated in the plans with approved Structural Fill.
 - 2. Soil surfaces that will receive fill shall be scarified to depth of at least six inches. The scarified soil shall be moisture-conditioned to obtain soil moisture near optimum moisture content. The scarified soil shall be compacted to a minimum relative compaction as listed in this Section.
 - 3. Place fill in controlled layers the thickness of which is compatible with the type of compaction equipment used. The loose thickness of each fill layer shall not exceed 12 inches when using heavy compaction equipment and 6 inches when using hand operated compaction equipment. Compact each layer to a minimum relative compaction as listed in this Section.
 - 4. Maintain optimum moisture content of fill materials to attain required compaction density.
 - 5. Do not fill over ponded surface water or existing subgrade surfaces which are yielding, disturbed, or softened.
 - 6. Suspend placing fill when the climatic conditions will not allow proper placement and fill compaction.
 - 7. Make grade changes gradual. Blend slope into level areas. Construct uniform grades between spot elevations or contours shown.
 - 8. The Geotechnical Engineer shall observe the placement of compacted fills and conduct in-place field density tests on the compacted fill to check for adequate moisture content and the required relative compaction. Where less than the required relative compaction is indicated, remove and replace the substandard soil or apply additional compactive effort and moisture-condition the soil as necessary until the relative compaction as specified in this Section is attained.
 - 9. Compaction Requirements: Compact all fill and backfill to prevent subsequent settlement. Water settling or jetting is not permitted as a means of compaction. Furnish heavy rollers or compactors except as follows:
 - a. Use pneumatic hand tampers for trenches and areas not accessible to heavy equipment.
 - 10. Required compaction: Compact fill and backfill to a minimum relative compaction (percentage of maximum dry density determined in accordance with ASTM D1557) as listed below:

- a. All fill placed under building footprint or within 1H:1V (horizontal:vertical) of foundations shall be compacted to a minimum of 95%.
- b. All fill within upper 2 feet of all pavement and hardscape subgrade elevations shall be compacted to a minimum of 95%.
- c. Subgrade below pipe bedding shall be compacted to a minimum of 95%
- d. Pipe bedding shall be compacted to a minimum of 95%
- e. All utility trench backfill below the upper two feet of pavement and hardscape subgrade elevation shall be compacted to a minimum of 90%.
- f. Common fill in landscape areas shall be compacted to a minimum of 90%
- g. Fill placed against walls shall be compacted to a minimum of 90%

3.6 SITE TOLERANCES

- A. Grading Tolerance: Finish grades shall match contours and elevations shown within 1/10 foot.
- B. Finish Grades along routes designed to meet ADA requirements shall match elevations shown on plans with ¼ inch.

3.7 FIELD QUALITY CONTROL

- A. In accordance with Division 01, "Quality Control".
- B. Owner will engage a qualified independent Geotechnical Engineer to perform field quality-control testing.
- C. Notify and allow Geotechnical Engineer to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- D. Site Tests: If tests indicate Work does not meet specified requirements, re-compact and retest at Contractor's Expense.
- E. Geotechnical Inspections shall include:
 1. Subgrade prior to placing fills
 2. Surface after completion of cuts and fills and prior to placing topsoil, bases, or pavements.
 3. Subgrades for all building foundations, floor slabs, and all other subgrades for structures.
 4. Each lift of structural fill as deemed necessary by the Geotechnical Engineer.

3.8 PROTECTION

- A. If subgrade or fill soils become loosened, wet, or disturbed, additional excavation to expose undisturbed soil and replacement with properly compacted fill will be required. The Contractor may reduce disturbance by the following methods:

1. Limit construction traffic over unprotected soil.
2. Provide gravel "working mats"
3. Sloping excavated surfaces to promote runoff. Collecting runoff and directing it to the sediment storage facility.
4. Sealing exposed surfaces by rolling with a smooth drum compactor or rubber-tiered roller at the end of each working day and removing wet surface soil prior to filling each day.
5. Completing earthwork activities in dry weather conditions and in the typical dry season (June through September).

- B. The Contractor shall repair and provide the additional excavation, disposal, and import of replacement material at no additional cost to the owner.

3.9 CLEANING

- A. Dispose of waste, surplus, and unsuitable materials according to laws, regulations, and ordinances off site at a site obtained by Contractor.

3.10 WET WEATHER WORK

- A. On-site soils are moisture sensitive and these soils will become unsuitable when allowed to become wet.
- B. Fill material and utility trench backfill material used between October 1 and April 30 shall be Imported Structural Fill.
- C. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when control of soil moisture content is not possible, the following procedures shall be followed.
1. Earthwork shall be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils shall be followed promptly by the placement and compaction of imported gravel borrow. The size and type of construction equipment used may have to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic.
 2. The ground surface within the construction area shall be graded to promote runoff of surface water and to prevent the ponding of water.
 3. Work areas shall be covered with plastic to protect from rainfall.
 4. Material used as imported structural fill shall consist of gravel borrow containing less than 5 percent fines. The fines shall be non-plastic.
 5. The ground surface within the construction area shall be sealed by a smooth drum vibratory roller, or equivalent, and under no circumstances shall be left uncompacted and exposed to moisture. Soils which become too wet for compaction shall be removed and replaced with clean granular materials.
 6. Excavation and placement of fill shall be observed by the Geotechnical Engineer to verify that all unsuitable materials are removed, and suitable compaction and site drainage is achieved.
 7. Bales of straw and/or geotextile silt fences shall be strategically located to control erosion as required and in addition to the requirements of the Temporary Erosion and Sediment Control Plan.

8. Contractor is responsible for over-excavation of material beneath subgrade that becomes unsuitable because it is left exposed, saturated, damaged, or adversely affected by the Contractor's work.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION

- A. Work shall consist of designing, furnishing, and installing Rammed Aggregate Pier foundations to the lines and grades designated on the project foundation plan and as specified herein. Aggregate piers will be installed to provide increased bearing pressure below the shallow foundations and reduce liquefaction settlement between footings as specified in Part 3. The aggregate piers shall be constructed by either augering a cavity or driving a hollow mandrel to the design depth and vertically ramming lifts of aggregate using the specially designed tamper head and high-energy impact densification equipment to create the compacted aggregate pier. The Rammed Aggregate Pier elements shall be in a columnar-type configuration and shall be used to produce an intermediate foundation system for support of foundation loads.
- B. Related Requirements:
 - 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 WORK INCLUDED

- A. Provision of all equipment, material, labor, and supervision to design and install Rammed Aggregate Pier elements. Design shall rely on subsurface information presented in the project geotechnical report. Layout of Rammed Aggregate Pier elements, spoil removal (as required), footing excavations, and subgrade preparation following aggregate pier installation is included in other scopes of work.
 - 1. The Rammed Aggregate Pier design and installation shall adhere to all methods and standards described in this Specification.
 - 2. Drawings and General Provisions of the Contract, including General and Supplemental Conditions, and Division 01 Specifications, apply to the work in this specification.

1.5 APPROVED INSTALLERS

- A. Installers of Rammed Aggregate Pier foundation systems shall have a minimum of 5 years of experience with the installation of Rammed Aggregate Pier systems and shall have completed at least 50 projects.

1.6 REFERENCE STANDARDS

A. Design

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.

B. Modulus Testing

1. ASTM D 1143 - Pile Load Test Procedures
2. ASTM D 1194 - Spread Footing Load Test

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 Rammed Aggregate Pier Designer shall make the final determination of the applicable document.

1.7 SUBMITTALS

A. Sustainable Design Submittals:

1. Comply with requirements of Section 01 81 13

B. Design Calculations: The Installer shall submit detailed design calculations and construction drawings prepared by the Rammed Aggregate Pier Designer (the Designer) for review and approval by the Geotechnical Engineer and Owner's Engineer. All plans shall be sealed by a Professional Engineer in the State in which the project is constructed.

1. The Installer shall submit detailed design calculations, construction drawings, and shop drawings, (the Design Submittal), for approval at least 2 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 where the piers are to be built. Submittals will be submitted electronically only unless otherwise required by specific submittal instructions.

C. Professional Liability Insurance: The Rammed Aggregate Pier Designer shall have Errors and Omissions design insurance for the work. The insurance policy should provide minimum coverage per Contractor's subcontract exhibit requirements.

- D. Modulus Test Reports: A modulus test(s) is performed on a non-production Rammed Aggregate Pier element as required by the Rammed 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.
- E. Daily Rammed Aggregate Pier Progress Reports: The Installer shall furnish a complete and accurate record of Rammed 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 AGGREGATE

- A. Aggregate used by the Rammed 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.

2.2 DESIGN REQUIREMENTS

- A. Rammed Aggregate Pier Design
 1. The design of the Rammed 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 Rammed Aggregate Pier system. The Rammed Aggregate Pier system shall be designed in accordance with generally-accepted engineering practice and the methods described in Section 1 of these Specifications. The design life of the structure shall be 50 years.
 2. Foundations require ground improvement support
 3. The design shall meet the following criteria.
 - a. Minimum Allowable Bearing Pressure for Footings supported by Rammed Aggregate Pier Reinforced Soils: 5000 psf
 - b. Total Long-Term Static and Liquefaction Settlement for Footings: \leq 1- inch
 - c. Long-Term Differential Settlement of Adjacent Footings (static and liquefaction settlement): \leq 1/2-inch
 - d. Maximum Aggregate Pier Foundation Support Spacing: 8 feet on-center
 4. The Rammed Aggregate Pier elements shall be designed using a Rammed Aggregate Pier stiffness modulus to be verified by the results of the modulus test described in Section 5.02 of these specifications if a modulus test is required, if not required, the stiffness value can be estimated based on experience and the soil conditions.

PART 3 - EXECUTION

3.1 APPROVED INSTALLATION PROCEDURES

- A. The following sections provide general criteria for the construction of the Rammed Aggregate Pier elements. Unless otherwise approved by the Designer, the installation method used for Rammed Aggregate Pier construction shall be that as used in the construction of the successful modulus test.
- B. Augered Rammed Aggregate Pier systems
 1. Augered Rammed Aggregate Pier system shall be pre-augered using mechanical drilling or excavation equipment.
 2. If cave-ins exceeding 10% of the lift volume 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 augered cavity in lift thicknesses as determined by the Rammed Aggregate Pier Designer.
 4. A specially-designed beveled tamper and high-energy impact densification apparatus shall be employed to densify lifts of aggregate during installation. The apparatus shall apply direct **downward** impact energy to each lift of aggregate. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.
- C. Displacement Rammed Aggregate Pier systems
 1. Displacement Rammed Aggregate Pier systems shall be constructed by advancing a specially designed mandrel with a minimum 15 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. Compaction equipment that induces horizontal vibratory energy (such as Vibroflot equipment) is not permitted.
 4. Downward crowd pressure shall be applied to the mandrel during installation.

3.2 PLAN LOCATION AND ELEVATION OF RAMMED AGGREGATE PIER ELEMENTS

- A. 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.

3.3 REJECTED RAMMED AGGREGATE PIER ELEMENTS

- A. Rammed 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.

3.4 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 Rammed Aggregate Pier Designer, the General Contractor, and to the Testing Agency.

B. Rammed Aggregate Pier Modulus Test

- 1. A minimum of two Rammed Aggregate Pier Modulus Test(s) will be performed at locations agreed upon by the Rammed Aggregate Pier Designer and the Testing Agency to verify or modify Rammed Aggregate Pier designs. Modulus Test Procedures shall utilize appropriate portions of ASTM D 1143 and ASTM D 1194, as outlined in the Rammed Aggregate Pier design submittal.

C. 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. Additional testing as required by the Rammed Aggregate Pier Designer shall be performed on selected production Rammed Aggregate Pier elements to compare results with the modulus test pier.

3.5 QUALITY ASSURANCE

A. Independent Engineering Testing Agency (Owner's Quality Assurance)

- 1. The Rammed Aggregate Pier Installer shall provide full-time Quality Control monitoring of Rammed Aggregate Pier construction activities. The Owner is responsible for retaining an independent engineering testing firm to provide Quality Assurance services.

B. Responsibilities Of Independent Engineering Testing Agency

- 1. 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.
- 2. The Testing Agency shall monitor the installation of Rammed Aggregate Pier elements to verify that the production installation practices are similar to those used during the installation of the modulus test elements.
- 3. The Testing Agency shall report any discrepancies to the Installer and General Contractor immediately.
- 4. 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.

3.6 RESPONSIBILITIES OF THE GENERAL CONTRACTOR

A. Site Preparation and Protection

1. The General Contractor shall locate and protect underground and above ground utilities and other structures from damage during installation of the Rammed Aggregate Pier elements.
2. Site grades for Rammed Aggregate Pier installation shall be within 1 foot of the top of footing elevation or finished grade elevation to minimize Rammed 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 Rammed Aggregate Pier installation.
4. Prior to, during and following Rammed 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 Rammed Aggregate Pier installation, spoil removal from the Rammed Aggregate Pier work area in a timely manner to prevent interruption of Rammed Aggregate Pier installation is required.

B. Rammed Aggregate Pier Layout

1. The location of Rammed Aggregate Pier-supported foundations for this project, including layout of individual Rammed Aggregate Pier elements, shall be marked in the field using survey stakes or similar means at locations shown on the drawings.

C. Owner's Independent Testing Agency (Owner's Quality Assurance)

1. The Owner 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 Of Obstructions

1. Should any obstruction be encountered during Rammed 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 Rammed Aggregate Pier installations so that excavations do not encroach on the piers as shown in the Rammed Aggregate Pier construction drawings. Protection of completed Rammed Aggregate Pier elements is the responsibility of the General Contractor. In the event that utility excavations are required in close proximity to the installed Rammed Aggregate Pier elements, the General Contractor shall contact the Rammed Aggregate Pier Designer immediately to develop construction solutions to minimize impacts on the installed Rammed 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 Rammed Aggregate Pier elements 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 Rammed Aggregate Pier elements before pouring structural concrete, and (3) achieve direct and firm contact between the dense, undisturbed Rammed Aggregate Pier elements and the concrete footing.
3. All excavations for footing bottoms supported by Rammed 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 Rammed Aggregate Pier elements 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 (which may soften the unconfined matrix soil between and around the Rammed Aggregate Pier elements and may have detrimental effects on the supporting capability of the Rammed Aggregate Pier reinforced subgrade) has not been allowed to pond in the footing excavation at any time.
 - b. That all Rammed Aggregate Pier elements designed for each footing have been exposed in the footing excavation.
 - c. That immediately before footing construction, the tops of Rammed Aggregate Pier elements 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 Rammed 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 Rammed Aggregate Pier Installer, may void any written or implied warranty on the performance of the Rammed Aggregate Pier system.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work includes but is not limited to following:
 - 1. Subgrade for asphalt concrete paving for Parking Lots and Roadways.
 - 2. Asphalt concrete paving.
 - 3. Asphalt patching for utilities.

- B. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
 - 1. Section 31 20 00 – Earth Moving.
 - 2. Section 32 13 00 – Concrete Paving & Sidewalks

1.3 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of the each of the following documents at the job site. The bidder in submitting a bid acknowledges that he is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.
 - 1. Standard Specifications: WSDOT-APWA: Standard Specifications for Road, Bridge, and Municipal Construction, 2022
 - 2. Standard Plans: WSDOT/APWA Standard Plans for Road, Bridge, and Municipal Construction
 - 3. City of Kirkland Public Works Pre-Approved Plans
 - 4. Geotechnical Report:
Geotechnical Engineering Services
Fire Station 27, Kirkland WA
December 13, 2021

1.4 DEFINITIONS

- A. Asphalt Binder Reference Cost: Index price of asphalt binder as published on the following website: <https://wsdot.wa.gov/business-wsdot/how-do-business-us/public-works-contracts/payments-reporting/asphalt-binder-reference-cost>.
 - 1. Base Cost = Most recent "Date Effective" Asphalt Binder Reference Cost for Western Washington at the time of Bid Opening.
 - 2. Current Reference Cost = Most recent "Date Effective" Asphalt Binder Reference Cost for Western Washington at the time of HMA Purchase.
- B. Hot Mix Asphalt (HMA) – Top layer of asphalt paving section above the crushed surfacing course. See Part 2.
- C. Crushed Surfacing: Gravel layer placed between the compacted subgrade and final surfacing. Includes Top Course and Base Course.
- D. Excavation: Removal of material encountered above subgrade elevations, or as indicated on project documents.
- E. Fill: Soil materials placed at a specified degree of compaction used to obtain an indicated grade or elevation.
- F. Structural Fill: See Specification 31 20 00 Earth Moving
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. Subgrade: See Specification 31 20 00 Earth Moving
- I. Unauthorized over-excavation: Excavation below subgrade elevations or beyond indicated dimensions without approval of the Geotechnical Engineer.
- J. Unsuitable Soils: See Specification 31 20 00 Earth Moving
- K. Wet Weather Earthwork: Earthwork performed between dates of October 1 and April 30 or during wet weather regardless of the time of year.

1.5 SUBMITTALS

- A. Submit under provisions of Division 013300.
- B. Submit product data for all materials specified.

1.6 QUALITY ASSURANCE

- A. Contractor shall correct any work that exhibits aggregate separation, soft spots, and excess porosity at no additional cost to the Owner.
- B. Repair cracks and unsatisfactory elevation irregularities immediately upon notification.
- C. Replace any paving not draining properly.

1.7 SYSTEM DESCRIPTION

- A. This work shall consist of one or more courses of plant mixed asphalt concrete placed on a prepared base in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross-sections shown in the plans or established by the Owner's representative.
- B. Asphalt concrete shall be composed of asphalt and aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed in the proportions specified to provide a homogenous, stable, and workable mixture.

1.8 PROJECT SITE CONDITIONS

- A. Environmental Requirements:
 - 1. Accomplish paving in accordance with the Weather Limitations outlined in Section 5-04.3(1) of the Standard Specifications. Asphalt Paving shall be in accordance with referenced standard specifications and the following:
 - a. Do no paving in rain or when subgrade or base is wet or frozen.
 - b. Do not apply tack coats when base is wet.

1.9 DIMENSIONS AND LAYOUTS

- A. See Section 31 10 00, "Site Preparation".

1.10 MODIFICATIONS TO HOT MIX ASPHALT (HMA) PRICING

- A. A price adjustment is included in the Contract based on the Asphalt Binder Reference Cost.
 - 1. This price adjustment shall only apply to the material cost of HMA. Equipment, labor, and all other materials shall not be included in this price adjustment.
- B. HMA pricing will be adjusted using the following formulas:

1. If the Asphalt Binder Reference Cost increases from the time of Bid Opening to the time of HMA Purchase, the Contractor will be compensated using the following formula:
 - a. $\text{Change Order to Contractor} = (\text{Current Reference Cost} - (1.05 \times \text{Base Cost})) \times (\text{Quantity of HMA purchased in tons} \times 0.056)$.
 2. If the Asphalt Binder Reference Cost decreases from the time of Bid Opening to the time of HMA purchase, the Contractor will issue a credit back to the owner using the following formula:
 - a. $\text{Credit to Owner} = (\text{Current Reference Cost} - (0.95 \times \text{Base Cost})) \times (\text{Quantity of HMA purchased in tons} \times 0.056)$.
 3. The Current Reference Cost will be reviewed for each pay period when HMA is purchased, and either a Change Order to the Contractor or Credit to the Owner will be issued at that time.
 4. No Change Order or Credit shall be issued if the Current Reference Cost is within 5% of the Base Cost.
- C. The maximum quantity of HMA for which this price adjustment can be applied is 313 tons for the entire project scope.
- D. The Contractor shall include the Base Reference Cost for Western Washington and the corresponding "Date Effective" on the Bid Form. This Base Reference Cost will be effect at the time of Bid Opening and confirmed by the Owner prior to Contract Award.
- E. The Contractor shall provide an invoice of the HMA cost as part of the documentation for a Change Order to the Contractor or a Credit to the Owner.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Comply with "Quality Control" provisions, "References," Specifications, and Manufacturer's data. Where these may be in conflict, the more stringent requirements govern.
- B. Conform to APWA - Section II, "Specifications for Asphalt Paving" of above referenced manual. Provide bases, type and thickness of asphalt concrete as required by type of soils for indicated use.

2.2 ASPHALT PAVING

- A. Headers, Benders & Stakes: Construction Grade Douglas fir; preservative treated.
- B. Crushed Rock Base Course shall be per Specification 31 20 00, "Earth Moving".

- C. Asphalt Binder shall be viscosity grade AR-4000, PG 58-22.
- D. Hot Mix Asphalt ("HMA") shall be ½-inch HMA in accordance with Section 9-03.8 of the Standard Specifications
- E. Crack Filler: Flexafil rubberized asphalt, or equal.
- F. Other Materials: Provide all accessory and incidental materials, equipment, tools, and methods required for completion of paving, where indicated on drawings, including the following.
 - 1. Tack Coat: CSS-1 in accordance with Section 9-02.1(6) of the Standard Specifications. Apply to all vertical surfaces to which "HMA" abuts.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes your acceptance of conditions as satisfactory.
 - 1. Construction shall conform to the details, dimensions and grades specified. Maximum variations in finished grade of paving shall be +/- 0.05 feet.
 - 2. Grade and compact all areas to be paved in accordance with Section 31 20 00, "Earth Moving".

3.2 PREPARATION

- A. Protect surrounding areas and surfaces to preclude damage from work of this Section.
 - 1. Protect work of other trades.
 - 2. Should any defacement or damage occur, repair or replace as directed.
- B. Traffic Control: Traffic Control shall be provided as required in accordance with the City of Kirkland requirements and the Manual on Uniform Traffic Control Devices.

3.3 ASPHALT PAVING INSTALLATION

- A. General: Remove all existing fill, debris, vegetation, and other perishable materials from areas to be paved. Proof-roll subgrade and address soft yielding areas per Geotechnical Engineers recommendation. Bring areas requiring fills to rough grade elevations. Install wood headers and benders to true lines as indicated and securely staked to prevent movement or displacement during paving operations. Remove upon completion.

- B. Base Course: Place in accordance with the requirements of Section 4-04 of the Standard Specifications and to the thickness shown on the plan or to match existing depth, whichever is greater. Materials shall be graded and compacted in 4-inch maximum layers to at least 95 percent of maximum density in accordance with ASTM D1557, Method D.
- C. Tack Coat: All contact surfaces, curbs and cold pavement joints shall be painted with asphalt emulsion before the surfacing is laid. All longitudinal and transverse joints shall be fully compressed by the spreading machine and be free from surface irregularities.
- D. Hot Mix Asphalt (HMA) Paving: Provide HMA as indicated on the plans, consisting of mineral aggregate, uniformly mixed with bituminous material in a central plant. Provide all labor, equipment and materials required to complete the work. All asphalt concrete pavement work shall conform to the requirements of Section 5-04.3 of the Standard Specifications.
- E. Place asphalt in accordance with Section 5-04 of the Standard Specifications. Spread, finish and compact in accordance with Sections 5-04.3(7) and 5-04.3(10) of the Standard Specifications. Minimum lift thickness shall be 1 ½ inches. Compact to a minimum of 92% of the theoretical Rice Density.
- F. Construct joints in accordance with Section 5-04.3(12) of the Standard Specifications. Provide surface smoothness in accordance with Section 5-04.3(13) of the Standard Specifications.
- G. Sample and test asphalt concrete in accordance with Section 5-04.3(10)B of the Standard Specifications.

3.4 ASPHALT PAVEMENT PATCHING

- A. Patching Bituminous Pavement: Replace the existing pavement with ½" HMA asphalt concrete pavement and compacted aggregate base course to either match the existing thickness as the existing HMA and base the asphalt paving section as shown on the plans, whichever is greater.

3.5 CLEANING

- A. After completion of paving operations, clean surfaces of excess or spilled asphaltic materials.
- B. Contractor shall phase the final lift of pavement in a manner to limit Construction traffic within this area after completion.
- C. Do not permit vehicular traffic on asphaltic paving until it has cooled and hardened, and in no case sooner than twelve (12) hours after placing.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. Landscape Architect's Plans and Specifications for scoring and joint placement, specialty pavers and specialty finishes, dimensions, and seat walls.

1.2 SUMMARY

- A. Work includes installation of exterior concrete work including walks, slabs, pavements, and curbs.
- B. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
 - 1. Section 01 57 00 "Erosion Control"
 - 2. Section 31 10 00 "Site Preparation"
 - 3. Section 31 20 00 "Earth Moving"

1.3 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of each of the following documents at the job site. The bidder in submitting a bid acknowledges that he is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.
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 - 3. City of Kirkland Public Works Pre-Approved Plans
 - 4. Geotechnical Report:
Geotechnical Engineering Services
Fire Station 27, Kirkland WA
December 13, 2021

1.4 SUBMITTALS

- A. General: Submit in accordance with Section 01 30 00 and as further provided.

- B. Cement concrete mix: Submit concrete mix design and certificate showing compliance with specifications.
- C. Photographs of existing conditions of pavements, joining construction, and site improvements that might be misconstrued as damage caused by the construction activities.

1.5 QUALITY ASSURANCE

- A. Qualifications: Provide at least one person who shall be present at all times during the execution of this portion of the work who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this section.
- B. Codes and Standards: Comply with the current standards of the City of Kirkland and the Standard Specifications. Keep one copy of Standard Specifications and the project plans and specifications on-site.
- C. Protection: Use all means necessary to protect curb, walk and slab materials before, during and after installation. Protect the existing work to remain, the installed work, and materials of all other trades.
- D. Replacements: In the event of damage, repair or replace walks and slabs to the satisfaction of the Architect at no additional cost to the owner.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Provide wood edge forms, Douglas Fir and Larch, number two grade minimum, seasoned, SAS, straight and true.
- B. Special edge forms for radii shall be approved in advance by the Architect.

2.2 CEMENT CONCRETE

- A. Cement concrete for Curbs, Walks, Utility Pads, and Pavements: Conform to Standard Specification 8-14 except use Class 4000 PSI Portland Cement Concrete with air entrainment in accordance with Standard Specification 6-02 and City of Kirkland Standard Plans CK-R.17 and CK-R.23.

2.3 BASE COURSE

- A. See Specification 31 20 00, "Earth Moving".

- A. Premolded Joint Filler: Conform to Standard Specification Section 9-04.1(2).

2.5 DETECTABLE WARNING SURFACE

- A. Detectable Warning Surface: Conform to City of Kirkland Standard Plan CK-R.25B and Standard Specification Section 8-14.3(5).

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection: Prior to all work of this Section, inspect work of other trades to verify that such work is complete to a point where walk and slab installation may properly commence.
 - 1. Verify that utilities, conduit, and other items requiring installation beneath the surface have been completed.
 - 2. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Verify that curbs, walks and slabs may be placed in accordance with the design.
- C. Discrepancies: In the event of discrepancy, immediately notify the Architect.
- D. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 SURFACE PREPARATION

- A. Prepare subgrade for pouring of concrete per Sections 31 10 00 "Site Preparation" and 31 20 00 "Earth Moving" to address soft yielding areas per Engineer's recommendation.
- B. Provide minor excavation and hand preparation required for placement of crushed rock base course. Remove all organic materials. Fill all voids, compact soft spots and other soils disturbed by excavation and compact to 95% maximum soil density. Moisture condition soil as needed to achieve required moisture content.
- C. Place crushed surfacing base course to depth shown on drawings and compact to 95%.

3.3 DIMENSIONS AND LAYOUTS

- A. See Section 31 10 00, "Site Preparation".

- B. Notify Architect of any finish grade irregularities or apparent closed depressions which might result in ponding water, prior to placing concrete. Form for all required walks and slabs to shapes, sizes, lines and dimensions indicated on the Drawings. Layouts to be in accordance with all lines and elevations established by survey data.
- C. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to the required lines, grades, and elevations. Install forms to allow continuous progress of the work and so forms can remain in place at least 24 hours after concrete placement.

3.4 EXPANSION JOINTS

- A. Place expansion joints as shown on the Drawings. Extend joint-filler full width of joint and to within 1/4" to 1/2" of finished concrete surface. Seal with approved high quality, weather tight, flexible joint sealant.

3.5 CONSTRUCTION JOINTS

- A. Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolations joints.

3.6 SCORE JOINTS

- A. Place score lines as shown on the Landscape Drawings. Control joints or tooled score joints shall not exceed intervals as shown on drawings. On straight work, the joints shall be parallel with and at right angles to the line of the work. The markings shall be made by hand tooling creating rounded edges at the scoring line with a radius of 1/2 "and with a depth of not less than 1/2". No shiners. The finished joint opening shall not be wider than 1/8".

3.7 FINISH TOLERANCES

- A. Finish all walks and slabs to plus or minus 1/2" at any point from line and grade shown on the Drawings.
- B. ADA ramps shall be within 1/4" of the grade shown on the Drawings.
- C. Where abutting existing pavements, provide a transition that will not exceed 1/4-inch change in elevation in 5 feet.
- D. Thickness: Plus 3/8-inch, minus 1/4 inch.

3.8 FINISH

- A. Refer to Landscape Architectural Plans for specialized finishes.

- B. Float and Trowel: Provide "broom finish" by lightly combing straight lines with a medium stiff broom. Pattern to be perpendicular to main pedestrian traffic route. No shiners.

3.9 WALKS

- A. Conform to detail on Plan and Standard Specification Section 8-14.3.

3.10 CURBS

- A. Provide cast-in-place concrete curbs in conformance with detail on Plan and Standard Specification Section 8-04.3.
- B. Provide pervious concrete mow strip in conformance with detail on Plan.

3.11 CONCRETE PAVEMENT

- A. Provide concrete pavements and utility pads in conformance with details on Plan and Standard Specification Section 5-05.3.

3.12 PROTECTION

- A. Protect finished and unfinished Work from disturbance and damage from equipment and other work.
- B. Protect all conduits, pipes, and aggregate cover from damage or displacement.

3.13 ADJUST UTILITIES

- A. Adjust manhole ring and cover, water valve lids, and other utilities to maintain finish grade of new pavement.

3.14 COLD-WEATHER PLACEMENT

- A. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- B. When air temperature has fallen, or is expected to fall below 40 degrees F (4.4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C) and not more than 80 degrees F (27 degrees C) at point of placement.
- C. Do not use frozen materials or materials containing ice or snow.

- D. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

3.15 HOT-WEATHER PLACEMENT

- A. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F (32 degrees C). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
- B. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
- C. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.16 REPAIR/REPLACEMENT

- A. Repair or replace to Owner's satisfaction any curbs or walks placement or finish is found to be defective or non-conforming. Replace all work damaged by Contractor's operations.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Concrete pavers.
 2. Curbs and edge restraints.

1.2 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] <Insert location>**.

1.4 ACTION SUBMITTALS

- A. Product Data:
1. For materials other than water and aggregates.
 2. For the following:
 - a. Pavers.
 - b. Edge restraints.
- B. Sustainable Design Submittals:
1. Environmental Product Declaration (EPD):
 - a. Include a Type III Product-Specific EPD created from a Product Category Rule.
 2. Material Ingredient Reporting:
 - a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.
- C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified unit paving installer. Installer's field supervisor must have Concrete Paver Installer Certification from the Interlocking Concrete Pavement Institute (ICPI) with one of the following designations:
 - 1. Residential Paver Technician Designation.
 - 2. Commercial Paver Technician Designation.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.8 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 CONCRETE PAVERS

A. Manufacturer: Abbotsford Concrete Products. 1-800-663-4091.

1. Pedestrian Pavers:
 - a. Model: Classic Standard.
 - b. Dimensions: 8-7/8" X 4-7/16" X 2-3/8"
 - c. Color: Shadow.
 - d. Pattern: Offset runner Bond.
2. Vehicular Pavers:
 - a. Model: VS-5
 - b. Dimensions: 3x12x4-5/16
 - c. Color: Shadow.
 - d. Offset runner bond.

2.3 CURBS AND EDGE RESTRAINTS

A. Plastic Edge Restraints: Manufacturer's standard triangular PVC extrusions 1-3/4 inches high by 3-1/2 inches wide designed to serve as edge restraints for unit pavers; rigid type for straight edges and flexible type for curved edges; with pipe connectors and 3/8-inch diameter by 12-inch- long steel spikes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Great North Hardscape.
 - b. Or approved equal.

B. Concrete drive aisle and curb, per civil plans and specifications.

2.4 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: see civil plans.
- B. Graded Aggregate for Base: see civil plans.
- C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C33/C33M for fine aggregate.
- D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.
- E. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2, AASHTO M 288.
 2. Apparent Opening Size: **No. 60** sieve, maximum; ASTM D4751.
 3. Permittivity: 0.02 per second, minimum; ASTM D4491.
 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D4355.
- F. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive **[subbase]** **[and]** **[base]** course for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
 1. For concrete pavers, a block splitter may be used.
- D. Joint Pattern: Running bond.
- E. Tolerances:

1. Do not exceed **1/4 inch in 10 feet** from level, or indicated slope, for finished surface of paving.
- F. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.

3.4 AGGREGATE SETTING-BED APPLICATIONS

- A. See Civil drawings for subgrade and aggregate installation information.
- B. Place leveling course and screed to a thickness of **1 to 1-1/2 inches**, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- C. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- D. Set pavers with a minimum joint width of **1/16 inch** and a maximum of **1/8 inch**, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed [**3/8 inch**] **<Insert dimension>** with pieces cut to fit from full-size unit pavers.
1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- E. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- F. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- G. Repeat joint-filling process 30 days later.

3.5 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.
- C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

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

1.2 SECTION INCLUDES

- A. Work includes but is not limited to following:
 - 1. Furnish and install pavement markings upon asphalt parking surfaces.
 - 2. Furnish and install site parking signs as indicated.
- B. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
 - 1. Section 321200 – Asphalt Paving
 - 2. Section 321300 – Concrete Curbs

1.3 REFERENCES

- A. This section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of the each of the following documents at the job site. The bidder in submitting a bid acknowledges that he is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.
 - 1. King County Design and Construction Standards, 2016 Edition
 - 2. WSDOT-APWA 2022 Standard Specifications for Road, Bridge, and Municipal Construction, (Herein: Standard Specifications)
 - 3. Manual on Uniform Traffic Control Devices (MUTCD) Current Edition.
 - 4. Federal Specification TT-P-115, Traffic Paint.

1.4 SUBMITTALS

- A. Submit under provisions of Division 013300.
- B. Submit product data for all materials specified.

1.5 SAMPLING AND TESTING

- A. Store materials proposed for use on the project site in sealed and labeled containers or segregate at source of supply, sufficiently in advance of needs. Clearly identify materials by designated name, specification number, batch number, intended use and quantity formulation number, project contract number, intended use, and quantity involved. At the discretion of the Owner's Representative, material may be approved for use based on the following data furnished by the Contractor.
 - 1. A test report showing that the proposed batch meets all specified requirements

1.6 TEMPORARY TRAFFIC CONTROLS

- A. Place suitable warning signs for alerting approaching traffic. Place traffic cones or markers along newly painted lines to control traffic and prevent damage to newly painted surfaces.
- B. Contractor shall review all proposed temporary and permanent striping and channelization with the owner prior to installation.

PART 2 - PRODUCTS

2.1 TRAFFIC PAINT

- A. Paint shall be lead free, Low VOC Solvent Based or Waterborne paint per Section 9-34.2 of the Standard Specifications.
- B. Paint shall be delivered and stored in sealed containers that plainly show the designated name, formulation, or specification number, batch number, color, date of manufacture, manufacturer's name, formulation number and directions, all of which shall be printed legibly at time of use. The paint shall be homogeneous, easily stirred to a smooth consistency, and shall show no hard settlement or other objectionable characteristics.
- C. Color shall conform to Section 9-34.2(2) of the Standard Specifications.

2.2 THERMOPLASTIC PAVEMENT MARKINGS

- A. Thermoplastic Pavements Markings shall be Type A – Liquid Hot Applied Thermoplastic conforming to Section 9-34.3(1) of the Standard Specifications.

2.3 SITE SIGNS

- A. Fire Lane Signs shall read "NO PARKING – FIRE LANE".

1. Signs shall be located at the entrance to each fire lane and at 150-foot intervals along the route.
 2. Signs shall measure 12" x 18" and have red letters on a white background.
- B. Site signs shall be 80-millimeter anodized aluminum with engineer grade reflective sheeting and graffiti film.
- C. Sign mounting hardware and fasteners shall be stainless steel or hot-dipped galvanized.
- D. Signposts shall be a minimum 2" diameter Schedule 40 galvanized pipe with top caps or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Verify installation conditions as satisfactory to receive work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes your acceptance of conditions as satisfactory.
1. Pavement markings shall conform to Section 8-22 of the Standard Specifications.
 2. All permanent signs shall conform to Section 8-21 of the Standard Specifications.

3.2 PREPARATION

- A. All surfaces shall be dry, free of any loose debris, and within the proper temperature range prior to striping. When required by the pavement marking manufacturer's installation instructions, pavement markings that will adversely affect the bond of new pavement marking material to the roadway surface shall be removed from pavement surfaces in accordance with Section 8-22.3(6) of the Standard Specifications.
- B. Apply materials to new HMA that is sufficiently cured according to the manufacturer's recommendations. Typically, Type D material applied to new HMA pavement requires a pavement cure period of 21 days. This cure period may be reduced if the manufacturer performs a successful bond test and approves the reduction of the pavement cure period.
- C. For new Portland cement concrete surfaces, remove curing compounds and laitance by an approved mechanical means. Air blast the pavement with a high-pressure system to remove extraneous or loose material. Apply materials to concrete that has reached a minimum compressive strength of 2,500 psi and that is sufficiently cured according to the manufacturer's recommendations. Typically, Type D material applied to Portland cement concrete pavement requires a pavement cure period of 28 days. This cure period may be reduced if the manufacturer performs a successful bond test and approves the reduction of the pavement cure period.

- D. After the pavement surface is clean and dry, apply primer as recommended by the manufacturer to the area receiving the pavement markings. Apply the primer in a continuous, solid film according to the recommendations of the primer manufacturer and the pavement markings manufacturer.

3.3 APPLICATION

- A. Pavement Markings shall be per Section 8.22.3 of the Standard Specifications.
- B. Glass Beads shall be per Section 8.22.3(3)G of the Standard Specifications.
- C. Application thickness shall be per Section 8.22.3(3)F of the Standard Specifications.
- D. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking letters and symbols. Sharply outline edges of marking. The maximum drying time requirement of the paint specifications shall be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the marking, until cause of the slow drying is determined and corrected.
- E. Parking Area:
 - 1. Parking stall striping shall be 4 inches wide painted white unless otherwise noted on the plans.
 - 2. Handicapped Parking Stall Symbol shall be in accordance with Figure 3B-22 of the MUTCD. The boarder and ADA symbol shall be white with a blue background.

3.4 SIGN INSTALLATION

- A. Install signs at locations as shown on plans and in accordance with Section 8-21.3(2) of the Standard Specifications and MUTCD.

3.5 CLEANING

- A. Leave premises clean and free of residue of work of this Section.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Wood Fencing. (To match existing material and design)
- B. Related Sections include the following:
 - 1. Division 01 Section "Sustainable Design Requirements" for applicable Sustainability requirements.
 - 2. Division 03 "Cast-In-Place Concrete".

1.3 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 REFERENCES

- A. Standards: Comply with the following unless otherwise specified or indicated on the Drawings
- B. Preservative Treatment: American Wood Preserver's Bureau (AWPB), by the American Woos Preserver's Institute (AWPI)

1.5 SUBMITTALS

- A. Shop Drawings: Show application to project. Machine duplication copies of Contract Drawings will not be accepted
 - 1. Indicate plan layout, grid, size and spacing of components, accessories, fittings, anchorage, and post section.

- B. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13
 - 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 - 3. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
 - 4. Chain-of-Custody Qualification Data: For manufacturer and vendor.

- C. Data: Submit manufacturer's installation instructions and procedures, including details of fence installation.

- D. Quality Controls submittals:
 - 1. Pressure Treatment Certificates: Certifications by treating plant stating chemicals and process used, net amount of slats retained, and conformance with applicable standards.

1.6 DELIVERY STORAGE AND HANDLING

- A. Keep materials dry during delivery. Store materials 6 inches minimum above ground surfaces. Protect against exposure to weather and contact with damp or wet surfaces. Stack Lumber and provide air circulation between stacks.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Lumber, General: Furnish seasoned dimensional lumber to nominal sizes indicated wutg 19% maximum moisture content at time of dressing, marked "S_DRY". Comply with dry size requirements of PS 20.
 - 1. Dress: Surfaced 4 sides (S4S) unless otherwise indicated

- B. Lumber; 2 inches through 4 inches thick, less than 6 inches wide: Furnish West Coast Doug Fir treated with 0.15 pcf CA_C, architectural appearance, comb. #2, or approved equal.
 - 1. Top And Bottom Rail: 2x4, stained.

- C. Board Lumber; less than 2 inches thick: Cedar fascia and trim "appearance grade". Select Tight Knot S1S2E elect tight knot.
 - 1. Infill: 1x6 cedar, stained.

- D. Timber; 5 inches and thicker: Furnish West Coast Doug Fir treated with 0.15 pcf CA-C. architectural appearance, comb. #2 or approved equal.
 - 1. Posts: 6x6 at 8'-0" o.c. max., stained

- E. All wood materials shall be treated wood, or wood of a natural resistance to decay. Materials shall be free from loose knots, cracks, and other imperfections.
- F. Steel Brackets: Hot Dipped galvanized, vandal resistant.
- G. Fasteners: Galvanized, furnish type and size required.
 - 1. Nails and Staples: FS FF-N-105
 - 2. Wood Screws: FS-FF-S-111
 - 3. Bolts and Studs: FS FF-B-575
 - 4. Nuts: FS FF-N-836
 - 5. Washers: FS FF-W-92
- H. Concrete: See specification section 03 30 00 "Cast-In-Place Concrete".

2.2 CAP

- A. Tapered cedar cap at each post, stained.

2.3 PRESERVATIVE TREATMENT

- A. Pressure treat lumber in accordance with applicable American Wood Preserver's Bureau (AWPB) Requirements.
- B. Complete fabrication of items to be treated to the greatest extent possible prior to treatments. Where items but be cut after treatment, coat surface with heavy brush coat of same chemical used of treatment.
- C. Inspect wood after treating and drying. Discard warped or twisted items.

PART 3 - EXECUTION

3.1 INSTALLATION; GENERAL

- A. Install wood members plumb, level true and straight, and free of distortion. Conform to all details shown on drawings.

3.2 INSTALLATION OF POSTS

- A. Posts shall be set true to line and grade.
- B. Set posts in 12-inch diameter concrete footings extending at least 24- inches into undisturbed natural ground or properly compacted fill.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Piping.
 - 2. Automatic control valves.
 - 3. Quick couplers.
 - 4. Controllers.
 - 5. Boxes for automatic control valves.
- B. Related Sections:
 - 1. Section 329300 Plants.
- C. Alternates: Refer to Section 012300.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Furnish and install a completely automatic irrigation system to provide adequate irrigation of all new and restored planting shown on the plans and described in specifications, complete and ready for operation. The work shall consist of providing and installing all material necessary for a complete system, including pipe, valves, fittings, automatic central control equipment, and all appurtenances related thereto. Included shall be all labor for trenching, plumbing, backfill, electrical connections and adjustments, mechanical connections, and other labor necessary for installation of satisfactorily operating systems. Whether mentioned or not, the intent is that the Contractor furnish a complete and operable system as indicated on the drawings.

- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated

1.5 SUBMITTALS

- A. Product Data: Submit product data in accordance with Section 013300 a minimum of 30 working days before beginning work, unless otherwise approved. Include data for all products to be installed in these systems. Include material showing manufacturer's name, catalog numbers, catalog cuts, technical data, and manufacturers' installation, operation, and maintenance instructions for each product.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Zoning Chart: Show each irrigation zone and its control valve.
- D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- E. Point of Connection Water Pressure Test: Test water pressure at the irrigation system point of connection prior to beginning work. Submit results of test to Landscape Architect and Owner's Representative.
- F. Site Inspection Report: Submit statement confirming a site inspection has been conducted, noting discrepancies between ground measures and plans, hazards or site conditions which will interfere with installation or operation of the system prior to beginning of work.
- G. Operation and maintenance data.
 - 1. Submit the name and address of permanent service organizations maintained or trained by the manufacturers that will render service within eight hours of receipt of notification of service request.
 - 2. Zone Map: Submit an irrigation plan for the site indicating, by varying colors, the area of coverage for each control valve. Indicate the number and location of the valve. The number is to correspond to that on the controller for that zone.
 - 3. Submit controller timing schedule indicating on a weekly basis the day, time, and duration of watering for each control valve.
 - 4. Provide the zone map and controller timing schedule for each system, folded into a plastic envelope, of a size capable of being installed in the door of the controller.
 - 5. Submit operating and maintenance guides for the entire system and for each piece of equipment in the system. Instructions for system winterization are to be included.
- H. Record Drawings:
 - 1. Maintain a complete set of record drawings, corrected daily, to show design and specification changes, and location of system components. Submit copies as requested.
 - 2. At completion, submit reproducible Mylar plan at the same scale as the construction plans, indicating the elevations of mainlines, valves, backflow preventers, zone outlines,

and other system elements, indicate locations with dimensions from building, curb lines, or other fixed site features.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Perform work under environmental conditions suitable for the tasks being undertaken.
- B. Ordinances, Codes, and Regulations: All local, municipal, and state laws, rules, and regulations governing or relating to any of this work are hereby incorporated into and made part of these specifications and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with above mentioned rules, regulations, or requirements. Where conflict may occur, rules, regulations, or requirements of the governing code shall be adhered to. However, when these specifications and/or drawings call for or describe materials, workmanship or construction of a better quality, higher standard or larger size, these specifications and/or drawings shall take precedence over the requirements of said rules, regulations, and codes.
- C. Existing Conditions:
 - 1. Visit the site and note conditions which affect work under this Section.
 - 2. Locate all utilities, lines, and piping in the work area. Provide adequate protection during all phases of work.
 - 3. Repair utilities, lines, and piping damaged by this work to the satisfaction of the Owner of the line, at no change in Contract Price.
 - 4. Notify Owner's Representative of unsatisfactory conditions. Proceed with work only after conditions have been corrected.
 - 5. Field Measurements: Take field measurements of irrigated areas to determine if differences occur between plans and ground dimensions. Notify Owner's Representative of differences before proceeding with work.
 - 6. Irrigation is not permitted during the following conditions:
 - a. When the temperature is less than 35 degrees F or greater than 90 degrees F.
 - b. When the planting area's soil is saturated, frozen, or dry.
 - c. When wind velocities are greater than 30 mph.

1.8 MATERIALS AND WORKMANSHIP

- A. General: Whenever any material is specified by name/number, such specifications are for the purpose of facilitating a description of materials and establishing quality, and shall be deemed and construed to be followed by the words "or approved equal." No substitutions will be permitted which have not been submitted for prior approval to Owner's Representative. All materials shall be new, without flaws or defects and shall be the best of their class and kind.

Furnish sufficient descriptive literature and/or samples for any material submitted as "equal" substitutes.

- B. Workmanship: All materials and equipment shall be installed in a neat and professional manner. The Owner or Owner's representative reserves the right to direct removal and replacement of any items, which in their opinion do not present an orderly and neat or professional appearance. Such removal and replacement shall be done, when directed in writing, at Contractor's expense without additional cost to Owner.

1.9 SEQUENCING AND SCHEDULING

- A. Complete irrigation system installation and make fully operational before landscape seeding and sodding takes place.
 - 1. Planting and soil preparation is not permitted during the following conditions:
 - a. When the temperature is less than 35 degrees F or greater than 90 degrees F.
 - b. When the planting area's soil is saturated, frozen, or dry.
 - c. When wind velocities are greater than 30 mph.
- B. Thirty days prior to beginning work, submit a work schedule to include dates, location, and type of work to be performed.

1.10 WARRANTY

- A. Refer to the General and Supplementary General Conditions.
- B. Additional Requirements:
 - 1. Repair settling of trenches. Include complete restoration of plantings, mulch, grades, pavements, or other improvements.
 - 2. Correct irrigation system problems or damage within five working days of notice until final acceptance of the irrigation system.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. PVC Pipe: ASTM D 1785, PVC 1120 compound, Schedules 40 and 80.
 - 1. PVC Socket Fittings: ASTM D 2466 Schedules 40 and 80.
 - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
 - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.

- C. PVC Sleeves: 6" or 8" class 200 PVC as indicated on the plans.

2.2 PIPING JOINING MATERIALS

- A. Solvent Cements for Joining PVC Piping: ASTM D 2564 type 711 gray. No Wet 'n Dry or 725 type cements. Include primer according to ASTM F 656.
- B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Not permitted.

2.3 LOW VOLTAGE CONTROL WIRE AND CONNECTORS:

- A. Control Wire: Wire, solid copper, UL listed for direct burial in ground, minimum size #14 AWG. Common wire shall be #12 AWG. Increase size as needed for length of wire run.
- B. Wire Connectors: 3-M DBY or DBR waterproof electrical connectors.
- C. Minimum size of wire is to be determined strictly by the following chart:

Maximum Length of Common Wire				
No. of Valves	500'	1000'	2000'	3000'
1	14	14	14	14
2	14	14	14	10
3	14	14	10	8
4	14	14	10	8
5	14	10	8	6
6	14	10	6	6
7	14	8	6	4
8	14	8	6	4
9	14	8	4	4
10	10	6	4	2
11	10	6	4	-

- D. Control wires shall be color coded as follows:
 - 1. Neutral or common wire - White.
 - 2. Lead-in wire – Each controller and WOB shall have a different color, using Red, Black, and Yellow.
 - 3. Spare wire – Orange.
 - 4. Control wires to be installed in 1 1/2-inch minimum PVC schedule 40 sleeve under all paved areas.
- E. Flow sensor wire: PE-89 communication cable.

2.4 VAULTS

- A. Plastic Boxes:

1. Description: Control valve boxes to be Carson/Oldcastle Pro Series vaults as detailed, Carson extensions as required. Quick coupler boxes to be Carson Pro Series 10" round vaults. All boxes to have locking T-type covers, bolt installed.
- B. Drainage Backfill: Cleaned gravel or round stone, graded from 3/4 inch minimum to 1-1/2 inches maximum, no fines.

2.5 OTHER MATERIALS

- A. Trench Backfill: Masons sand.
- B. "Air Compressor" Valve: Size to fit quick coupling valve keys.
- C. All other materials, not specifically described but required for a complete and proper irrigation system installation, shall be new, first quality of their respective kinds, and subject to approval of Owner or his representative:

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. Protection: The Contractor shall exercise care in handling, loading, unloading, and storing to avoid damage. The pipe and fittings shall be stored under cover and shall be transported in a vehicle with a bed long enough to allow the length of pipe to lay flat, so as not to be subject to undue bending or concentrated external load at any point. Any pipe that has been dented or damaged shall be discarded until such damage has been cut out and the pipe is rejoined with a coupling.
- B. Installation: No piping shall occur unless the Point of Connection is installed and water is available for flushing.
- C. All pipe within buildings to be installed by Mechanical.
- D. Trench Depth: Excavate straight trenches to a depth of 3" below invert of pipe, unless otherwise indicated. Unless otherwise specified, trenches shall be deep enough to allow 12" cover over lateral lines and 18" cover over supply main lines. 24" maximum cover. All trenches must be straight and not have abrupt changes in grade. Excavate straight and true with bottom uniformly sloped to low points. Trench bottoms with uniform slope, free of rocks or sharp-edged objects. Install pipe with label facing up.

- E. Route irrigation lines around roots of existing trees. Care shall be exercised by the Contractor when excavating trenches near existing trees. Trenches having exposed tree roots shall be backfilled within 24 hours unless adequately protected by moist burlap or canvas directed by the Owner's Representative. Pipe shall lay side by side in trench. No stacking of pipe permitted.
- F. Paved Areas: Sleeve all pipe under paved areas. Identify locations of existing sleeving under existing paving not to be disturbed and reuse. Where reuse is not possible, work with paving specialties to coordinate placement of new sleeving and repair of paving.
- G. Backfill: Backfilling shall be done when pipe is not in an expanded condition due to heat or pressure. Cooling of the pipe can be accomplished by operating system for a short time before backfilling, or by backfilling in the early part of the morning before heat of the day. Backfill shall contain no lumps or rocks larger than 1 inch.
- H. Compaction: Use hand-operated plate type vibratory or other suitable hand tampers in areas not suitable for larger rollers or compactors. Compact initial backfill material surrounding pipes and conduit to 90 percent maximum density. For pipes, conduits and sleeves under roads and slabs, compact backfill as specified herein for other utilities under roads and slabs. General: Install in a manner so as to provide for expansion and contraction as recommended by manufacturer. Cut plastic pipe to ensure a square cut. Remove burrs at cut ends prior to installation. Install piping free of sags and bends. Solvent-weld or slip seal all plastic joints. Only solvent recommended by pipe manufacturer shall be used. Install all plastic pipe and fittings as shown and instructed by pipe manufacturer. Install with label facing up. Contractor shall assume full responsibility for correct installation.
- I. Install groups of pipes parallel to each other, spaced minimum 3" apart to permit servicing.
- J. Install PVC piping in dry weather when temperature is above 40 deg F. Allow joints to cure at least 24 hours at temperatures above 40 deg F before testing.

3.3 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- B. Joints: All plastic to metal joints shall be made with plastic Schedule 80 male adapters. Care should be taken at solvent joints not to use an excess amount of solvent. Allow PVC joints to set at least 24 hours before pressure is applied to system. Use pre-primer at joints.
- C. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855. Use purple primer and type 705 gray or 721 blue glue. No Wet 'n Dry or type 725 or 738 glue.

3. PVC Non pressure Piping: Join according to ASTM D 2855.

3.4 VALVES

- A. General: Stake location of all valve boxes for approval prior to installation. Install as detailed on plans. Before installation, the supply line must be thoroughly flushed. Use valve box extensions to ensure that box extends completely below the bottom of the valve. Wire loops required at all valve boxes. Install locking cover bolts. Use Teflon tape only, no pipe dope.
- B. Use factory solenoid as detailed.

3.5 AUTOMATIC IRRIGATION CONTROL SYSTEM

- A. Equipment Mounting: Wall mount controller(s) as directed by Owner's Representative and shown in architectural and landscape plans.
- B. General: Install electrical Control Wire and Conduit as shown on drawings and/or specified. No splices of wires between valves and controller. Electrical wiring (120 VAC) shall be installed according to local code. A licensed electrician must perform hard wiring of controller(s), and the work must be permitted per City requirements. The cost of all electrical work necessary to make the automatic equipment operate properly shall be included in this contract.
- C. Conduit for power supply wires shall be installed as shown on Plans and Details and controller manufacturers shop drawings. The ends of all conduits, whether shop cut or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made square and true. Conduit bends, except factory bends, shall have a radius of not less than six times the inside diameter of the conduit. A 3/16-inch polyethylene pull rope shall be installed in all conduits with two feet of pull rope extended beyond the conduit openings and then secured. All conduit shall be free of debris. All conduit openings shall be sealed with duct tape to prevent fouling.
- D. Connections at Controller: Each control valve is connected to one station of controller and has wire sizes as shown or as specified. Provide separate common ground wire system. Provide junction box at controller location for connection. Connect master valve to master valve start circuit on controller.
- E. Underground Splices: Vinyl insulated connectors and sealed in epoxy resin. Splices to be made in electrical junction boxes. 3M-DBY or approved.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. As-Builts: Draft and up to date as-built drawings are required on site for all testing and inspections.
 2. Schedule: Provide 4 days' notice for test requests. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist. Request no tests until confident work will pass.

3. Main Line Pressure Test: After flushing is complete, pressure test mainline with all valves installed in operating order (flow control in working position), and associated isolation valves open, to 150 psi. System will pass test when it maintains less than 5% drop in a 30-minute time period in presence of Owner's Representative. Main line will be tested as one integral and complete unit at the time of the Punch List. Subsequent breaks or other breaches of mainline integrity require retesting of entire mainline.
4. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
6. Perform a water coverage test in presence of Owner's Representative to determine whether water coverage and operation of system is adequate for planting. If system is determined by Owner's Representative to be inadequate due to poor workmanship or materials, replace or repair and test repeated until accepted. Dry spots will not be acceptable.

B. Irrigation products will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

3.8 PROTECTION

A. Deactivate and drain system prior to onset of freezing season and reactivate at onset of spring season. Accomplish each at least once during warranty period. If construction is completed when system is not in use, winterize after testing. Certify by letter dates of winterization / activation. Repair damage from failure to comply.

B. When using compressed air to winterize the system, do so in short cycles at no more than 40 psi air pressure. Do not allow pipe close to the compressor to get hot to the touch.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes planting soils specified by composition of the mixes.
- B. Related Requirements:
 - 1. Section 32 92 00 "Turf and Grasses" for placing planting soil for turf and grasses.
 - 2. Section 32 93 00 "Plants" for placing planting soil for plantings.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.

- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for application and use.
 - 2. Include test data substantiating that products comply with requirements.
 - 3. Include sieve analyses for aggregate materials.

4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
 - a. Manufacturer's qualified testing agency's certified analysis of standard products.
 - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
 - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

- B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
 1. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on imported soil.
 1. Request amendment recommendations.

1.10 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article and testing lab's directions.

- B. Physical Testing:
 1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
 - a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages

- for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
- b. Hydrometer Method: Report percentages of sand, silt, and clay.
2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
 4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).
- C. Chemical Testing:
1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
 2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
 3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
 4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.
- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT WERA-103, including the following:
1. Percentage of organic matter.
 2. CEC, calcium percent of CEC, and magnesium percent of CEC.
 3. Soil reaction (acidity/alkalinity pH value).
 4. Buffered acidity or alkalinity.
 5. Nitrogen ppm.
 6. Phosphorous ppm.
 7. Potassium ppm.
 8. Manganese ppm.
 9. Manganese-availability ppm.
 10. Zinc ppm.
 11. Zinc availability ppm.
 12. Copper ppm.
 13. Sodium ppm and sodium absorption ratio.
 14. Soluble-salts ppm.
 15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
 16. Other deleterious materials, including their characteristics and content of each.
- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
 - 1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
 - 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways, and pavements, or on existing turf areas or plants.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Do not move or handle materials when they are wet or frozen.
 - 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
 - 2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.

- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.2 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
 - 1. Reaction: pH of 5.5 to 8.
 - 2. Soluble-Salt Concentration: Less than 4 dS/m.
 - 3. Moisture Content: 35 to 55 percent by weight.
 - 4. Organic-Matter Content: 30 to 40 percent of dry weight.
 - 5. Particle Size: Minimum of 98 percent passing through a 2-inch sieve.

2.3 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.
- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply manufactured soil on-site in its final, blended condition, having incorporated amendments recommended by soil testing lab that will not be met by compost. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches. Remove stones larger than 2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
- C. Application: Spread planting soil to total depth of 8 inches, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
 - 1. Lifts: Apply planting soil in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 6 inches in loose depth for material compacted by hand-operated tampers.
- D. Compaction: Compact each lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.3 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply 4 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

- B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 01 56 39 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Vehicle traffic.
 - 4. Foot traffic.
 - 5. Erection of sheds or structures.
 - 6. Impoundment of water.
 - 7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.5 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
 - 1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

A. Section Includes:

- 1. Seeding.
- 2. Hydroseeding.

B. Related Requirements:

- 1. Section 32 93 00 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.4 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 13 "Soil Preparation" and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.
 - 1. Experience: Three years' experience in turf.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 3. Pesticide Applicator: State licensed, commercial.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways, and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.10 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
 1. Spring Planting: March 1 – May 31.
 2. Fall Planting: September 15 – November 15.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

2.2 SEED SPECIES: SEE PLANS. TURFGRASS SOD

- A. Turfgrass Sod: per plan, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

2.3 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 13 "Soil Preparation."
- B. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
 - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate recommended by supplier.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.5 SODDING

- A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.6 TURF MAINTENANCE

- A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches in areas without permanent irrigation.
 - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 - 2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.
- D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.7 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:
 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
 3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
 4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.8 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.9 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

- D. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. ANSI A300 (Part 6) for Tree Care Operations – Tree, Shrub, and other Woody Plant Management: Standard Practices (Planting and Transplanting)
- C. Related Sections include the following:
 - 1. 31 20 00 "Earth Moving" for excavation, filling and backfilling, and rough grading.
 - 2. 32 91 13 "Soil Preparation."

1.2 SUMMARY

- A. This Section provides specifications for the following:
 - 1. Trees, shrubs, and Groundcover.
 - 2. Fertilizer.
 - 3. Mulch and Mineral Mulch.
 - 4. Miscellaneous Products – Landscape Edging.

1.3 LEED

- A. This project is targeting LEED gold certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.4 DEFINITIONS

- A. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum-laced as recommended by ANSI Z60.1.
- B. Finish Grade: Elevation of finished surface of planting soil, not including mulch layer.
- C. Planting Soil: Imported or manufactured topsoil.

- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing topsoil.
- E. Trunk flare:
 - 1. The area at the base of the tree trunk where the trunk broadens to form roots. This should not be confused with swelling at grafting location, if present.
 - 2. The area of transition between the root system and the stem or trunk.
- F. Rootball: The root mass of a tree or shrub after digging or removal from a container. The depth of the rootball shall be measured from the bottom of the trunk flare to the bottom of the ball.

1.5 SUBMITTALS

- A. Comply with requirements of Section 01 33 00.
- B. Submittals:
 - 1. One quart mulch product.
- C. Material Test Reports: For mulch.
- D. Documentation: For all plant material to be installed, including proposed substitutions.
- E. Product Data: For each type of product indicated.
- F. Sustainable Design Submittals:
 - 1. Comply with requirements of Section 01 81 13.
- G. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- H. Qualification Data: For Landscape Installer.
- I. Material Test Reports: For mulch.
- J. Planting Schedule: Indicating anticipated planting dates for exterior plants.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. A qualified Landscape Installer with a minimum of 3 years' experience in whose work has resulted in successful establishment of exterior plants.
 - 2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when exterior planting is in progress
- B. Provide source, quantity, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
- C. Tree Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.
- D. Observation: Landscape Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
 - 1. Notify Landscape Architect of sources of planting materials 6 weeks in advance of delivery to site.
- E. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
- F. Tree Planting Pre-installation Demonstration/Conference:
 - 1. Contractor shall schedule a tree planting demonstration and conference prior to the planting of any trees on site. The purpose of this conference is to demonstrate the contractor's understanding of the tree planting drawings and specifications, and for the landscape architect to observe and approve of the contractor's tree planting practices on a minimum of three trees before remaining tree planting commences.
 - 2. Any personnel that will be involved with tree planting shall be present, including the landscape foreman.
 - 3. Contractor shall, in the presence of all required attendees, including the landscape architect, perform the work of planting the first three trees.
 - 4. If these tree planting mock-ups are approved on-site by the landscape architect as adhering to the drawings and specifications, and the trees are the correct species and in the correct locations per plans, they may remain in place for permanent installation.
 - 5. All subsequent tree planting that is not found to be in accordance with drawings and specifications will be rejected and replanted or replaced at the contractor's expense.
 - 6. Please provide landscape architect with 2 weeks' notice in advance of Tree Planting Pre-Installation Demonstration/Conference.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver exterior plants freshly dug.
 - 1. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- B. Do not prune trees and shrubs before delivery, except as approved by Landscape Architect. Protect bark, branches, and root systems from sunscald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of exterior plants during delivery. Do not drop exterior plants during delivery.
- C. Handle planting stock by root ball.
- D. Deliver plants after preparations for planting have been completed and install immediately after Landscape Architect approval. If planting is delayed more than six hours after delivery, set plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 - 2. Water root systems of exterior plants stored onsite with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.8 SCHEDULING

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.
- B. Coordination with Lawns: Plant trees after finish grades are established and before planting lawns, unless otherwise acceptable to Landscape Architect. See Section 32 92 00 "Turf and Grasses" for allowable seeding periods.
 - 1. When planting trees, protect lawn areas and promptly repair damage caused by planting operations.

1.9 WARRANTY

- A. Warrant all plants for one full year from the date of Final Acceptance, against defects, including death and unsatisfactory growth, except for defects resulting from others lack of adequate maintenance, neglect, or abuse by Owner. Incidents after date of final acceptance that are beyond Contractor's control are not covered by the warranty.
 - 1. Remove dead plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - 2. Replace plants that are more than 50 percent dead or in an unhealthy condition at end of warranty period.

3. A limit of one replacement of each plant will be required, except for losses or replacements due to failure to comply with requirements.

1.10 MAINTENANCE

- A. Trees, Shrubs, and Groundcovers: Maintain for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.

1. Maintenance Period: 6 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, and disfigurement.
- B. Grade: Provide trees and shrubs of sizes and grades complying with ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
- C. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical name (including genus, species, variety, and cultivar) and common name.
- D. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

- A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
 1. Provide balled and burlapped trees. No trees shall be accepted after having been produced in grow bags or containers. No trees shall be accepted bare root.
 2. Branching Height: One-half of tree height or 6' where branches extend above paving.
- B. Multi-stem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1: stem form as follows:
 1. Stem Form: Clump.

2. Provide balled and burlapped trees. No trees shall be accepted after having been produced in grow bags or containers. No trees shall be accepted bare root.

2.3 DECIDUOUS SHRUBS

- A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
 1. Provide balled and potted or container-grown shrubs.

2.4 BROADLEAF EVERGREENS

- A. Form and Size: Normal quality, well balanced, broadleaf evergreens of type, height, spread, and shape required, complying with ANSI Z60.1.
 1. Provide balled and burlapped or container-grown shrubs.

2.5 GROUND COVER PLANTS

- A. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.6 FERTILIZER

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 1. Composition: 20 percent nitrogen, 10 percent phosphorous, 10 percent potassium, by weight.

2.7 MULCH

- A. Ground fir or hemlock aged bark of uniform dark black color, free from weed, seeds, sawdust, and splinters and shall not contain resin, tannin, wood fiber, salts, or other compounds detrimental to plant life. Fine size range of 1/2 inch to 1 inch. Mulch shall be a medium bark manufactured by Cedar Grove, or approved equal. Submit sample for Owner acceptance.

2.8 STAKES AND GUYS

- A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 inches by 2 inches by length indicated, pointed at one end.
- B. Straps: Tree-loc or approved alternate.

2.9 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Landscape Edgings
 - 1. Steel Edging: Install Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
 - a. Manufacturer's: Subject to compliance with requirements.
 - b. Edging Size: 3/16-inch thick by 4 inches deep.
 - c. Stakes: Tapered steel, a minimum of 12 inches.
 - d. Accessories: Standard tapered ends, corners, and splicers.
 - e. Finish: Manufacturer's standard paint.
 - 1) Paint Color: Black.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.

- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Stake locations of individual trees and shrubs and outline areas with multiple shrub and/or groundcover plantings. Adjust locations if necessary or if requested by owner or Landscape Architect and get Landscape Architect's written approval of layout before planting.
- D. Apply anti-desiccant to trees and shrubs using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
 - 1. If deciduous trees are moved in full leaf, spray with anti-desiccant at nursery before moving and again two weeks after planting.

3.3 TREE AND SHRUB EXCAVATION

- A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base, leaving center area slightly higher to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
 - 1. Excavate approximately two times as wide as ball diameter for balled and burlapped container-grown stock.
 - 2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
- B. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch diameter holes into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- C. Fill excavations with water and allow it to percolate away before positioning trees and shrubs. Notify Landscape Architect if subsoil conditions create unexpected water seepage or retention in tree or shrub pits.

3.4 TREE PLANTING

- A. Set balled and burlapped stock plumb and in center of pit or trench with the bottom of the trunk flare a minimum of 1" above finish grade.
 - 1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

3.5 TREE PRUNING

- A. Prune, thin, and shape trees and shrubs as directed by Landscape Architect.

3.6 GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72-inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses. Support trees with two strands of straps. Allow enough slack to avoid rigid restraint of tree and to prevent strangulation. Use the number of stakes as follows:
 - 1. Use two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.

3.7 EDGING INSTALLATION

- A. Steel Edging: Install steel edging between all seeded areas and areas planted with trees, shrubs, and groundcovers according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.

3.8 CLEANUP AND PROTECTION

- A. During planting, keep adjacent pavement and construction work areas in an orderly condition.
- B. Protect exterior plants from extreme heat or damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged exterior planting.

3.9 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Welded wire grid panels, including gate panels.
 - 2. Panel channel and angle trim.
 - 3. Panel posts.
 - 4. Necessary clips, straps and spacers.
 - 5. Powdercoat finish.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Division 03 Section "Cast-In-Place Concrete" for concrete footings.
 - 2. Division 32 Section "Plants" for furnishing and installing related plants.

1.4 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project. Review Section 01 81 13 for Low-emitting Materials submittal requirements.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog details for specified products demonstrating compliance with referenced standards. Provide list of fittings being provided with descriptions and either photographs or drawings for each type.
- B. Shop Drawings: Submit Shop Drawings for fabrication and installation. Include the following:
 - 1. Plans, elevations, and detail sections showing sizes, critical dimensions, panel layout constraints using a 2 x 2 inch modular grid, and details and locations of accessories.

2. Indicate materials, methods, finishes, fittings, fasteners, anchorages, and accessory items.
- C. Verification Samples: Two samples representing actual products and finishes as follows:
1. Welded wire grid panel, 6 in. x 6 in., with one edge of channel trim and one edge of angle trim, all as one unit.
 2. Color Submittals: Submit metal chips, 2 in. x 3-1/2 in. minimum, showing color and texture to be provided.
- D. Sustainable Design Submittals:
1. Building product disclosure and optimization – environmental product disclosures: Products with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that have at least a cradle to gate scope are valued as one quarter (1/4) of a product for the purposes of credit achievement calculation.
 2. Building product disclosure and optimization – material ingredients: The end use product has a published, complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration open Standard.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum 10 years experience in manufacturing and supplying welded wire panel systems of the type required for this Project.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Protect materials from damage. Store panels flat. Provide edge protection when strapping is used. Do not apply loads to panel edges.
- B. Inspect products upon delivery in order to submit timely freight claim for any damaged materials.
- C. Store products in manufacturer's packaging until ready for installation.
- D. Handle and store products according to manufacturer's recommendations. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- E. Exercise care not to scratch, mark, dent, or bend metal components during delivery, storage, and installation.

1.8 PROJECT CONDITIONS

- A. Verify actual openings by field measurements before fabrication; show recorded measurements on shop drawings.

- B. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Available Products: Subject to compliance with requirements, rubber floor coverings that may be incorporated into the Work include, but are not limited to:
 - 1. Basis of Design Product: greenscreen®, 725 S. Figueroa St. Suite 1825, Los Angeles, CA 90017; Tel: 1-800-450-3494; sales@greenscreen.com, www.greenscreen.com.
 - 2. Or Approved Equal.

2.2 PANELS

- A. Panels shall be rigid, three dimensional welded wire grid fabricated of 14 gauge galvanized steel wire.
 - 1. Metallic-Coated Steel Wire: Welded-wire, galvanized in accordance with ASTM A641.
- B. Face Grid: Wires shall be welded at each intersection to form a 2 x 2 inch face grid on the front and back of panels,
- C. Trusses: Face grids shall be separated by bent wire trusses spaced at 2-inch centers and welded to front and back face grids at each truss apex.
- D. Thickness: 3 inches.
- E. Length and Width: As indicated on the Drawings.
- F. Tolerance: 1/8 inch in width and 1/8 inch in length.

2.3 ACCESSORIES

- A. Trim:
 - 1. Fabricate from 20-gauge ASTM A879 galvanized steel.
 - 2. Types:
 - a. Channel Trim: Thickness of panel x ½ inch legs.
 - b. Angle Trim: ½ inch x ½ inch legs.
 - 3. Locations:
 - a. As indicated on the Drawings.

- B. Clips and Straps: Provide manufacturer's standard types of clips and straps suitable for mounting conditions. Fabricate from ASTM A879 galvanized steel. Adjustable clips shall have ¼ inch diameter 18-8 stainless steel bolt, washer, and nut.
- C. Plastic Spacers: Provide ½ inch thick black Ultra High Molecular Weight polyethylene (UHMW) washers [to hold clips away from mounting surface].
- D. Fence Posts: 3-inch **square ASTM A500, Grade B** steel tube. The steel strip used in the manufacture of the post shall conform to ASTM A1011. Minimum yield strength shall be 45,000 psi. **Provide steel post caps.** Overall post length shall be as indicated on the Drawings.
- E. Fasteners for Mounting Clips to Fence Posts: Self drilling, self tapping hex washer head screws, with strength of Type 410 stainless steel, and corrosion resistance of Type 304 stainless steel.
- F. Fasteners for Attachment to Structure Pull Out Value:
 - 1. To Concrete or Masonry: 480 lbs.
 - 2. To Structural Steel: 480 lbs.
 - 3. To Light-Gauge Steel Framing: 480 lbs.
 - 4. To Wood Framing: 480 lbs.

2.4 FABRICATION

- A. Cut to size.
- B. Weld trim to panels and grind smooth exterior surfaces of welds.

2.5 FINISH

- A. Metal components (except fasteners) shall receive commercial grade finish system after fabrication.
- B. Finish System:
 - 1. Pretreat with general purpose, alkaline, water based cleaner / degreaser applied at 240 degrees F.
 - 2. Prime with fusion bond epoxy powder coat.
 - 3. Topcoat with TGIC polyester or polyester-urethane powder coat with a minimum total dry film thickness of not less than 6 mils (0.15 mm).
- C. Salt Spray Resistance: Finish shall remain rust free when tested 1680 hours in accordance with ASTM B117.
- D. Finish and Color: **Color selected by Architect from manufacturer's standards and RAL Classic colors.**

- E. Touch-Up Paint: Provide high quality, exterior-grade spray paint suitable for conditions of use.

2.6 WARRANTY

- A. Manufacturers's Warranty: Submit, for Owners acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not a limitation of, other rights Owner may have under the contract documents.
 - 1. Warranty Period: 1 year commencing from Substantial Completion.

2.7 MISCELLANEOUS MATERIALS

- A. Concrete: Refer to Section 03 30 00 "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of **fence lines and posts**. Do not exceed intervals of **500 feet (152.5 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
 - 1. Construction layout and field engineering are specified in Division 01 Section "Execution".
- B. Verify alignment, support dimensions, and tolerances are correct.
- C. Inventory components to ensure all required items are available for installation. Inspect components for damage. Remove damaged components from site and replace.

3.3 INSTALLATION - GENERAL

- A. Spans: For freestanding fences and screens, span between structural supports should not exceed 8' for 3" thick panels without thorough review of specific site conditions and mounting details. For overhead horizontal or inclined panels span between structural supports should not exceed 4'. All curved panel spans should be reviewed based on specific panel radius and center to center of proposed structural support spacing.
- B. Install panels plumb and square, centered within area designated for panels, and aligned to maintain modular grid.
- C. Avoid cutting panels in field. Where field cutting is essential, clean and dry area and apply touch-up paint to cut edges.
- D. Install securely with fasteners located To meet manufacturer's requirements.
- E. Repair bent or damaged panels. If panels cannot be repaired to satisfaction of Architect or Owner, remove from jobsite and replace with new panels.

3.4 INSTALLATION

- A. Install welded wire panel plant support system according to manufacturer's written instructions.
- B. Install welded wire panel plant support system by setting posts as indicated on the Drawings and fastening panels to posts according to manufacturer's written instructions.

3.5 ADJUSTING AND CLEANING

- A. Remove temporary coverings and protection of adjacent work areas. Clean installed products in accordance with manufacturer's instructions before Owner's acceptance.
- B. Do not use abrasive cleaners.
- C. Remove from project site and legally dispose of construction debris associated with this work.

3.6 PROTECTION

- A. Protect installed products until completion of Project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.
- C. Protect installed products and finished surfaces from damage during construction.
- D. Replace defective or damaged components as directed by Architect.

3.7 PLANT INSTALLATION

- A. Refer to Section 32 93 00 "Plants."

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

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

1.2 SUMMARY

- A. Section includes but is not limited to: Furnishing, layout and installing waterlines, meters, fittings, connections to existing water mains and connections to new and existing building services.
- B. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
 - 1. Section 31 20 00 "Earth Moving"
 - 2. For Interior Plumbing systems, refer to Division 21

1.3 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of the each of the following documents at the job site. The bidder in submitting a bid acknowledges that he is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.
 - 1. Northshore Utility District (NUD, or District) 2021 Engineering Specifications: Materials of Construction (Standards)
 - 2. Northshore Utility District (NUD, or District) 2021 Engineering Specifications: Methods of Construction (Standards)
 - 3. Standard Specifications: WSDOT/APWA Standard Specifications for Road, Bridge, and Municipal Construction, 2022
 - 4. Standard Plans: WSDOT/APWA Standard Plans for Road, Bridge, and Municipal Construction
 - 5. Geotechnical Report:
Geotechnical Engineering Services
Fire Station 27, Kirkland WA
December 13, 2021
 - 6. Technical Memorandum – Fire Station 27 Vault and Signal Poles
Geotechnical Engineering Services
Dated January 19, 2002

1.4 SUBMITTALS

- A. Comply with pertinent provisions of Section 013300. Submit Manufacturer's Literature on proposed material prior to the start of any work.
- B. No installation of the material concerned shall be made until written approval has been obtained from the Engineer. Approval of materials and equipment shall in no way obviate compliance with the plans and specifications.
- C. Contractor shall complete and submit the following information to NUD prior to construction:
 - 1. Contractor Application (found on NUD's website)
 - 2. Material Submittals for piping, water services, valves, fittings, meter boxes, fire hydrants, and all other materials used on the water portion of the project.
 - 3. Certificate of Insurance with the following minimum requirements:
 - a. Bodily injury and property damage liability (per person) of \$1,000,000.00 (One Million) per occurrence and \$2,000,000.00 (Two Million) per aggregate.
 - b. Northshore Utility District is to be named as additional insured and certificate holder.
 - c. Include Additional Insured Endorsement.
 - d. For Developer Extension Projects, list the project name on the certificate under "project description" or list "General Side Sewer Work" to be able to pull sewer permits for all addresses within the District.
- D. No installation of the material concerned shall be made until written approval has been obtained from the NUD and Project Engineer. Approval of materials and equipment shall in no way obviate compliance with the plans and specifications.

1.5 QUALITY ASSURANCE

- A. All Contractors installing, inspecting, servicing or maintain fire protection systems shall be licensed by the State Director of Fire Protection Services in accordance with Chapter 18.106 RCW.
- B. Contractor is responsible for coordinating water main and fire system work on site with the City of Kirkland and the Northshore Utility District.
- C. Manufacturer's and Installer's Qualifications: Firms regularly engaged in manufacture or installation of water projects consisting of similar scope and materials.
- D. General: Use adequate numbers of skilled personnel who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work in this section.

1.6 QUALIFICATIONS

- A. Contractor shall have completed (5) projects of similar nature within the last 5 years.

1. Project information, including construction dollar amount, shall be submitted to NUD.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Storage:

1. Piping: Inspect materials delivered to the site for damage. Store with minimum of handling. Store materials on site in enclosures or under protective coverings. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
2. Metal Items: Check upon arrival and identify and segregate as to types, functions, and sizes. Store in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
3. Handling: Handle pipe, fittings, and other accessories in such a manner as to ensure delivery to the trench in sound, undamaged condition. Take special care not to injure fittings. Carry pipe to trench; do not drag it.

1.8 RECORD DRAWINGS

- A. One complete set of drawings will be provided as record drawings which shall be separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed. The contractor shall coordinate the record drawing requirements with the NUD Inspector.
- B. These drawings shall also serve as work progress report sheets and the Contractor shall make any notations, neat and legible, thereon daily as work proceeds. These drawings shall be available for inspection at all times and shall be kept at the job.
- C. All buried piping and indicated future connections, exterior of any building, shall be located both by depth and by accurate measurement from a permanently established landmark. All notations on record drawings of buried piping shall be made before any backfilling is started.
- D. At completion of the work, these record drawings shall be signed by the Contractor, dated, and returned to the Architect.
- E. At the conclusion of construction, a Registered Professional Surveyor shall prepare a drawing based on the surveyed location of the sewer system. The survey shall include water main, meter boxes, blowoffs, valves boxes, hydrants and bends.
- F. The District will provide locates to assist the Surveyor in locating the water main between appurtenances and locating the bends. The drawing shall be provided to the District in AutoCAD format, R 2000 or newer. In addition, all water easements shall be staked and flagged at their intersection with property lines and at 25-foot stations along the easement lines.

1.9 REGULATORY REQUIREMENTS

- A. All work shall comply with Northshore Utility District (NUD) standards. The Contractor shall coordinate with the NUD Inspector.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be in accordance with NUD Standards.
- B. All materials shall be new and undamaged. The same manufacturer of each item shall be used throughout the work.
- C. All materials not specifically referenced shall comply with applicable sections of ANSI, ASTM, AWWA or the WSDOT Standard Specifications.
- D. Ductile iron pipe shall be new, restrained joint, Class 52, cement-lined, conforming to AWWA C151.
 - 1. Ductile iron pipe shall be U.S. Pipe "TR Flex" or push-on joint pipe restrained with U.S. Pipe "Field Lok" gaskets, or equal.
 - 2. Each length of pipe shall be clearly marked with the manufacturer's identification, year, thickness, class of pipe and weight.
 - 3. The Contractor shall furnish certification from the manufacturer of the pipe and gasket being supplied that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of this standard.
 - 4. Ductile iron pipe shall be encased with polyethylene encasement.
- E. Ductile iron fittings shall be short body with a 350-psi pressure rating for mechanical joint fittings and 250-psi for flanged fittings.
 - 1. All fittings shall be cement lined and shall be in conformance with AWWA C153 for mechanical joint fittings and AWWA C110 for flanged fittings.
 - 2. All mechanical joint fittings shall be restrained with EBAA Iron, Inc. "MegaLug" mechanical joint restraints, or equal. Megalug fittings are prohibited for use on cast iron pipe.
 - 3. Restrained joint connections to existing cast iron water main shall be made with Romac Alpha Couplings and fittings only.
 - 4. All deactivated water mains shall be capped with Romac EC501 End Cap Coupling or equal.
- F. Polyethylene Pipe Encasement shall be 8 mil's thick in accordance with AWWA C105. Installation shall be in accordance with AWWA C105, Method A or Method C.
- G. Fire hydrants shall conform to AWWA Standard Specification C502
 - 1. Fire Hydrants shall be one of the following types:

- a. Mueller Super Centurion
 - b. American Darling B-62-B
 - c. Clow Medallion
 - d. M & H 129
 - e. East Jordan Iron Works WaterMaster 5CD250
2. They shall be a rising stem compression-type which opens counterclockwise and closes with the pressure. The minimum main valve opening diameter shall be 5-1/4-inch unless otherwise specified. The hydrant seat and hydrant seat retaining ring shall be bronze. All external bolts, nuts and studs shall be cadmium plated in accordance with ASTM A165 Type HS or rust proofed by some other process approved by the District.
 3. Gaskets shall be of rubber composition. Fire hydrants shall be equipped with one 5-inch pumper connection (Seattle Standard Thread) with Storz Adapter (integral or non-integral) as required by those jurisdictions shown on the Standard Details. The hydrant shall include two 2-1/2-inch NST hose ports. Pentagon nuts or caps and operating stem shall measure 1-1/4-inch point to flat and shall open by turning to the left. Nozzle shall be fitted with renewable bronze nipples locked in place.
 4. Fire hydrants shall be set plumb, and ports shall be oriented as directed by the City of Kirkland Fire Marshal.
 5. Fire hydrant piping from the main line valve to the hydrant base shall be restrained joint pipe or shall be restrained with stainless steel shackle rods and nuts.
 6. The hydrants shall be coated with enamel paint in accordance with the Standard Details.
- H. Gate valves shall be ductile iron body valves with resilient wedge conforming to the latest revision of AWWA Standard C515 and shall be NSF 61 approved.
1. Valves shall have epoxy coating fusion bonded to all internal and external surfaces of the valve body and bonnet in compliance with AWWA C550. The wedge shall be fully encapsulated in rubber. The valves shall be non-rising stem, open to the left, equipped with standard 2-inch square operating nuts and O-ring seals at all joints.
 2. Resilient wedge gate valves shall be one of the following manufacturers:
 - a. American Flow Control Series 2500
 - b. Clow model 2638
 - c. Mueller 2360 series
 - d. Kennedy 7000 series
 - e. East Jordan FlowMaster
 - f. M&H Style 7000.

I. SERVICE SADDLES

1. For ductile iron and cast iron water mains larger than 4-inch diameter, direct tapping of 1-inch standard corporation stop threaded tap will be required. Saddles will not be allowed on ductile iron and cast-iron pipe larger than 4-inch diameter for 1-inch water services. Service taps for all other water main sizes and materials shall be as follows:
 - a. Service saddles for 1-inch, 1-1/2-inch, and 2-inch standard corporation stop threaded tap, shall be single strap and shall be equal to Mueller Company DR1S, Ford Meter Box Company FC101, or Romac Industries, Inc. 101NS.

2. On existing water mains that are live and connected to the existing system; the Contractor shall furnish and install all parts of the water service and reconnection as required, except the tap. The District will provide all parts necessary to perform the tap (including but not limited to the corporation stop and saddle) and the Contractor shall repair the polyethylene encasement material per manufacturer's recommendations and per the District's Standard Detail.
 3. On new water mains installed and not yet connected to the existing system; the Contractor shall provide all parts and equipment necessary to tap the new main and repair the polyethylene encasement material per manufacturer's recommendations and per the District's Standard Detail.
- J. Valve boxes shall be two-piece, cast iron, East Jordan Iron Works:
1. Valve box cover, 06800209
 2. Valve box top, 85557016U
 3. Valve box bottom, 85556036U
- K. Building Connections: Service connections shall be per Section 9-30.6 of the WSDOT Specifications.
- L. Fire Protection Connections: shall be in accordance with NFPA-13 and NFPA-20. Coordinate with building sprinkler connections shown on mechanical drawings and as constructed by the building sprinkler installer.
- M. Post Indicator Valve: Per detail on plans.
- N. Foundation gravel shall consist of clean, granular material free from objectionable materials such as organic matter or other deleterious substances with at least 90% coarse material ranging from 1" in diameter to 3" in diameter and 100% 3" in diameter or less, unless otherwise specified or approved by the District.
- O. Pipe Bedding Material:
1. Water Main shall be Gravel Backfill For Drains per Section 9-03.12(4) of the Standard Specifications.
 2. Water Service Pipe shall consist of 100% clean sand per Section 9-03.13(1) of the Standard Specifications.
- P. Trench Backfill shall be Gravel Barrow conforming to Section 9-03.14(1) of the Standard Specifications.
- Q. Tracer Wire shall be blue 14-gauge solid copper wire with polyethylene insulation.
1. Wire shall be placed in the trench on top of the water main and the ends brought into the valve boxes, per the Standard Detail.
 2. Tracer wire shall also be wrapped around the water service line and brought up into the meter box.
 3. All connections or splicing shall be made with District approved split-bolt wire connectors.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Installation of all water pipe, fittings and appurtenances shall be in accordance with NUD Standards.

3.2 EXAMINATION

- A. **Site and Drawings:** Carefully examine the site and compare the drawings with existing conditions. By the act of submitting bids, the Contractor shall be deemed to have made such examination and to have accepted such conditions, and to have made allowance therefore in preparing their figure.
- B. **Verification of Existing Elevations:** Verify all connection elevations prior to laying pipe.
- C. **Verification of Dimensions:** Before proceeding with any work, the Contractor shall carefully check and verify all dimensions, sizes, etc. and shall assume full responsibility for the fitting in of his equipment and to the structure. Where apparatus and equipment have been taken from typical equipment of the class indicated, the Contractor shall carefully check the drawings to see that the equipment they contemplate installing will fit into the spaces.

3.3 GENERAL CONSTRUCTION REQUIREMENTS

- A. The improvements shall be constructed as shown on the plans and in accordance with these Standards, Standard Details, and Standard Specifications. Manufacturer's equipment shall be installed in compliance with specifications of the manufacturer, except where a higher quality of workmanship is required by the plans and specifications. All materials and work shall be in strict accordance with any applicable regulations NUD Standards and City of Kirkland Fire Marshal. The Contractor shall arrange for such inspection by these agencies as may be required and shall submit evidence of their approval, if requested by the Engineer.
- B. The plans may show the approximate locations of various existing utilities known to the engineer, such as gas lines, water mains, sanitary sewers, power lines, telephone lines, television cables, and other obstructions based on information obtained from various sources. This information is not guaranteed to be accurate, and the Contractor is directed to check for interferences and obstructions by inquiry from the different utilities and by underground exploration ahead of his regular excavation.
- C. The Contractor shall request field locates and notify the owners of underground facilities about the scheduled commencement of excavation through a one-call number: (1-800-424-5555).
- D. The Contractor shall excavate around and under service pipes with special care and shall support and maintain them in service. Where it is necessary to cut, move or reconnect any service lines, arrangements shall be made with the respective utility.

3.4 INSTALLATION

A. Alignment and Staking

1. All work done under a Project shall be to the lines shown on the approved plans or to approved revisions. All surveying and/or staking shall be performed by a qualified surveying firm. All construction staking shall be reviewed by NUD prior to construction.
2. Stake locations of all proposed tees, bends, valves, meters, etc. prior to construction.

B. All trenching shall conform to the Washington Administrative Code (WAC) 296-155 requirements for Excavation, Trenching and Shoring.

C. The maximum length of open trench permissible on any line, in advance of pipe laying, will be 100 feet for sewer pipe and 250 feet for water mains, except at the end of each day's operations, there shall be no trench in which pipe laying, embedment and backfill have not been completed. Upon completion of work each day, all open trenches shall be completely backfilled, leveled and temporarily patched, graveled, fenced, or sheeted as required by the regulatory agency and the District.

D. Ductile Iron Pipe:

1. Pipe shall be laid in a straight grade through localized breaks in grade, the excavation shall be deepened gradually at changes in the street grades so that there are no abrupt changes in pipeline grade. To maintain the required alignment, use short lengths and deflect the joints or use necessary bends. Each pipe section shall be carefully lowered into place in the ditch after inspecting it for defects.
2. All pipe shall be kept free of gravel, dirt, and other contaminants. Temporary pipe plugs must be installed at all exposed pipe ends at the end of each working day. The pipe plug must be a watertight, mechanical device, and shall be cleaned thoroughly prior to installation.

E. Pipe Zone Bedding

1. Bedding material shall be carefully placed and firmly compacted to provide a firm, uniform cradle for the pipe.
2. The minimum thickness of the layer of bedding material required shall be 4-inches under the bell. The Contractor shall provide firm, continuous support for the pipe. After the pipe laying operation, additional bedding material shall be placed and compacted by hand tools for the full width of the trench to a height of 6" above the top of the pipe.

F. Trench Backfill

1. Trenches shall be backfilled in 24" maximum lifts using heavy machinery, or 12" lifts using hand equipment, and compacted to 95% of maximum dry density.
2. The moisture content of all soils used shall be within 2% of optimum. All densities shall be determined by the ASTM D-1557 (Modified Proctor) test procedure.

G. Valve Installation

1. Gate valves shall be set in the ground vertically and shall be opened and shut under pressure to check operation and, at the same time, show no leakage.

2. Valves 8-inches and larger that are not flanged to other fittings shall be blocked in accordance with the Standard Blocking Details.
- H. Valve box top sections shall be adjusted flush with the finished pavement and, in those areas to be excavated for future roadway grades, enough adjustment shall be provided in the valve box to allow the top of the box to be adjusted to the required grade.
- I. Fire Hydrant Installation:
1. Fire hydrant shall be set as shown in the Standard Detail. Mega-lugs or stainless-steel tie rods shall be used to restrain the ductile iron pipe between the hydrant foot and the 6-inch hydrant valve. The location of the fire hydrant shall be shown on the plans to determine length of hydrant run required. The hydrant shall be set on a solid concrete block 4-inch x 8-inch x16-inch and a minimum of 6 cubic feet of clean gravel shall be placed around the base of the hydrant for a drain pocket. Fire hydrants shall be set plumb and with the ports oriented as directed by the Fire Marshal.
 2. The area for at least a three (3) foot radius around the hydrant shall be graded and leveled, and the cut slopes or fill slopes shall be neatly graded by hand.
 3. No tool other than an approved hydrant-operating wrench shall be used when operating hydrants.
 4. Fire hydrants shall be prime-coated and finish coated in accordance with the Standard Detail.
- J. Concrete blocking shall be 2500 psi minimum strength, cast in place and have a minimum of 1/2 square foot bearing against the fitting. Blocking shall bear against fittings only and shall be clear of joints so as to permit taking up or dismantling joint. The Contractor shall install blocking which is adequate to withstand full test pressure as well as to continuously stand operating pressures under all conditions of service. For concrete blocking based upon a 250-psi test pressure, see the Standard Details.
- K. Service connections: Shall be in accordance with NUD Standards.

3.5 TESTING AND DISINFECTION

- A. Testing of water services shall conform to Section 10.21 of the NUD Standards.
- B. Disinfection and flushing of water services shall conform to Section 10.22 NUD Standards.
- C. Before a performance test is to be observed by the NUD, the Contractor shall make whatever preliminary tests are necessary to assure that the material and/or equipment are in accordance with the plans and specifications.
- D. Contractor shall correct any deficiencies within seven days of the notice and before final inspection will be made by the NUD, unless otherwise approved.

3.6 CONNECTION TO EXISTING WATERMAIN

- A. Connection to existing water mains shall conform to Section 10.23 of the NUD Standards.

- B. Points of connection to existing water mains shall be exposed prior to trenching of the new line, and not less than 48 hours prior to the anticipated connection time. The Contractor shall notify the Owner and the NUD 48 hours in advance prior to any water main shut-off or connection.
- C. Water main shut-offs shall not be scheduled to take place on Fridays, or on the day before a National holiday, unless otherwise approved by the NUD, Owner, and City of Kirkland. The Contractor shall ensure that the existing fittings are in accordance with the Contract Plans and that the connection can be made in accordance with the Contract Plans. The Contractor shall immediately notify the Engineer if the connection cannot be made in accordance with the plans in order that the connection detail may be revised.
- D. Opening and closing of valves and use of water from NUD's system will be done only by the NUD.
- E. Contractor shall have the responsibility of giving at least forty-eight (48) hours' notice to the Owner, NUD and affected water customers of intention to disrupt service.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

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

1.2 SUMMARY

- A. Work includes but is not limited to following:
1. Furnishing and installing sanitary sewer piping, grease interceptor, and cleanouts.
 2. Connections to new plumbing connections.
 3. Connections to existing sanitary sewer systems.
- B. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
1. Section 31 20 00 "Earth Moving"
 2. For Interior Plumbing systems, refer to Division 21

1.3 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of the each of the following documents at the job site. The bidder in submitting a bid acknowledges that he is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.
1. Northshore Utility District (NUD, or District) 2021 Engineering Specifications: Materials of Construction (Standards)
 2. Northshore Utility District (NUD, or District) 2021 Engineering Specifications: Methods of Construction (Standards)
 3. Standard Specifications: WSDOT/APWA Standard Specifications for Road, Bridge, and Municipal Construction, 2022
 4. Standard Plans: WSDOT/APWA Standard Plans for Road, Bridge, and Municipal Construction
 5. Geotechnical Report:
Geotechnical Engineering Services
Fire Station 27, Kirkland WA
December 13, 2021

1.4 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 33 00. Submit Manufacturer's Literature on proposed material prior to the start of any work.
- B. No installation of the material concerned shall be made until written approval has been obtained from the Engineer. Approval of materials and equipment shall in no way obviate compliance with the plans and specifications.
- C. Contractor shall complete and submit the following information to NUD prior to construction:
 - 1. Contractor Application (found on NUD's website)
 - 2. Material Submittals for piping, frames and covers, cleanouts, and other materials to be used on the sewer portion of the project.
 - 3. Certificate of Insurance with the following minimum requirements:
 - a. Bodily injury and property damage liability (per person) of \$1,000,000.00 (One Million) per occurrence and \$2,000,000.00 (Two Million) per aggregate.
 - b. Northshore Utility District is to be named as additional insured and certificate holder.
 - c. Include Additional Insured Endorsement.
 - d. For Developer Extension Projects, list the project name on the certificate under "project description" or list "General Side Sewer Work" to be able to pull sewer permits for all addresses within the District.

1.5 QUALITY ASSURANCE

- A. Standard Compliance: In addition to complying with all codes and regulation, comply with all pertinent recommendations contained in the following documents. When a conflict arises between the following standards, the more stringent provision shall apply. Delete references to measure and payment.
- B. Manufacturer's and Installer's Qualifications: Firms regularly engaged in manufacture or installation of sewer projects consisting of similar scope and materials.
- C. General: Use adequate numbers of skilled personnel who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work in this section.

1.6 QUALIFICATIONS

- A. Contractor shall have completed (5) projects of similar nature within the last 5 years.
 - 1. Project information, including construction dollar amount, shall be submitted to NUD.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage:

1. Piping: Inspect materials delivered to the site for damage. Store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
2. Cement: Store cement immediately upon receipt at site of work. Store bagged cement in a suitable waterproof structure made as air-tight as practicable, and with floors elevated above ground a sufficient distance to prevent absorption of moisture. Stack bags close together to reduce circulation of air, but do not stack against outside walls; arrange storage to permit easy access for inspection and identification of each shipment.
3. Metal Items: Check upon arrival and identify and segregate as to types, functions, and sizes. Store in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
4. Handling: Handle pipe, fittings, and other accessories in such a manner as to ensure delivery to the trench in sound, undamaged condition. Take special care not to injure fittings. Carry pipe to trench; do not drag it. Do not leave rubber gaskets and plastic piping that are not to be installed immediately in the sunlight, but store under cover out of direct sunlight.

B. Layout and Dimensions shall be in conformance with Section 31 10 00 "Site Preparation".

1.8 RECORD DRAWINGS

- A. One complete set of drawings will be provided as record drawings which shall be separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed. The contractor shall coordinate the record drawing requirements with the NUD Inspector.
- B. These drawings shall also serve as work progress report sheets and the Contractor shall make any notations, neat and legible, thereon daily as work proceeds. These drawings shall be kept at the job and available for inspection at all times.
- C. All buried piping and indicated future connections, exterior of any building, shall be located both by depth and by accurate measurement from a permanently established landmark. All notations on record drawings of buried piping shall be made before any backfilling is started.
- D. At completion of the work, these record drawings shall be signed by the Contractor, dated, and returned to the Architect.
- E. At the conclusion of construction, a Registered Professional Surveyor shall prepare a drawing based on the surveyed location of the sewer system. The survey shall include:
 1. Location of existing manholes including rim & all invert elevations
 2. New manhole locations including rim & all invert elevations.
- F. The drawing shall be provided to the District in AutoCAD format, R 2000 or newer. In addition, all sewer easements shall be staked and flagged at their intersection with property lines and at 25-foot stations along the easement lines.

1.9 REGULATORY REQUIREMENTS

- A. All work shall comply with Northshore Utility District (NUD) standards. The Contractor shall coordinate with the NUD Inspector.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials shall be in accordance with NUD Standards.
- B. All PVC pipe and fittings shall be integral wall bell and spigot, rubber gasket joint, unplasticized polyvinyl chloride (PVC) pipe in conformance with ASTM D3034 and shall have a maximum SDR of 35.
 - 1. PVC pipe shall have a minimum "pipe stiffness" of 46 psi at 5 percent deflection when tested in accordance with ASTM Designation D2412 and a minimum impact strength of 210 foot-pounds based upon ASTM D3034.
 - 2. All pipes shall be clearly marked with the manufacturer's identification, year, and class of pipe.
 - 3. All fittings and accessories shall be manufactured and furnished by the pipe supplier, or shall be District approved equal.
 - 4. Pipe joints shall use flexible elastomeric gaskets conforming to ASTM D3212.
 - 5. Connections for side sewer stubs shall be 6 inches inside diameter tee fittings. Wye branches shall be used where the sewer line size is less than 8- inch inside diameter.
- C. SSMH Adaptors shall be GPK PVC Manhole Adapters (also known as "sand collars") with an external abrasive silica layer or Kor-N-Seal Connector manufactured by NPC. Inc.
- D. Cleanouts: Per NUD Standard Detail.
- E. Grease Interceptor: Per detail on plan.
- F. Neoprene foam pad shall be Dow Plastics Ethafoam 220, or an approved equal meeting the same ASTM requirements.
- G. Grout for all uses including, but not limited to, shelves, pick-holes, and adjusting rings, shall be cement based, nonshrink, noncorrosive, and nonmetallic grout conforming to ASTM C 1107. Grout shall be Dayton Superior 1107 Advantage Grout, Basalite Non-Shrink Grout - Fast Set, SpecChem SC Multipurpose Grout, or Quikrete Commercial Grade FastSet Non-Shrink Grout. The District may sample and test grout to determine conformance with the specifications.
- H. Foundation gravel shall consist of clean, granular material free from objectionable materials such as organic matter or other deleterious substances with at least 90% coarse material ranging from 1" in diameter to 3" in diameter and 100% 3" in diameter or less, unless otherwise specified or approved by the District.

- I. Pipe Bedding Material shall be Pea Gravel conforming to the following gradation requirements:

US Sieve Size	% Passing by Weight
½ inch	100
3/8 inch	85-95
No. 4	5-15
No. 8	0-2

- J. Trench Backfill shall be Gravel Barrow conforming to Section 9-03.14(1) of the Standard Specifications.
- K. Tracer Tape: 3-inch wide, green metallic sewer detector tape shall be laid 24-inch above the pipe bedding, for the entire length of the sewer main between manholes. Identification on the tape shall include the words "Sanitary Sewer".

PART 3 - EXECUTION

3.1 EXECUTION

- A. Installation of all water pipe, fittings and appurtenances shall be in accordance with NUD Standards.

3.2 EXAMINATION

- A. Site and Drawings: Carefully examine the site and compare the drawings with existing conditions. By the act of submitting bids, the Contractor shall be deemed to have made such examination and to have accepted such conditions, and to have made allowance therefore in preparing their figure.
- B. Verification of Existing Elevations: Verify all connection elevations prior to laying pipe.
- C. Verification of Dimensions: Before proceeding with any work, the Contractor shall carefully check and verify all dimensions, sizes, etc. and shall assume full responsibility for the fitting in of his equipment and to the structure. Where apparatus and equipment have been taken from typical equipment of the class indicated, the Contractor shall carefully check the drawings to see that the equipment they contemplate installing will fit into the spaces.

3.3 GENERAL CONSTRUCTION REQUIREMENTS

- A. The improvements shall be constructed as shown on the plans and in accordance with the NUD Standard Specifications and Details. Manufacturer's equipment shall be installed in compliance with specifications of the manufacturer, except where a higher quality of workmanship is required by the plans and specifications. All materials and work shall be in strict accordance with any applicable regulations of the State, County and local authorities. The Contractor shall arrange for such inspection by these agencies as may be required and shall submit evidence of their approval, if requested by the Engineer.
- B. The plans may show the approximate locations of various existing utilities known to the engineer, such as gas lines, water mains, sanitary sewers, power lines, telephone lines, television cables, and other obstructions based on information obtained from various sources. This information is not guaranteed to be accurate, and the Contractor is directed to check for interferences and obstructions by inquiry from the different utilities and by underground exploration ahead of his regular excavation.
- C. The Contractor shall request field locates and notify the owners of underground facilities about the scheduled commencement of excavation through a one-call number: (1-800-424-5555).
- D. The Contractor shall excavate around and under service pipes with special care and shall support and maintain them in service. Where it is necessary to cut, move or reconnect any service lines, arrangements shall be made with the respective utility.

3.4 STAKING

- A. All surveying and staking shall be performed a surveying firm Capable of performing such work. The engineer or surveyor directing and/or performing such work shall be currently licensed by the state of Washington to perform said tasks.
- B. A preconstruction meeting shall be held with the NUD prior to commencing staking.
- C. The minimum staking of the sewer system shall be as follows:
 - 1. Stake centerline alignment every 25' with cuts and/or fills to the invert of the pipe.
 - 2. Stake location, finished grade, and IE of all cleanouts and other fixtures for grade and alignment.

3.5 GRADE ESTABLISHMENT

- A. Sewer grades shall be established by means of laser beam or grade boards or other means approved by the Engineer. The grades shall be checked at periodic intervals as directed by the Engineer. A plumb bob shall be used to check the line of the pipe. Both grade and line shall be checked for each length of pipe laid, except at tunnels or through jacked casings where adequate methods shall be used to carry forward the line and grade.

- B. If the Contractor chooses to use a laser beam the equipment and methods shall meet the approval of the engineer. Laser beam alignment and grade shall as a minimum be verified at a point 50' from the laser by use of a grade board.
- C. The Contractor shall replace all monuments, right-of-way markers, property stakes, etc., that are removed or disturbed, to the satisfaction of the Engineer.

3.6 EXCAVATION AND BACKFILL

- A. Sewer trenching shall be per Section 10.25 of the NUD Standards.
- B. Trenches shall be in straight lines as indicated on the drawings. Where feasible, trench width at the top shall be no greater than 24". If sloughing of trench side is encountered, a cribbing form will be required to maintain trench side stability. Excavate to a depth below invert grade to allow for bedding as specified.
- C. Keep the trench free from water until pipe is laid and backfilled. Divert all surface water so as not to enter the trench. Entirely remove boulders, rocks, roots and other obstructions, or cut out to the width of the trench and to a depth of 6" below the elevation of bottom of pipe. Remove and dispose of all loose and excess excavated materials off-site at Contractor's prearranged location.

3.7 PIPE LAYING

- A. Sewer trenching shall be per Section 10.5 of the NUD Standards.
- B. Sewer pipe shall be laid per Section 10.5(c) of the NUD Standards.
- C. Pipe Joints
 - 1. Sewer pipe jointing shall be per Section 10.5(d) of the NUD Standards.
 - 2. DI Pipe shall have restrained joints.
- D. Existing sewage flow shall be diverted away from the segment being worked on by method approved by the Engineer.
- E. Adjustment to the line and grade shall be done by scraping away or filling in and tamping material under the body of the pipe. Adjustment to the line and grade by wedging and blocking shall not be permitted.
- F. The pipe shall be lowered into the trench by means of ropes, tripod, crane or any other suitable means. The pipe shall not be dropped or handled roughly. The pipe shall be checked for cracks and defects prior to use and any defective pipe rejected.
- G. Tees, wyes, and standing services shall be installed as shown on the Standard Details and at such locations as are shown on the plans or as otherwise directed by the Engineer.

- H. Pipe laying shall start from the lowest point unless otherwise approved by the Engineer.

3.8 ALIGNMENT TOLERANCE

- A. Pipe alignment tolerance shall be per Section 10.7(b) of the NUD Standards.
 - 1. Variance from established line and grade shall not be greater than (1/32) of an inch per inch of pipe diameter and not to exceed one-half (1/2) inch, provided that such variation does not result in a level or reverse sloping invert
 - 2. The variation in the invert elevation between adjoining ends of pipe, due to non-concentricity of joining surface and pipe interior surfaces, does not exceed one sixty-fourth (1/64) of an inch per inch of pipe diameter, or one-half (1/2) inch maximum.

3.9 PIPE BEDDING

- A. Pipe bedding shall be per Section 10.25(d) of the NUD Standards.

3.10 PIPE BACKFILL

- A. Backfilling shall be per Section 10.26 of the NUD Standards.

3.11 CONNECTING TO AN EXISTING MANHOLE

- A. Connect sewer pipe to existing manhole per Section 10.5(a) of the NUD Standards.
 - 1. Connections to existing manholes shall be made by core-drilling.
 - 2. Connections shall be watertight.
- B. Adjust new structures to grade per Section 10.28 of the NUD Standards.

3.12 CLEANING & FLUSHING

- A. Cleaning and flushing shall be per Sections 10.7(a) and 10.33 of the NUD Standards.

3.13 TESTING

- A. Testing of pipe shall be per Section 10.7 of the NUD Standards prior to connecting to building stubs.
 - 1. Gravity sewers shall be low-pressure tested per Section 10.7(c) of the NUD Standards.
 - 2. Gravity sewers shall be tested for deflections per Section 10.7(d) of the NUD Standards.

3. Gravity sewers shall be inspected by a Closed-Circuit TV per Section 10.7(e) of the NUD Standards.
- B. All manholes shall be vacuum tested per Section 10.9 of the NUD Standards.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

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

1.2 SUMMARY

- A. Section includes but is not limited to, the following:

1. Temporary and permanent storm drainage piping, fittings, and accessories.
2. Catch basins and grates.
3. Area drains and grates.
4. Flow control structures.
5. Trench drains and grates.
6. Conveyance pipe.
7. Connection to existing storm systems.
8. Protection of existing storm systems.
9. Cleaning storm system at completion of project.

- B. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:

1. Section 31 20 00 "Earth Moving".
2. Section 01 57 00 "Erosion Control"

1.3 REFERENCES

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this section insofar as specified and modified herein. The Contractor shall have one copy of the each of the following documents at the job site. The bidder in submitting a bid acknowledges that he is familiar with the documents named in References and that they are incorporated into this document by reference. The Standard Plans and Policies apply only to performance and materials and how they are to be incorporated into the work. The legal/contractual relationship sections and the measurements and payment sections do not apply to this document.

1. Standard Specifications: WSDOT-APWA: Standard Specifications for Road, Bridge, and Municipal Construction, 2022
2. Standard Plans: WSDOT/APWA Standard Plans for Road, Bridge, and Municipal Construction
3. City of Kirkland Public Works Pre-Approved Plans
4. Hydraulic Permit Approval

5. Geotechnical Report:
Geotechnical Engineering Services
Fire Station 27, Kirkland WA
December 13, 2021
6. Technical Memorandum – Fire Station 27 Vault and Signal Poles
Geotechnical Engineering Services
Dated January 19, 2002

1.4 SUBMITTALS

- A. Comply with pertinent provisions of Section 013300. Submit Manufacturer's Literature on proposed material prior to the start of any work.
- B. No installation of the material concerned shall be made until written approval has been obtained from the Engineer. Approval of materials and equipment shall in no way obviate compliance with the plans and specifications.
- C. Products:
 1. Catch basins, frames, and grates.
 2. Area drains and grates.
 3. Trench drains and grates.
 4. Conveyance pipe.
 5. Underdrain/footing drain pipe.
 6. Flow control structures.
 7. Cleanouts.
- D. Contractor shall complete and submit their Business License to City of Kirkland prior to construction.

1.5 QUALITY ASSURANCE

- A. Standard Compliance: In addition to complying with all codes and regulation, comply with all pertinent recommendations contained in the following documents. When a conflict arises between the following standards, the more stringent provision shall apply. Delete references to measure and payment.
- B. Manufacturer's and Installer's Qualifications: Firms regularly engaged in manufacture or installation of sewer projects consisting of similar scope and materials.
- C. General: Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work in this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Storage:

1. Piping: Inspect materials delivered to the site for damage. Store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.
2. Cement: Store cement immediately upon receipt at site of work. Store bagged cement in a suitable waterproof structure made as air-tight as practicable, and with floors elevated above ground a sufficient distance to prevent absorption of moisture. Stack bags close together to reduce circulation of air, but do not stack against outside walls; arrange storage to permit easy access for inspection and identification of each shipment.
3. Metal Items: Check upon arrival and identify and segregate as to types, functions, and sizes. Store in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.
4. Handling: Handle pipe, fittings, and other accessories in such a manner as to ensure delivery to the trench in sound, undamaged condition. Take special care not to injure fittings. Carry pipe to trench; do not drag it. Do not leave rubber gaskets and plastic piping that are not to be installed immediately in the sunlight, but store under cover out of direct sunlight.
5. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 RECORD DRAWINGS:

- A. One complete set of drawings will be provided as record drawings which shall be separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed. The contractor shall coordinate the record drawing requirements with the City Inspector.
- B. These drawings shall also serve as work progress report sheets and the Contractor shall make any notations, neat and legible, thereon daily as work proceeds. These drawings shall be available for inspection at all times and shall be kept at the job.
- C. All buried piping and indicated future connections, exterior of any building, shall be located both by depth and by accurate measurement from a permanently established landmark. All notations on record drawings of buried piping shall be made before any backfilling is started.
- D. At completion of the work, these record drawings shall be signed by the Contractor, dated, and returned to the Architect.
- E. In addition, a CAD survey of the newly installed on and off-site storm system shall be prepared by a Professional Land Surveyor in the State of Washington and submitted to the Architect.
 1. All structures sizes (SDCO, type 1, type 2-48", etc.) rim elevations, pipe inverts, pipe sizes, and pipe slopes shall be noted on surveyed drawing.
 2. Bottom corner elevations and locations of the detention vault and pipe penetrations (location and invert elevations).

- F. The detention vault riser pipe shall be confirmed through pictures and submitted to the Civil Engineer for review.
 - 1. Size and depth of orifices relative to the outlet pipe invert.
 - 2. Diameter of riser.
 - 3. Notch size: depth, width and elevation above the outlet pipe invert.

1.8 REGULATORY REQUIREMENTS

- A. All work shall comply with City of Kirkland standards. The Contractor shall coordinate with the City of Kirkland Inspector.
- B. Conform to the requirements set forth in the Hydraulic Project Approval (HPA) Permit No. 2022-4-89+01.

1.9 HYDRAULIC PROJECT APPROVAL

- A. See Section 31 20 00 "Earth Moving"

PART 2 - PRODUCTS

2.1 STRUCTURES

- A. Storm Structures shall conform to the following Pre-Approved Plans:
 - 1. Cleanout: CK-D.05B
 - 2. Catch Basin, Type 1: CK-D.07
 - 3. Circular Riser and Transition for Type 1 and 1-L CB: CK-D.07A
 - 4. Catch Basin, Type 1-L: CK-D.08
 - 5. Catch Basin, Type 2. 48", 54", 60", 72", 96": CK-D.09
 - 6. Type 2 Catch Basin with Oil Separator Flow Restrictor : CK-D.10
 - 7. Manhole / CB Frame and Grate Adjustment: CK-D.11
 - 8. Catch Basin Precast Cover and Extension Units: CK-D.12
 - 9. Vaned Grate for Catch Basin and Inlet : CK-D.14
 - 10. Standard Frame with Curb Installation: CK-D.16A
 - 11. 24" Manhole Frame with Locking Lid and Logo: CK-D.18
 - 12. Modified 24" Manhole Frame with Locking Lid: CK-D.18A

2.2 TRENCH DRAINS AND GRATES:

- A. Trench Drain:
 - 1. KlassikDrain K200 8" internal width, or approved equal.
 - 2. KlassikDrain K100 4" internal width, or approved equal.
- B. Grates:

1. ACO Type 676D Longitudinal Iron locking grate, or approved equal.
 - a. Use with 4" trench drain.
2. Iron Age Design "Rain" Series 10"x20" heel-proof trench grate, or approved equal.
 - a. Use with 8" trench drain.

2.3 STORM DRAIN PIPE:

- A. Polyvinyl Chloride: PVC pipe shall conform to Section 9-05.12 Standard Specifications.
- B. Polyethylene: PE smooth wall pipe per Advanced Drainage Systems (ADS) N12 (bell and spigot), or City-approved equal, constructed per Sections 9-05.1(6) and (7) Standard Specifications
- C. Ductile Iron Pipe and Fittings: Class 50 ductile iron pipe conforming to Section 9-05.13 of the Standard Specifications.

2.4 PERFORATED PIPE:

- A. Polyvinyl Chloride: Perforated PVC underdrain pipe shall conform to WSDOT Specification 9-05.2(6).
- B. Polyethylene: Perforated Corrugated PE underdrain pipe shall conform to WSDOT Specification 9-05.2(7).
- C. Tracer Tape: Shall be per Section 312000 for Storm Sewer Pipe.

2.5 CAST-IN-PLACE CONCRETE DETENTION VAULT:

- A. Conform to detail on plans.
- B. Conform to structural plans for design of walls, floor, and top.

2.6 FLOW CONTROL RISER:

- A. Conform to detail on plans.

2.7 PREFABRICATED TREATMENT SYSTEM:

- A. Modular Stormwater Wetland as manufactured by Bio Clean.
- B. Conform to detail on plans.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Execution shall conform to Sections 7-01.3, 7-04.3, 7-05.3, and 7-08.3 of the Standard Specifications.

3.2 GENERAL CONSTRUCTION REQUIREMENTS

- A. The improvements shall be constructed as shown on the plans and in accordance with these Specifications, Standard Details, and Standard Specifications. Manufacturer's equipment shall be installed in compliance with specifications of the manufacturer, except where a higher quality of workmanship is required by the plans and specifications. All materials and work shall be in strict accordance with any applicable regulations of the State, City and local authorities. The Contractor shall arrange for such inspection by these agencies as may be required and shall submit evidence of their approval, if requested by the Engineer.
- B. The plans may show the approximate locations of various existing utilities known to the Engineer, such as gas lines, water mains, sanitary sewers, power lines, telephone lines, television cables, and other obstructions based on information obtained from various sources. This information is not guaranteed to be accurate, and the Contractor is directed to check for interferences and obstructions by inquiry from the different utilities and by underground exploration ahead of his regular excavation.
- C. The Contractor shall request field locates and notify the owners of underground facilities about the scheduled commencement of excavation through a one-call number: (1-800-424-5555).
- D. General Locations and Arrangements: Drawing plans and details indicated general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practicable.
- E. The Contractor shall excavate around and under service pipes with special care and shall support and maintain them in service. Where it is necessary to cut, move or reconnect any service lines, arrangements shall be made with the respective utility.

3.3 EXAMINATION

- A. Site and Drawings: Carefully examine the site and compare the drawings with existing conditions, including public utility records. By the act of submitting bids, the Contractor shall be deemed to have made such examination and to have accepted such conditions, and to have made allowance therefore in preparing his figure.
- B. Verification of Existing Elevations: Verify all connection elevations prior to laying pipe.

- C. Verification of Dimensions: Before proceeding with any work, the Contractor shall carefully check and verify all dimensions, sizes, etc. and shall assume full responsibility for the fitting-in of his equipment and to the structure. Where apparatus and equipment have been taken from typical equipment of the class indicated, the Contractor shall carefully check the drawings to see that the equipment he contemplates installing will fit into the spaces.

3.4 STAKING

- A. All surveying and staking shall be performed a surveying firm Capable of performing such work. The engineer or surveyor directing and/or performing such work shall be currently licensed by the state of Washington to perform said tasks.
- B. The minimum staking of the storm drainage system shall be as follows:
 - 1. Stake centerline alignment every 25' with cuts and/or fills to the invert of the pipe or flow line.
 - 2. Stake location of all catch basins and other fixtures for grade and alignment.
 - 3. Stake finished grade of catch basin rim elevation and invert elevations of all pipes in catch basins.

3.5 INSTALLATION

- A. Catch Basins and Concrete Structures:
 - 1. Construct catch basins, culverts, and other drainage structures at locations, and to the design and dimensions indicated.
 - 2. Set covers and grates flush with finished surface in paved areas.
 - 3. Provide grates, frames, and covers for catch basins as detailed and indicated.
- B. Conveyance Piping:
 - 1. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert.
 - 2. Place bell ends of pipe facing upstream.
 - 3. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 4. Maintain swab or drag in line, and pull past each joint as it is completed.
 - 5. Use catch basins or area drains for changes in direction unless otherwise indicated.
 - 6. Reducing the size of pipe in direction of flow is prohibited.
 - 7. Pipe ends projecting from soil embankments shall have beveled ends matching the embankment side slope.
 - 8. Debris barriers shall be installed on all 12-inch or larger pipe that projects from embankments.
- C. Tracer Tape: During backfilling of storm drain systems, install continuous underground-type plastic line marker, located directly over buried line at six to eight inches below finished grade or per manufactures recommendation.
- D. Excavation, Bedding, and Backfill:

1. Trenching: Shall be per Section 7-08.3(1)A of the Standard Specifications.
2. Excess excavated trench material shall be removed and disposed of off-site (per section 312000 and the conditions of all local ordinances and regulations for dumping/filling), or if deemed suitable by the Geotechnical Engineer, shall be placed adjacent to the trench in piles so that the toe of the slope is at least two feet from the edge of the trench. Free access shall be maintained to all fire hydrants, water valves, and meters.
3. Where trench excavation equals or exceeds a depth of 4 feet, the contractor shall provide, construct, maintain and remove, as required, safety systems that meet the requirements of the Washington Industrial safety and Health Act, RCW 49.17, including WAC 296-155.
4. Excavation for structures: shall be in accordance with Section 7-05.3 of the Standard Specification.
5. Bedding: Bedding shall be installed in accordance with Standard Specification Section 7-08.3(1)C of the Standard Specifications and the Contract Documents.
 - a. Bedding shall provide uniform support along the entire pipe barrel, without load concentration at joint collars or bells.
 - b. No blocking of any kind shall be used to adjust the pipe to grade except when used with embedment concrete.
 - c. Bell holes shall be dug as required to ensure uniform support along the pipe barrel.
 - d. Bedding disturbed by pipe movement or by removal of shoring or movement of a trench shield or box shall be reconsolidated prior to backfill.
6. Backfill: Shall be in accordance with Section 7-08.3(3) of the Standard Specifications; material shall be per Section 31 20 00.
 - a. Backfill shall be placed in successive layers with the first layer not to exceed 2 feet above the pipe, and the following layers not exceeding 8 inches in loose thickness, with each layer compacted to the required density.
 - b. Trenches shall be backfilled as soon after the pipe laying as possible.
 - c. Backfill of trenches in the vicinity of catch basins, manholes, or other appurtenances will not be permitted until the masonry has become thoroughly hardened. Backfill above the pipe zone will be accomplished in such a manner that the pipe will not be shifted out of position nor damaged by impact or overloading.

E. Laying Pipe:

1. Survey line and grade shall be established in a manner consistent with accepted practices.
2. Existing flows shall be diverted away from the pipe segment being worked on by method approved by the Engineer.
3. The pipe shall be lowered into the trench by means of ropes, tripod, crane or any other suitable means. The pipe shall not be dropped or handled roughly. The pipe shall be checked for cracks and defects prior to use and any defective pipe rejected.
4. Connections:
 - a. Connections to manholes shall be made in accordance with the drawings.
 - b. Pipe branches, stubs or other open ends which are not to be immediately connected shall be capped or plugged.
 - c. Join piping made of different materials or dimensions with couplings made for this purpose. Use couplings that are compatible with, and that fit, both systems; materials and dimensions.

F. Roof Drain Installation:

1. Provide a "tee" or "wye" in the roof drain at each building downspout locations.
2. Provide all fittings required to connect downspouts to roof drains.
3. See Architectural plans for downspout locations.
4. Downspouts shall not discharge directly to any paved surface.
5. Provide a cleanout on each downspout connection per plan details.

G. Detention Vault Installation:

1. Excavate to specified subgrade elevation. Exposed subgrade shall be observed by Geotechnical Engineer to confirm soil conditions.
2. Construct base, walls, interior supports, lids, and openings per plans.
3. Provide temporary plug in flow control structure to prevent turbid water or sediment from being discharged to the downstream storm system.
4. Provide temporary pumps and pipes to remove water from plugged detention system. Direct pumped water to sediment tank and/or treatment system as necessary to meet NPDES discharge requirements before discharge from the site.

H. Pre-fabricated Stormwater Treatment System Installation:

1. Excavate to specified subgrade elevation. Exposed subgrade shall be observed by the Geotechnical Engineer to confirm soil conditions before vault is placed.
2. Install in accordance with Manufacturer's written recommendations.
3. Do not allow drainage to enter unit until final surfacing (pavements and landscaping) is provided and facility will not be contaminated with sediment and construction debris.
4. Contractor will be required to replace units that become contaminated with sediment and construction debris before project closeout.

I. Trench Drain Installation:

1. Install trench drain in accordance with Manufacturer's written recommendations.
2. Place trench drain with rim to match proposed pavement grade.
3. Connect to storm system as indicated on the plans.
4. Refer to Landscape Architecture plans for coordination with seat walls, concrete joint patterns, and other related improvements.

J. Miscellaneous:

1. Removal of Water: The contractor shall provide and maintain ample means and devices to remove and dispose of all water entering the trench excavation during the process of laying the pipe.
2. Preparation of Pipe: All pipe and fittings shall be carefully inspected before being laid and cracked, broken or defective pipe shall not be used in the work.
3. Restoration: At minimum, road paved areas shall be restored to existing thickness using like materials. Disturbed roadside-shoulders shall be restored with 6 inches of crushed surfacing top course. Disturbed cut and fill slopes shall be fertilized and re-seeded.

3.6 CLEANING

- A. Vaults, Pipes, trench drains, and area drains shall be cleaned per Section 7-17.3(2)A of the Standard Specifications.
- B. Cleanliness of Site: During progress of work, keep premises reasonably free of debris and waste materials.
- C. Removal of Debris: Upon completion and before final acceptance of work, remove all debris, rubbish, left-over materials, tools, and equipment from site.
- D. Prior to acceptance of work, each line and structure shall be cleaned to ensure that the entire system is clean and free of obstructions of any nature and provide written certification attesting thereto. Mechanically remove all sediment displaced from lines from the system, and do not flush downstream.

3.7 INSPECTION

- A. Inspect interior of piping and detention vault to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, at completion of backfill, and again at completion of Project.
- B. Defects requiring correction include, but are not limited to, the following:
 - 1. Alignment: Less than full diameter of inside of pipe is visible between structures.
 - 2. Deflections: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - 3. Crushed, broken, cracked, or otherwise damage piping.
 - 4. Infiltration of water into piping.
 - 5. Exfiltration of water from piping.
- C. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
- D. Re-inspect and repeat procedure until results are satisfactory.
- E. Provide Owner with camera inspection of all piping at completion of Project.

3.8 TESTING

- A. Storm Drainage Pipe shall be per the following:
 - 1. Exfiltration Testing per Section 7-04.3(1)B of the Standard Specifications.
 - 2. Low Pressure Testing per Section 7-04.3(1)F of the Standard Specifications.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All construction shall be in accordance with Appendix A – Pavement Markings, Signing, Traffic Signal, and Illumination System Specifications.
- B. This Section specifies traffic signal and illumination systems, including but not limited to, construction requirements, materials, configuration, and testing, for but not limited to, the following:
 - 1. Traffic signal poles and foundations
 - 2. Traffic signal controller cabinets and foundations
 - 3. Vehicle signal heads
 - 4. Pedestrian signal heads and pushbuttons
 - 5. Vehicle detection systems
 - 6. CCTV camera systems
 - 7. Communications systems
 - 8. Junction boxes, conduits, and conductors
- C. Related Sections include the following:
 - 1. Appendix A – Pavement Markings, Signing, Traffic Signal, and Illumination System Specifications.
 - 2. Division 1 Section "Submittal Procedures" for submittal requirements.
 - 3. 10 14 53 – Traffic Signage.
 - 4. 26 57 00 – Roadway Lighting.
 - 5. 32 17 23 – Pavement Markings.

1.2 LEED

- A. This project is targeting LEED silver certification from the US Green Building Council. It is the contractor's responsibility to familiarize themselves with this program, to determine which points in the system that are relevant for this project are influenced by their work, and to meet the requirements of those sections for this project.

1.3 SUBMITTALS

- A. Comply with requirements of Part 1.1.C above.
- B. Submit complete manufacturer's product literature, cut sheets, shop drawings, installation instructions, etc. for each of the materials used if available.

1.4 QUALITY ASSURANCE

- A. Comply with requirements of Part 1.1.C above.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of Part 1.1.C above.

1.6 WARRANTY

- A. Comply with requirements of Part 1.1.C above.

PART 2 - PRODUCTS

- A. Comply with requirements of Part 1.1.C above.

PART 3 - EXECUTION

- A. Comply with requirements of Part 1.1.C above.

END OF SECTION

**KIRKLAND FIRE STATION 27
REPLACEMENT**

SPECIAL PROVISIONS

**APPENDIX A – PAVEMENT
MARKINGS, SIGNING, TRAFFIC
SIGNAL, AND ILLUMINATION
SYSTEM SPECIFICATIONS**

1 INTRODUCTION

2
3 This Contract shall be constructed in accordance with the 2022 Standard Specifications for
4 Road, Bridge, and Municipal Construction.

5
6 SPECIAL PROVISIONS

7
8 Several types of Special Provisions are included in this contract; General, Region, Bridges
9 and Structures, and Project Specific. Special Provisions types are differentiated as follows:

10
11 (date) General Special Provision
12 (*****) Notes a revision to a General Special Provision
13 and also notes a Project Specific Special
14 Provision.
15 (Regions¹ date) Region Special Provision

16
17 **General Special Provisions** are similar to Standard Specifications in that they typically apply
18 to many projects, usually in more than one Region. Usually, the only difference from one
19 project to another is the inclusion of variable project data, inserted as a “fill-in”.

20
21 **Region Special Provisions** are commonly applicable within the designated Region. Region
22 designations are as follows:

23
24 Regions¹
25 ER Eastern Region
26 NCR North Central Region
27 NWR Northwest Region
28 OR Olympic Region
29 SCR South Central Region
30 SWR Southwest Region
31
32 WSF Washington State Ferries Division

33
34 **Project Specific Special Provisions** normally appear only in the contract for which they were
35 developed.

1 **DIVISION 8 MISCELLANEOUS CONSTRUCTION**

2
3 **8-20 Illumination, Traffic Signal Systems, Intelligent Transportation Systems, and**
4 **Electrical**

5
6 **(*****)**

7 **8-20.1 Description**

8 Section 8-20.1 is supplemented with the following:

9
10 This Work shall consist of the construction of traffic signal and illumination systems as
11 shown and described in the Contract Documents.

12
13 The Contractor shall provide all labor, equipment, and materials for a complete and
14 operational signal and illumination system(s) in accordance with the Plans, WSDOT
15 Standard Specifications, WSDOT Standard Plans and these Special Provisions. Work to
16 be performed shall include, but not be limited to the following items:

- 17
18 • Furnish and install a fully functioning traffic signal system, including but not limited to
19 signal poles, mast arms, foundations, signal heads, Accessible Pedestrian
20 Signal systems, video detection cameras, CCTV cameras, traffic signal controller
21 cabinet, fiber optic communications, and all associated equipment, junction boxes,
22 conduits, wiring, and all other hardware necessary to provide a fully functioning
23 system.
24
25 • Furnish and install a fully functioning roadway illumination system, including but
26 not limited to luminaire poles, luminaire arms, foundations, luminaire fixtures,
27 service cabinet, service connection, and all associated equipment, junction boxes,
28 conduits, wiring, and all other hardware necessary to provide a fully functioning
29 system.
30

31 **(*****)**

32 **8-20.1(1) Regulations and Code**

33 Section 8-20.1(1) is supplemented with the following:

34
35 All electrical work on this project shall be accomplished in accordance with the
36 Standard Specifications for Road, Bridge, and Municipal Construction, 2022
37 edition (Standard Specifications), and the Standard Plans for Road, Bridge, and
38 Municipal Construction, latest edition (Standard Plans), and the Amendments to
39 the Standard Specifications, all as published by the Washington State
40 Department of Transportation unless supplemented otherwise by these Special
41 Provisions and the Plans.
42

43 Where applicable, materials and installation procedures shall conform to the
44 Washington State Department of Labor and Industries and City of Kirkland
45 standards.
46

1 Safe wiring labels and an Electrical Work Permit per the State Department of
2 Labor and Industries are required for this project, as well as an Electrical Permit
3 from the City of Kirkland.
4

5 Prior to the start of work, the Contractor shall obtain all necessary licenses,
6 permits, and approvals including a City of Kirkland electrical permit. The
7 Contractor shall comply with all laws, ordinances, rules, orders, and regulations
8 relating to the performance of the Work, the protections of adjacent property,
9 and the maintenance of all facilities. The Contractor shall be required to comply
10 with all of the provisions of these instruments and shall save and hold the City
11 of Kirkland harmless from any damage that may be incurred as a result of the
12 Contractor's failure to comply with all of the terms of these permits.
13

14 **8-20.2 Materials**

15 **8-20.2(1) Equipment List And Drawings**

16 Section 8-20.2(1) is supplemented with the following:
17

18 **(*****)**

19 The Contractor shall also be required to submit product data for the following:
20

- 21 • Video detection equipment and mounting hardware
- 22 • Video detection cabling
- 23 • Emergency vehicle pre-emption system
- 24 • CCTV cameras, mounting hardware, and cabling
- 25 • Vehicle signal heads and mounting hardware
- 26 • Pedestrian signal heads and mounting hardware
- 27 • Conduit and innerduct
- 28 • Conductors
- 29 • Junction boxes and cable vaults
- 30 • Service cabinets and service connections
- 31 • Traffic signal controller cabinet and components
- 32 • APS pushbuttons, control unit, and mounting hardware
- 33

34
35 Approval of submittals may require up to 20 calendar days from the date the Engineer
36 receives the submittals until they are returned to the Contractor. The actual time
37 required for approval is dependent upon the completeness and appropriateness of
38 the drawings as submitted.
39

40 Any deficiencies will require additional time for approval based on the degree of the
41 deficiency and the additional review time required. If the submittals are returned to
42 the Contractor to correct deficiencies, an additional 20 calendar days may be
43 required for the approval process.
44

1 If more than 20 calendar days are required for routine approval of submittals that are
2 completed and accurate, the Contractor will be granted an extension of time equal to
3 the additional review time.
4

5 Materials not approved by the Engineer will not be permitted on the jobsite.
6 All materials for review shall be submitted in a single package.
7

8 *(March 13, 1995, WSDOT GSP)*
9 Pole base to light source distances (H1) for lighting standards with pre-approved
10 plans shall be as noted in the Plans.
11

12 Pole base to light source distances (H1) for lighting standards without pre-approved
13 plans will be furnished by the Engineer as part of the final approved shop drawings,
14 prior to fabrication.
15

16 *(March 13, 1995, WSDOT GSP)*
17 If traffic signal standards, strain pole standards, or combination traffic signal and
18 lighting standards are required, final verified dimensions including pole base to signal
19 mast arm connection point, pole base to light source distances (H1), mast arm length,
20 offset distances to mast arm mounted appurtenances, and orientations of pole
21 mounted appurtenances will be furnished by the Engineer as part of the final
22 approved shop drawings prior to fabrication.
23

24 **8-20.3 Construction Requirements**

25 **8-20.3(1) General**

26 Section 8-20.3(1) is supplemented with the following:
27

28 *(*****)*
29 Signal turn-ons shall be limited to Tuesdays through Thursdays, 7AM to 2PM only.
30 The City of Kirkland prefers that cabinet turn-ons be scheduled on Tuesdays, if
31 possible. All wires are to be pulled and brought to the terminal cans when possible,
32 prior to scheduling a switch over to ensure all pathways are usable and cables are
33 of the proper length. Signal turn-on and flash-out will be coordinated with the City of
34 Kirkland's Signal Technicians a minimum of 5 working days in advance of performing
35 the turn-on. Flash-out will be scheduled approximately 2 working days prior to signal
36 turn-on between 7AM and 2PM. Upon completion of flash-out, contractor will have 2
37 working days to address issues. During this period, contractor will conduct Ohms test
38 for APS pushbuttons per Section 8-20.3(14)G and City Traffic Engineer will confirm
39 all head directionality, signage, and channelization. Signal turn-on will then be
40 performed.
41
42

43 All equipment shall be handled and protected so as to prevent damage. Damaged
44 equipment, if any, shall be repaired or replaced by the Contractor to the satisfaction
45 of the Engineer at no additional cost to the Owner.
46
47

1 No new fixtures shall be constructed as part of this Contract, which are in conflict
2 with any existing utilities, or the code required thereby. It shall be the Contractor's
3 responsibility to locate all utilities whether above, on, or below the ground, and to
4 protect against any and all damages arising from work under this project. At least 48
5 hours before digging, the Contractor shall call the Utilities Underground Locator
6 Center (telephone 1-800-424-5555). Contractor must maintain locates during the
7 duration of the project once they have been identified.

8
9 All manufacturers' warranties or guarantees on all electrical and mechanical
10 equipment, consistent with those provided as customary trade practice, shall be
11 assigned to the City of Kirkland.

12
13 **8-20.3(2) Excavating and Backfilling**

14 Section 8-20.3(2) is supplemented with the following:

15
16 (*****)

17 Backfill for all electrical trenches shall consist of crushed surfacing top course
18 meeting the requirements of Section 9-03.9(3) of the Standard Specifications.

19
20 All trenches shall be mechanically compacted by a power operated mechanical
21 tamper or other mechanical compaction device approved by the Engineer.
22 Compaction shall be in conformance with Section 2-30.3(14), Method C of the
23 Standard Specifications. The temporary restoration of conduit trenches shall be as
24 directed by the Engineer.

25
26 The Contractor warrants and represents awareness of the statutory provisions
27 contained in RCW 19.122.010 through .900, that the Contractor has read and fully
28 understands the same, and will comply with the requirements of these provisions,
29 which are incorporated by reference herein. The Contractor agrees that all trenching
30 as well as excavating for all pole foundations shall be an "excavation" as defined
31 under RCW Chapter 19.122 and that such utilities constitute underground facilities.
32 The parties agree that remedies affected under RCW Chapter 19.122 are also
33 incorporated by reference herein. Any cost to the Contractor as a result of this law
34 shall be at the Contractor's expense.

35
36 Add the following new sub-sections:

37
38 (*****)

39 **8-20.3(2)A Resolving Utility Conflicts**

40
41 Underground utilities of record will be shown on the construction plans insofar
42 as it is possible to do so. These, however, are shown for convenience only and
43 the City and Engineer assumes no responsibility for improper locations or
44 failure to show utility locations on the construction plans.

45
46 The location of existing underground utilities, when shown on the plans, is
47 approximate only, and the Contractor shall be responsible for determining their

1 exact location. The Contractor shall check with the utility companies
2 concerning any possible conflict prior to commencing excavation in any area,
3 as not all utilities may be shown on the plans.
4

5 The Contractor shall be entirely responsible for coordination with the utility
6 companies and arranging for the movement or adjustment, either temporary or
7 permanent, of their facilities within the project limits.
8

9 If a conflict is identified, the Contractor shall contact the Engineer. The
10 Contractor and City shall locate alternative locations for cabinet or junction
11 boxes. The Contractor shall get approval from the Engineer prior to installation.
12 The Contractor may consider changing depth or alignment of conduit to avoid
13 utility conflicts. Potholing alternative locations, as directed by the Engineer, will
14 be paid for by a separate bid item with approval of the engineer.
15

16 Before beginning any excavation work for foundations, vaults, junction boxes
17 or conduit runs, the contractor shall confirm that the location proposed on the
18 Contract Plans does not conflict with utility location markings placed on the
19 surface by the various utility companies. If a conflict is identified, the following
20 process shall be used to resolve the conflict:
21

- 22 1. Contact the Engineer and determine if there is an alternate location for
23 the foundation, junction box, vault or conduit trench.
- 24 2. If an adequate alternate location is not obvious for the underground
25 work, select a location that may be acceptable and pothole to determine
26 the exact location of other utilities. Potholing must be approved by the
27 Engineer.
- 28 3. If an adequate alternate alignment still cannot be identified following
29 potholing operations, the pothole area should be restored and work in
30 the area should stop until a new design can be developed.
31

32 The Contractor shall not attempt to adjust the location of an existing utility
33 unless specifically agreed to by the utility owner.
34

35 **8-20.3(4) Foundations**

36
37 Section 8-20.3(4) is supplemented with the following:
38

39 (*****)
40 The foundations for the traffic signal controller cabinet with service cabinet shall
41 conform to Kirkland Standard Plan CK-TS.04.
42

43 **8-20.3(5) Conduit**

44
45 Section 8-20.3(5) is supplemented with the following:
46

47 (*****)

1 Each empty conduit run shall contain a 200-pound breaking strength polyolefin pull
2 cord, which shall be tied off at both ends. Pull rope or tape removed from fiber optic
3 conduit runs shall be replaced with new pull tape as described in 9-29.27 of these
4 special provisions.

5
6 All conduits that are not in use shall be plugged with a watertight duct plug designed
7 specifically to prevent entrance of water and debris.

8
9 All conduit installed underground shall have polyethylene Underground Hazard
10 Marking Tape, 6 inches wide, red legend "Caution-Electric Line Buried Below," placed
11 approximately 12 inches above the conduit.

12
13 The location of the conduit within the junction box shall be such that the side of the
14 junction box through which the conduit enters shall indicate from which direction the
15 conduit came.

16
17 Where intercepting and splicing to an existing conduit is called out on the plans, the
18 Contractor shall verify the conduit size and schedule before ordering the new conduit
19 sections. The size provided on the plans is an estimation.

20
21 **8-20.3(5)B Detectable Pull Tape**

22
23 Section 8-20.3(5)B is supplemented with the following:

24
25 (*****)

26 For all conduits that do not contain electrical conductors, the Contractor shall
27 add a detectable pull tape as indicated on the plans. The pull tape shall be in
28 conformance with Section 9-29.27 of these Special Provisions.

29
30 **8-20.3(6) Junction Boxes, Cable Vaults, and Pull boxes**

31
32 Section 8-20.3(6) is supplemented with the following:

33
34 (*****)

35 Junction boxes shall be located and oriented as shown on the Plans but may be
36 adjusted in the field by the Engineer to better fit existing conditions. No junction boxes
37 shall be located in pedestrian ramp areas.

38
39 **8-20.3(8) Wiring**

40
41 Section 8-20.3(8) is supplemented with the following:

42
43 (March 13, 1995, WSDOT GSP)

44 **Field Wiring Chart**

45 501	AC+ Input	516-520 Railroad Pre-empt
46 502	AC- Input	5A1-5D5 Emergency Pre-empt

**CITY OF KIRKLAND
FIRE STATION 27 REPLACEMENT
KIRKLAND, WASHINGTON**

**APPENDIX A –
PAVEMENT MARKINGS, SIGNING
TRAFFIC SIGNAL, AND ILLUMINATION
SYSTEM SPECIFICATIONS**

	503-510	Control-Display			541-580 Coordination					
	511-515	Sign Lights			581-599 Spare					
	Movement Number	1	2	3	4	5	6	7	8	9
6	Vehicle Head									
7	Red	611	621	631	641	651	661	671	681	691
8	Yellow	612	622	632	642	652	662	672	682	692
9	Green	613	623	633	643	653	663	673	683	693
10	Spare	614	624	634	644	654	664	674	684	694
11	Spare	615	625	635	645	655	665	675	685	695
12	AC-	616	626	636	646	656	666	676	686	696
13	Red Auxiliary	617	627	637	647	657	667	677	687	697
14	Yellow Auxiliary	618	628	638	648	658	668	678	688	698
15	Green Auxiliary	619	629	639	649	659	669	679	689	699
16	Pedestrian Heads & Dets.									
17	Hand	711	721	731	741	751	761	771	781	791
18	Man	712	722	732	742	752	762	772	782	792
19	AC-	713	723	733	743	753	763	773	783	793
20	Detection	714	724	734	744	754	764	774	784	794
21	Common-Detection	715	725	735	745	755	765	775	785	795
22	Spare	716	726	736	746	756	766	776	786	796
23	Spare	717	727	737	747	757	767	777	787	797
24	Spare	718	728	738	748	758	768	778	788	798
25	Spare	719	729	739	749	759	769	779	789	799
26	Detection									
27	AC+	811	821	831	841	851	861	871	881	891
28	AC-	812	822	832	842	852	862	872	882	892
29	Common-Detection	813	823	833	843	853	863	873	883	893
30	Detection A	814	824	834	844	854	864	874	884	894
31	Detection B	815	825	835	845	855	865	875	885	895
32	Loop 1 Out	816	826	836	846	856	866	876	886	896
33	Loop 1 In	817	827	837	847	857	867	877	887	897
34	Loop 2 Out	818	828	838	848	858	868	878	888	898
35	Loop 2 In	819	829	839	849	859	869	879	889	899
36	Supplemental Detection									
37	Loop 3 Out	911	921	931	941	951	961	971	981	991
38	Loop 3 In	912	922	932	942	952	962	972	982	992
39	Loop 4 Out	913	923	933	943	953	963	973	983	993
40	Loop 4 In	914	924	934	944	954	964	974	984	994
41	Loop 5 Out	915	925	935	945	955	965	975	985	995
42	Loop 5 In	916	926	936	946	956	966	976	986	996
43	Loop 6 Out	917	927	937	947	957	967	977	987	997
44	Loop 6 In	918	928	938	948	958	968	978	988	998
45	Spare	919	929	939	949	959	969	979	989	999

1 **8-20.3(10) Services, Transformer, Intelligent Transportation System (ITS) Cabinets**

2
3 Section 8-20.3(14) is supplemented with the following:

4
5 (*****)

6 Connection to Puget Sound Energy power source shall be where shown on the plans.
7 All connections and interfacing with Puget Sound Energy shall conform to Puget
8 Sound Energy requirements.

9
10 **8-20.3(14) Signal Systems**

11
12 Section 8-20.3(14) is supplemented with the following:

13
14 **8-20.3(14)A Signal Controllers**

15
16 Section 8-20.3(14)A is supplemented with the following:

17
18 (*****)

19 The persons performing the controller cabinet installation and wiring and their
20 Supervisor shall be personally experienced in traffic signal and controller cabinet
21 systems and shall have been engaged in this work for a minimum of three years.
22 Qualifications shall be submitted to the Engineer at least 30 calendar days prior
23 to the start of the first controller cabinet replacement. These qualifications shall
24 include:

- 25
26 1. The name of each person who will be performing controller cabinet and
27 traffic signal wiring work and their employer's name, business address
28 and telephone number.
29 2. The name and addresses of 5 similar projects that the foregoing people
30 have worked on during the past 3 years.
31 3. All information required showing the experience criteria have been met.

32
33 **8-20.3(14)C Induction Loop Vehicle Detectors**

34
35 Section 8-20.3(14)C is supplemented with the following:

36
37 (*****)

38 **Construction Requirements**

39 Install loop detectors during conditions of zero precipitation and when the
40 pavement temperature is between 40 degrees F and 100 degrees F.

41
42 Clean roadway surface of debris, standing water, or other material which may
43 enter the saw cut and thereby degrade the quality of the installation.

44
45 Loops shall be installed as shown in the Plans.
46

1 Loop wires shall be connected to lead –in cable using uninsulated butt splices.
2 The connection shall be soldered and the connection shall then be encapsulated
3 using approved heat shrinkable, thin wall, flexible, polyolefin tubing or 3M Scotch
4 2200 Vinyl Mastic Pads wrapped in 3M Scotch Super 88 Vinyl Electrical Tape.
5

6 In areas where no conduit exists between the junction box and the edge of the
7 roadway, conduit stub outs shall be installed. This installation may require curb
8 and/or side walk replacement to install the required conduit sweeps. Holes
9 greater than 3.5 inches in diameter may require an asphalt patch. Existing stub
10 outs not being re-used shall be plugged or removed from the junction box. Install
11 a 2-inch conduit between each saw cut in the pavement surface and the junction
12 box.
13

14 **Saw Cutting Round Loops**

15 Round loops shall be constructed in accordance with requirements of Method A
16 (Circular Saw). Construction shall conform to WSDOT Standard Plans J-50.12
17 and J-50.15, as modified by the following:
18

- 19 1. Round saw cuts shall be 6 feet in diameter and shall be constructed
20 using equipment designed for cutting round loops. The equipment shall
21 use a concave, diamond-segmented blade. The saw cuts shall be
22 vertical and shall be a minimum of 0.25 inches wide. The saw cut depth
23 shall be a minimum of 2.5 inches measured at any point along the
24 perimeter. Other methods of constructing the saw cut, such as anchoring
25 a router or flat blade saw, will not be allowed.
- 26 2. The bottom of the saw cut shall be smooth. No edges created by the
27 differences in saw cut depths will be allowed.
- 28 3. All saw cuts corner shall be rounded to a minimum 1.6 inches radius.
- 29 4. All saw cuts shall be cleaned with a 1000-psi high pressure washer.
30 Wash water and slurry shall be vacuumed out. Saw cuts shall be blown
31 out dry with compressed air.
- 32 5. Loops shall be installed after paving the final lift of asphalt.
- 33 6. The loops shall be constructed using three turns of conductor if its home
34 run is less than 400 feet, and four turns of conductor if its home run is
35 greater than 400 feet. The conductor shall be installed one turn on top of
36 the previous turn. All turns shall be installed in clockwise direction.
37

38 **Loop Materials**

39 Loop sealant shall be MSI 34271. Loop sealant shall be installed in two layers.
40 The first layer shall be allowed to cool before the second layer is applied.
41 Installation of the sealant shall completely encapsulate the loop conductors. A
42 minimum of 1-inch of sealant shall be provided between the top conductors and
43 the top of the saw cut. All sealant shall be installed per manufacturer
44 recommendations using equipment recommended by the manufacturer.
45

46 Electrical conductors shall conform to the requirements of Section 9-29.3
47 Conductors, Cable of the Standard Specifications, unless otherwise noted.

1 Electrical wiring shall conform to the requirements of Section 8-20.3(8) Wiring of
2 the Standard Specifications.
3 Loop wire shall be No. 12 AWG Class B stranded copper wire with cross-linked
4 polyethylene type USE insulation. Loop lead-in wire shall be IMSA loop cable
5 specification 50-2-1984, #14 AWG
6
7 **Loop Wire Installation**
8 A minimum of 2-inch-diameter PVC conduit shall be used to contain the loop
9 lead-in from the saw cut in the roadway to the junction box.
10
11 The Contractor shall coil at least 10 feet extra wire at the junction box prior to
12 placing it in the saw cut so that the loop wire will not require any splices.
13
14 The loop wires shall be placed in the saw cut so that at no time is any tension
15 placed on the wires. The wires shall not bind against the pavement at any point
16 in the saw cut.
17
18 The loop wires in the lead-in saw cut and loop conduit shall be twisted in a
19 symmetrical fashion with a minimum of 3 twists per foot at a uniform rate of turns
20 per foot between the loop saw cut and the junction box. The twisted loop wire
21 shall be pulled into the junction box through the conduit placed between the saw
22 cut and the junction box. Unless specified by the Engineer there shall be wiring
23 for no more than 3 (three) loops (6 twisted loop wire conductors) in each lead-
24 in (home run) saw cut.
25
26 **Loop Testing**
27 Loop installation shall be tested in accordance with Section 8-20.3 (14) D Test
28 for Induction Loops and Lead-in Cable of the Standard Specifications. In
29 addition, prior to installing the loop sealant material the Contractor shall perform
30 the required inductance testing. The inductance reading shall not be less than
31 60 nor greater than 120 microhenries. If any of the installation fail to pass all
32 tests, the installation shall be repaired or re-tested until satisfactory results are
33 obtained.
34
35 **(*****)**
36 Add the following new section:
37 **8-20.3(14)F Video Detection**
38
39 The Contractor shall furnish, install, and test a complete Video Detection System
40 capable of providing presence and advance vehicle detection at locations
41 defined in the Contract Plans, consistent with manufacturer's recommendations.
42 All Video Detection System configurations will be completed by the City's signal
43 technicians after installation. The Contractor shall coordinate with the City of
44 Kirkland Signal Shop for all configurations.
45

1 The Video Detection System and the Hybrid Radar/Video Detection System
2 shall be comprised of components from the same manufacturer, with the
3 exception of the LED monitors.
4

5 Detection cameras shall be located approximately as noted on the Plans;
6 however, the locations shall be field adjusted as directed by the Engineer and
7 equipment manufacturer for maximum coverage. Detection shall be fully
8 operable before request can be made for turn on of intersection. The installation
9 shall include all field equipment as well as all equipment required in the controller
10 cabinet, including but not limited to:

- 11 • Video detection cameras
- 12 • Mounting equipment
- 13 • Central control unit and extension modules, as needed.
- 14 • 8-inch video monitor
- 15 • Programming devices, configuration tools, licenses, and/or software
- 16 • Surge suppressors
- 17 • Communications and power cabling
- 18 • All other equipment necessary for a fully operable detection system

19
20 If the installation cannot be completed in one day, the controller shall be put on
21 fixed time operation by the Contracting Agency.
22

23 Detection cameras shall be mounted at a sufficient height to prevent occlusion
24 from cross traffic. A factory-certified representative of the equipment
25 manufacturer shall install controller cabinet equipment, and program the
26 cameras to provide detection. The Contractor shall notify the Engineer 48 hours
27 in advance of changes that will require Contracting Agency staff to reprogram
28 cameras.
29

30 All detection system equipment shall remain the property of the City of Kirkland
31 upon completion of the Contract Work. The Contractor shall be responsible for
32 any damage to the detection equipment.
33

34 A factory-certified representative of the equipment manufacturer shall also be
35 on-site during the installation of the permanent equipment to supervise the
36 installation and testing of the equipment. The factory representative shall install,
37 make fully operational, and test the system as indicated in the Plans and in these
38 Special Provisions.
39

40 The equipment manufacturer shall provide 2 days training to Contracting Agency
41 personnel in the operation, setup, and maintenance of the permanent Video
42 Detection System. Instruction and materials shall be provided for a maximum of
43 10 persons and shall be conducted at a location selected by the Contracting
44 Agency. The Contracting Agency shall be responsible for travel, room and
45 board, and other related expenses for its own personnel.
46

47 (*****)

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Add the following new section:
8-20.3(14)G Hybrid Radar/Video Detection

The Contractor shall furnish, install, and test a complete Hybrid Radar/Video Detection System capable of providing presence and advance vehicle detection at locations defined in the Contract Plans, consistent with manufacturer's recommendations. All Hybrid Radar/Video Detection System configurations will be completed by the City's signal technicians after installation. The Contractor shall coordinate with the City of Kirkland Signal Shop for all configurations.

The Video Detection System and the Hybrid Radar/Video Detection System shall be comprised of components from the same manufacturer, with the exception of the LED monitors.

Detection cameras shall be located approximately as noted on the Plans; however, the locations shall be field adjusted as directed by the Engineer and equipment manufacturer for maximum coverage. Detection shall be fully operable before request can be made for turn on of intersection. The installation shall include all field equipment as well as all equipment required in the controller cabinet, including but not limited to:

- Hybrid radar/video detection cameras
- Mounting equipment
- Central control unit and extension modules, as needed.
- 8-inch video monitor
- Programming devices, configuration tools, licenses, and/or software
- Surge suppressors
- Communications and power cabling
- All other equipment necessary for a fully operable detection system

If the installation cannot be completed in one day, the controller shall be put on fixed time operation by the Contracting Agency.

Detection cameras shall be mounted at a sufficient height to prevent occlusion from cross traffic. A factory-certified representative of the equipment manufacturer shall install controller cabinet equipment, and program the cameras to provide detection. The Contractor shall notify the Engineer 48 hours in advance of changes that will require Contracting Agency staff to reprogram cameras.

All detection system equipment shall remain the property of the City of Kirkland upon completion of the Contract Work. The Contractor shall be responsible for any damage to the detection equipment.

A factory-certified representative of the equipment manufacturer shall also be on-site during the installation of the permanent equipment to supervise the installation and testing of the equipment. The factory representative shall install,

1 make fully operational, and test the system as indicated in the Plans and in these
2 Special Provisions.

3
4 The equipment manufacturer shall provide 2 days training to Contracting Agency
5 personnel in the operation, setup, and maintenance of the permanent Hybrid
6 Radar/Video Detection System. Instruction and materials shall be provided for a
7 maximum of 10 persons and shall be conducted at a location selected by the
8 Contracting Agency. The Contracting Agency shall be responsible for travel,
9 room and board, and other related expenses for its own personnel.

10
11 **(*****)**
12 Add the following new section:
13 **8-20.3(18) CCTV Camera**

14
15 Add the following new sub-section:
16 **8-20.3(18)A CCTV Camera**

17
18 The CCTV cameras shall be furnished and installed by the Contractor as shown
19 in the mounting details in the Plans. CCTV cameras shall be mounted 90
20 degrees from attachment point (i.e. mast arm). The Contractor is responsible
21 for installing cameras and mounts per manufacturer recommendations,
22 including correct sealing to make camera housing watertight.

23
24 After all cameras are installed the Contractor shall arrange an interactive
25 session with the Engineer to fine-tune and test the cameras in the field. The
26 Contractor shall test the CCTV system using a Contractor-supplied control
27 device such as a laptop computer running Vendor-supplied software. All test
28 cables and connections shall be the responsibility of the Contractor. The
29 Contractor shall demonstrate to the Engineer the following features of the
30 camera installation:

- 31
- 32 1. Display camera video on the Contractor-provided monitor.
 - 33 2. Pan and tilt the camera with no detectable delay.
 - 34 3. Zoom and focus the camera in both fast and slow modes.
 - 35 4. Turn the camera off and on.
 - 36 5. Change the iris to auto and manual.
 - 37 6. Demonstrate faceplate wiper operation.

38
39 The Contractor is required to document video output for the following video level
40 measurements and show their results in comparison to the required range
41 provided by the camera manufacturer:

- 42
- 43 1. Signal-to-noise ratio
 - 44 2. Horizontal resolution
 - 45 3. Vertical phase
 - 46 4. Color and black and white Lux levels
 - 47 5. Video output

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CCTV Camera Cabling

The Contractor shall install and terminate the CCTV camera cabling into the CCTV using a RJ45 IP67 coupler. The Contractor shall furnish and install a PoE++ injector and termination block in each traffic signal cabinet at camera locations per manufacturer’s recommendation for termination of the camera control cable and PoE++ injector power supply cable. Cable shall be identified and marked by the Contractor.

(*****)

Add the following new section:

8-20.3(19) Communication Vault

The location of all communication vaults shall be as indicated on the Plans and shall be field verified by the Contractor.

Communication vaults shall be configured such that the tensile and bending limitations of the fiber optic cable are not compromised. Communication vaults shall be configured to mechanically protect the fiber optic cable against installation force as well as inert forces after cable pulling operations.

Where indicated on the Plans, new communication vaults shall be installed as described herein and shown in the details on the Plans. The Contractor shall furnish and install racking hardware for cable storage in all new communication vaults and in all existing communication vaults where cable storage is identified on the plans. The Contractor shall secure and store the cable in the racking hardware per manufacturer’s instruction.

New communication vaults shall be adjusted to be flush with the finished grade and such that water drainage will continue after the installation. In some instances the soil grading will be sufficient, while in other instances gravel may have to be placed at specified depths. The location of the communication vault should be away from traffic conditions that could cause injury to personnel, yet it should be easily accessible for maintenance. All voids created in and around the communication vault while adjusting it to grade shall be filled with grout.

8-20.4 Measurement

Section 8-20.4 is supplemented with the following:

(*****)

“Traffic Signal System – _____, Complete” shall be measured per lump sum for the total of all items for a complete traffic signal system. All items and labor necessary to supply, install, and test the conduit, junction boxes, service circuit breaker and connections, signal/service cabinets and foundation(s), vehicular and pedestrian signal heads, pedestrian pushbuttons, emergency vehicle preemption, vehicle detection system, connections with existing conduit and junction boxes, mast

1 arm mounted traffic signs, restoring facilities destroyed or damaged during
2 construction, salvaging existing materials, and all other components necessary to
3 make a complete traffic signal system shall be included within the lump sum
4 measurement. Luminaires, photocells, and luminaire arms positioned on signal poles
5 will be considered a part of the traffic signal system lump sum measurement.
6 Removal of an existing signal system or existing signal components shall be included
7 within the lump sum measurement. After construction is complete, it is Contractor's
8 responsibility to adjust, relocate, and reposition all traffic signal heads to their final
9 position as shown on the Contract Documents, and shall be considered incidental to
10 the lump sum measurement. All painting of components shall be considered
11 incidental to the lump sum measurement. No specific unit of measurement shall
12 apply, but measurement will be made for the sum total of all items to be furnished
13 and installed.

14
15 Excavation, trenching and bedding, backfill of trenches, pavement restoration of
16 trenches and conduit/junction box installations containing traffic signal system
17 elements as well as illumination system, and/or interconnect system elements will be
18 included in the lump sum measurement for "Traffic Signal System – _____,
19 Complete".

20
21 8-20.5 Payment

22 Section 8-20.5 is supplemented with the following:

23
24 (*****)

25 Payment will be made in accordance with Section 1-04.1 for each of the following
26 Bid Items:

27 "Traffic Signal System – _____, Complete", per lump sum.

28
29 The lump sum price for "Traffic Signal System – _____, Complete" shall be full
30 pay for furnishing all labor, equipment, materials, tools and supplies necessary or
31 incidental to the construction to complete the work as specified in the Plans and as
32 defined in the Standard Specifications and these Special Provisions. The lump sum
33 bid price shall include all costs associated with the construction of the cement
34 concrete pad and pedestal for the controller and service cabinets, construction of
35 the cement concrete pads around signal poles, and illumination positioned on signal
36 poles. All costs for installing signing on signal mast arms or temporary signal
37 installations shall be incidental to the bid item(s) in this section and no additional
38 compensation will be made.

39
40 Coordination of service connections with Puget Sound Energy shall be considered
41 incidental to the bid items included in this section and no additional compensation
42 will be made.

43
44 Coordination with communication connections with communication providers
45 affected by this project shall be considered incidental to the bid items included in this
46 section and no additional compensation will be made.

47

1 All costs for installing junction boxes and conduit containing traffic signal system,
2 illumination system, and/or interconnect system wiring shall be incidental to the one
3 bid item per this section and Section 8-20.4 and no additional compensation will be
4 made.

5
6 All costs for painting shall be incidental and included in the bid items included in this
7 section and no additional compensation will be made.

8
9 Restoration of facilities destroyed or damaged during construction shall be
10 considered incidental to the bid items included in this section and no additional
11 compensation will be made.

12

13 **8-21 PERMANENT SIGNING**

14

15 **8-21.2 Materials**

16 Section 8-21.2 is supplemented with the following:

17

(*****)

18

Sign sheeting shall be Type III (High Intensity Grade) retroreflective in accordance
19 with Section 9-28.

20

21 **8-21.5 Payment**

22 Section 8-21.5 is supplemented with the following:

23

(*****)

24

“Permanent Signing” includes the installation, removal, relocation, and disposal of
25 existing and new signs.

26

27

28

8-22 PAVEMENT MARKING

29

Add the following new Section 8-22.3(7):

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31

(*****)

32

8-22.3(7) Raised Pavement Markers

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34

Install raised pavement markers as shown in the Plans and in accordance with
35 Section 8-09.

36

37

38 **8-22.4 Measurement**

39 Section 8-22.4 is supplemented with the following:

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(*****)

41

No unit of measurement shall apply to the lump sum price for “Removing Pavement
42 Markings”.

43

44

45

END OF DIVISION 8

1 **DIVISION 9 MATERIALS**

2
3 **9-06 Structural Steel and Related Materials**

4
5 **9-06.16 Roadside Sign Structures**

6 Section 9-06.16 is supplemented with the following:

7
8 *(January 3, 2011, WSDOT GSP)*

9 **Perforated Steel Square Sign Post System**

10 Where noted in the Plans, steel sign post systems shall be square, pre-punched
11 galvanized steel tubing, that are NCHRP 350 Test Level 3 Certified and FHWA
12 approved. The steel sign post system shall include all anchor sleeves, and other
13 hardware required for a complete sign installation.

14
15 **System Acceptance**

16 Systems listed in the current QPL will be accepted per the QPL approval code.
17 Systems not listed in the QPL will be accepted based on a Supplier's Certificate of
18 Compliance. The Supplier's Certificate of Compliance will be a contract specific letter
19 from the supplier stating the system is NCHRP 350 Test Level 3 compliant.

20
21 **9-28 Signing Materials and Fabrication**

22
23 **9-28.14 Sign Support Structures**

24 Section 9-28.14 is supplemented with the following:

25
26 *(September 8, 2020, WSDOT GSP)*

27 **Manufacturers for Steel Roadside Sign Supports**

28 The Standard Plans lists several steel sign support types. These supports are
29 patented devices and many are sole-source. All of the sign support types listed below
30 are acceptable when shown in the Plans.

31

<u>Steel Sign Support Type</u>	<u>Manufacturer</u>
Type TP-A & TP-B	Transpo Industries, Inc.
Type PL, PL-T & PL-U	Northwest Pipe Co.
Type AS	Transpo Industries, Inc.
Type AP	Transpo Industries, Inc.
Type ST 1, ST 2, ST 3, & ST 4	Ultimate Highway Solutions, Inc., Allied Tube & Conduit Corp. (Mechanical Division), Trinity Highway Products, LLC.
Type SB-1, SB-2, & SB-3	Ultimate Highway Solutions, Inc.,

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Xcessories Squared Development and
Manufacturing Incorporated,
Trinity Highway Products, LLC.

9-29 Illumination, Signal, Electrical

Section 9-29 is supplemented with the following:

(*****)

General

All electrical materials shall be U.L. approved.

9-29.1 Conduit, Innerduct, and Outerduct

9-29.1(11) Foam Conduit Sealant

Section 9-29.1(11) is supplemented with the following:

(January 7, 2019, WSDOT GSP)

The following products are accepted for use as foam conduit sealant:

- CRC Minimal Expansion Foam (No. 14077)
- Polywater FST Foam Duct Sealant
- Superior Industries Foam Seal
- Todol Duo Fill 400

9-29.2 Junction Boxes, Cable Vaults, and Pull Boxes

Section 9-29.2 is supplemented with the following:

(September 3, 2019, WSDOT GSP)

Slip-Resistant Surfacing for Junction Boxes, Cable Vaults, and Pull Boxes

Where slip-resistant junction boxes, cable vaults, or pull boxes are required, each box or vault shall have slip-resistant surfacing material applied to the steel lid and frame of the box or vault. Where the exposed portion of the frame is ½ inch wide or less, slip-resistant surfacing material may be omitted from that portion of the frame.

Slip-resistant surfacing material shall be identified with a permanent marking on the underside of each box or vault lid where it is applied. The permanent marking shall be formed with a mild steel weld bead, with a line thickness of at least 1/8 inch. The marking shall include a two character identification code for the type of material used and the year of manufacture or application. The following materials are approved for application as slip-resistant material, and shall use the associated identification codes:

1. Harsco Industrial IKG, Mebac #1 - Steel: **M1**
2. W. S. Molnar Co., SlipNOT Grade 3 – Coarse: **S3**

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3. Thermion, SafTrax TH604 Grade #1 – Coarse: T1

(*****)

Junction boxes shall be of the type noted on the Plans and shall conform to the latest WSDOT Standard Plans for locking lid units.

All junction boxes in the sidewalk area shall have a non-slip surface on the lid.
All lids and frames shall be hot-dip galvanized.

Cover markings shall conform to the WSDOT Standard Specifications. The System Identification letters shall be 1/8" line thickness formed by stainless steel weld bead only. Engraving or stamping will not be allowed.

(*****)

Junction boxes with metal lids located in pedestrian walkway or sidewalk areas shall have non-slip lids provided and installed. Retrofit or replacement lids shall be non-slip.

9-29.3 Fiber Optic Cable, Electrical Conductors, and Cable

9-29.3(1) Fiber Optic Cable

Add the following new sub-section:

(*****)

9-29.3(1)C Fiber Optic Splicing and Termination Materials

A. Fiber Optic Pigtails

Fiber optic pigtails shall be 6 and 12 count color coded fiber optic simplex LC/UPC pigtail kits for splicing the field fiber into the 6 or 12 port connector panels used in new or existing patch panels. The pigtail shall be factory connectorized with simplex LC/UPC connectors, unless otherwise notes on the Plans. The LC/UPC connectors shall meet the following requirements:

- Insertion Loss Change (SM): < 0.30 dB
- Connector ratings shall be from -22 degrees to 140 degrees Fahrenheit for operations and from -40 degrees to 140 degrees Fahrenheit for storage.
- Connectors shall have protective caps.
- Reflectance (UPC) < -40dB
- Apex Offset: < 50 µm

B. 6 and 12-Port Wall Mount Fiber Patch Panels

The 6 and 12 port wall mount fiber patch panels shall be a wall mounted fiber termination panel for all terminations in traffic signal controller

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cabinets. The panel shall be a Corning SPH-01P or approved equivalent meeting the following requirements:

- The panel shall be a maximum of 6.5” high, 5.5” wide and 2” deep.
- The panel shall contain 6 or 12 LC/UPC fiber ports that are equipped with dust covers. The panel shall include a splice holder for up to 12 fusion splices. The Contractor shall fusion splice the lateral fiber cable to pre-connectorized pig tail.
- The panel shall have cable entrances on the top and bottom. All cable entrances shall have a gasket to prevent the ingress of foreign material into the panel.

C. Fiber Optic Splice Closure

The closure shall be a Tyco FOSC 450 or equivalent and shall be suitable for both vault and aerial applications. The enclosure will meet the following requirements:

- The contractor shall supply a fiber optic splice enclosure made of two injection-molded high-density thermoplastic shells that is a maximum of 25 inches in length and can store up to six splice trays. The shell shall bolt together with stainless steel bolts and shall be fitted with a neoprene gasket.
- The closure shall have a cable entry block on one end that is sealed with a gel profile. The closure shall accommodate up to six cables. The block shall be re-enterable without having to replace the gel. The block shall accommodate cables that are between 0.35” and 1.00”. Upon sealing the closure, the Contractor shall show that the closure maintains 10psi of pressure for a 24 hour period.
- The splice closure shall be re-enterable and shall not require a re-enter kit.
- The splice closure shall be rated for 1310 and 1550 nanometer wavelengths
- The splice enclosure shall be suitable for outdoor applications with a temperature range of -10°C to 60°C.
- The splice enclosure shall provide sufficient space to allow entry of fiber optic cable without exceeding the cable minimum bending radius.
- The enclosure shall protect the splices from moisture and mechanical damage and shall be resistant to corrosion.
- The enclosure shall permit selective splicing to allow one or more fibers to be cut and spliced without disrupting other fibers.
- The enclosure shall have strain relief for the cable to prevent accidental tension from disturbing the splices.
- Each splice tray shall be hinged and shall accommodate a minimum of 12 individual fusion splices securely.

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- The Contractor shall furnish and install the mounting hardware for mounting the splice closure to splice box hangers at both splice locations.

D. Fiber Optic LC Connectors

The Contractor shall supply Single-mode LC Fiber Optic Straight Polished Connectors that utilize epoxy for attaching to the tight-buffered lateral cables terminated in traffic signal controller cabinets. The connectors shall meet the following standard and specifications and be tested to Telcordia GR-326, Issue 3:

- Insertion Loss (SM): < 0.30 dB
- Insertion Loss (MM): < 0.50 dB
- Reflectance (APC): < -65 dB
- Fiber Height: ± 50 nm
- Radius of Curvature (APC): 5 - 12 mm
- Apex Offset: < 50 µm
- Designed for terminating single mode fiber with 125 µm cladding
- Factory-measured attenuation less than 0.5 dB
- Connector attenuation will not change more than 0.2 dB following 1000 matings

9-29.3(2) Electrical Conductors and Cable

9-29.3(2)J Ethernet Cable

Section 9-29.3(2)J is supplemented with the following:

(*****)

All Category 6 (Cat6) cabling shall be suitable for outdoor use with a UV stabilized, lead-free, polyethylene jacket. The cable shall comply with TIA/EIA-568-B.2-1 Category 6. The cabling shall be suitable for horizontal, vertical, and aerial applications. The performance requirements shall be compatible with Gigabit Ethernet.

Cabling shall be 23 AWG, 4-pair unshielded twisted pair conductors. Cabling shall be shielded where cabling is shown on the Plans to be installed in conduit with cabinet power cabling. Cable shall be listed to UL Standard 444. Flammability shall comply to NEC article 800. Cable shall be constructed with water blocking material.

Cable shall, at a minimum, meet IEEE 802.3bt Type 3 ratings.

9-29.6 Light And Signal Standards

Section 9-29.6 is supplemented with the following:

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(January 13, 2021, WSDOT GSP)

Traffic Signal Standards

Traffic signal standards shall be furnished and installed in accordance with the methods and materials noted in the applicable Standard Plans, pre-approved plans, or special design plans.

All welds shall comply with the latest AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals. Welding inspection shall comply with Section 6-03.3(25)A Welding Inspection.

Hardened washers shall be used with all signal arm connecting bolts instead of lockwashers. All signal arm ASTM F 3125 Grade A325 connecting bolts tightening shall comply with Section 6-03.3(33).

Traffic signal standard types, applicable characteristics, and foundation types are as follows:

Type PPB

Pedestrian push button posts shall conform to Standard Plan J-20.10 or to one of the following pre-approved plans:

Fabricator	Pre-Approved Drawing No.
Valmont Ind., Inc.	DB01165 Rev. B (4 sheets)
Ameron Pole Products Division	WA15TR10-1 Rev. C (1 sheet) and WA15TR10-3 Rev. B (1 sheet)
Millerbend Manufacturing, Co.	74514-WA-PED-PPB Rev H (2 sheets)

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Foundations shall be as noted in Standard Plan J-20.10

Type PS, Type I, Type RM, and Type FB

Type PS pedestrian signal standards, Type I vehicle signal standards, Type RM ramp meter signal standards, and Type FB flashing beacon standards shall conform to Standard Plan J-20.16, J-21.15, J-21.16, and J-22.15 respectively, or to one of the following pre-approved plans:

Fabricator	Pre-Approved Drawing No.
Valmont Ind., Inc.	DB01165 Rev. B (4 sheets)
Ameron Pole Products Division	WA15TR10-1 Rev. C (1 sheet) and WA15TR10-2 Rev. C (1 sheet)
Millerbend Manufacturing, Co.	74514-WA-PED-FB Rev. H (2 sheets)
Millerbend Manufacturing Co.	74514-WA-PED-SB Rev. H (2 sheets)

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Foundations shall be as noted in Standard Plan J-21.10.

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Type II

Type II signal standards are single mast arm signal standards with no luminaire arm or extension. Type II standards shall conform to one of the following pre-approved plans. Maximum arm length (in feet) and wind load (XYZ value, in cubic feet) is noted for each manufacturer.

Fabricator	Pre-Approved Drawing No.	Max. Arm Length (ft)	Max. Wind Load (XYZ) (ft ³)
Valmont Ind., Inc.	DB00162 Rev. B (5 sheets)	65	3206
Ameron Pole Products Division	WA15TR3724-1 Rev. C (sheet 1 of 2), and WA15TR3724-2 Rev. D (sheet 2 of 2)	65	2935
Millerbend Manufacturing, Co.	74516-WA-TS-II Rev. H (3 sheets)	65	3697

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Foundations shall be as noted in the Plans and Standard Plan J-26.10. Type II signal standards with two mast arms installed 90 degrees apart may use these pre-approved drawings. Standards with two arms at any other angle are Type SD and require special design.

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Type III

Type III signal standards are single mast arm signal standards with one Type 1 (radial davit type) luminaire arm. The luminaire arm has a maximum length of 16 feet and a mounting height of 30, 35, 40, or 50 feet, as noted in the Plans. Type III standards shall conform to one of the following pre-approved plans. Maximum arm length (in feet) and wind load (XYZ value, in cubic feet) is noted for each manufacturer. Wind load limit includes a luminaire arm up to 16 feet in length.

Fabricator	Pre-Approved Drawing No.	Max. Arm Length (ft)	Max. Wind Load (XYZ) (ft ³)
Valmont Ind., Inc.	DB00162 Rev. B (5 sheets), with Type "J" luminaire arm	65	3259
Ameron Pole Products Division	WA15TR3724-1 Rev. C (sheet 1 of 2), and WA15TR3724-2 Rev. D (sheet 2 of 2), with Series "J" luminaire arm	65	2988
Millerbend Manufacturing, Co.	74516-WA-TS-III Rev. H (4 sheets)	65	3750

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Foundations shall be as noted in the Plans and Standard Plan J-26.10. Type III signal standards with two mast arms installed 90 degrees apart may use these pre-

1 approved drawings. Standards with two arms at any other angle are Type SD and
 2 require special design.

3
 4 **Type IV**

5 Type IV strain pole standards shall be consistent with the Plans and Standard Plan
 6 J-27.15 or one of the following pre-approved plans:

Fabricator	Pre-Approved Drawing No.
Valmont Ind., Inc.	DB01167 Rev. B (2 sheets)
Ameron Pole Products Division	WA15TR15 Rev. A (2 sheets)
Millerbend Manufacturing, Co.	74554-WA-SP-IV Rev. H (2 sheets)

7
 8 Foundations shall be as noted in the Plans and Standard Plan J-27.10.

9
 10 **Type V**

11 Type V strain poles are combination strain pole and light standards, with Type 1
 12 (radial davit type) luminaire arms. Luminaire arms may be up to 16 feet in length,
 13 and a mounting height of 40 or 50 feet, as noted in the Plans. Type V strain poles
 14 shall be consistent with the Plans and Standard Plan J-27.15 or one of the following
 15 pre-approved plans:

Fabricator	Pre-Approved Drawing No.
Valmont Ind., Inc.	DB01167 Rev. B (2 sheets),
Ameron Pole Products Division	WA15TR15 Rev. A (2 sheets)
Millerbend Manufacturing, Co.	74554-WA-SP-V Rev. J (3 sheets)

16
 17 Foundations shall be as noted in the Plans and Standard Plan J-27.10.

18
 19 **Type CCTV**

20 Type CCTV camera pole standards shall conform to Standard Plan J-29.15 or to one
 21 of the following pre-approved plans:

Fabricator	Pre-Approved Drawing No.
Valmont Ind., Inc.	DB01166 Rev. C (4 sheets)
Ameron Pole Products Division	WA15CCTV01 Rev. B (2 sheets)
Millerbend Manufacturing, Co.	74577-WA-LC1 Rev. H (2 sheets)
Millerbend Manufacturing, Co.	74577-WA-LC2 Rev. H (2 sheets)
Millerbend Manufacturing, Co.	74577-WA-LC3 Rev. H (3 sheets)

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1 Foundations shall be as noted in the Plans and Standard Plan J-29.10.

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Type SD

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Type SD signal standards are outside the basic requirements of any pre-defined signal standard and require special design. All special design shall be based on the latest AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and pre-approved plans and as follows:

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1. A 115 mph wind loading shall be used.
2. The Mean Recurrence Interval shall be 1700 years.
3. Fatigue category shall be III.

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Complete calculations for structural design, including anchor bolt details, shall be prepared by a Professional Engineer, licensed under Title 18 RCW, State of Washington, in the branch of Civil or Structural Engineering or by an individual holding valid registration in another state as a civil or structural Engineer.

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All shop drawings and the cover page of all calculation submittals shall carry the Professional Engineer's original signature, date of signature, original seal, registration number, and date of expiration. The cover page shall include the contract number, contract title, and sequential index to calculation page numbers. Two copies of the associated design calculations shall be submitted for approval along with shop drawings.

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Details for handholes and luminaire arm connections are available from the Bridges and Structures Office.

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Foundations for Type SD standards shall be as noted in the Plans.

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9-29.6(5) Foundation Hardware

30

Section 9-29.6(5) is supplemented with the following:

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32

(January 13, 2021, WSDOT GSP)

33

Anchor bolt assemblies for light standards installed on top of barrier (median barrier mount) shall consist of the following:

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- (4) 1-inch diameter threaded rods (bolts), minimum 36 inches in length
- (24) heavy hex nuts, six per anchor rod
- (24) flat washers, six per anchor rod
- Two anchor plates

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Each anchor plate shall be constructed from 1/2" ASTM A36 plate and hot-dip galvanized in accordance with AASHTO M111. Each anchor plate shall be ring shaped, with an outside diameter of 16 inches and an inside diameter of 12 inches. Each anchor plate shall have four 1 1/8" diameter holes on a 13.89" bolt circle, with the holes positioned to match the anchor rod layout shown in the Standard Plans.

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1 Anchor rods shall extend a minimum of five inches and a maximum of six inches
2 above the top of the traffic barrier. The lower anchor plate shall be embedded
3 29 inches below the top of the traffic barrier. Each anchor plate shall be
4 clamped with a heavy hex nut and washer above and below the anchor plate.
5 The lower heavy hex nut for the pole base plate shall be no more than one inch
6 from the top of the traffic barrier.
7

8 **9-29.10 Luminaires**

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10 **9-29.13(1) Conventional Roadway Luminaires**

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12 (*****)

13 **9-29.10(1)B Light Emitting Diode (LED) Conventional Roadway**
14 **Luminaires**

15 Section 9-29.10(1)B is supplemented with the following:

16
17 The LED Conventional Roadway Luminaire shall be as noted on the Plans.
18

19 **9-29.13 Control Cabinet Assemblies**

20 Section 9-29.13 is supplemented with the following:

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22 (*****)

23 **9-29.13(3) Traffic Signal Controller**

24 Section 9-29.13(3) is supplemented with the following:

25
26 **Controller Unit (CMU)**

27
28 **1 General Description**

29 This specification describes the minimum requirements for a traffic controller.
30 The controller shall be configurable to meet, at a minimum, all applicable
31 sections of the referenced NEMA Standards.
32

33 **2 Hardware**

34 **2.1 Required Standards**

35 Siemens M62 control equipment shall be used in this contract.
36 All traffic signal controllers shall be furnished with Siemens
37 SEPAC Version 3.5x local intersection software. Traffic signal
38 controller shall meet the applicable standards as described
39 herein. Equipment supplier shall provide a letter from an
40 independent testing laboratory certifying controller compliance
41 to the standards and specifications referred to in this section.

42 2.1.1 NEMA TS2 Standard.

43 2.1.2 ATC 5.2b Specification

44 **2.2 Configurations**

45 2.2.1 It shall be possible to configure the controller for multiple
46 configurations:

47 2.2.1.1 ATC NEMA Configuration.

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- 2.2.1.2 It shall be possible to configure the controller to comply the NEMA ATC 5.2b specification.
 - 2.2.2 TS-2 Type 2 NEMA Configuration.
It shall be possible to initially setup the controller for a NEMA TS-2 Type 2 configuration without ATC compliance.
 - 2.2.3 The controller shall be suitable for both a direct parallel connection to load switches and detectors and an SDLC port to communicate with NEMA BIUs.
 - 2.2.4 Vendor shall provide a field upgrade kit to easily upgrade a Standard NEMA Configuration to a compliant ATC Configuration.
 - 2.3 Central Processor Unit (CPU) or Engine Board
In addition to NEMA requirements, the CPU shall provide the following:
 - 2.3.1 Linux Operating System with runtime license and Kernel x.y.z.
 - 2.3.2 MPC 8270 microprocessor operating at 266 MHz.
 - 2.3.3 64 Megabytes minimum dynamic random-access memory (DRAM).
 - 2.3.4 512 Megabytes minimum FLASH memory organized as a disk drive.
 - 2.3.5 2 Megabytes minimum static random-access memory (SRAM).
 - 2.3.6 Time of Day (TOD) clock with hours, minutes, seconds, month, year, and automatic day- light savings time adjustment. TOD may be implemented in the CPU via electronic circuitry, operating system software, or a combination.
 - 2.3.7 During power failures, the SRAM and TOD shall be powered by STANDBY voltage from the power supply.
 - 2.4 ATC Communications Module
 - 2.4.1 The ATC Communication module shall be a plug-in type module.
 - 2.4.2 The ATC Communication module shall provide the following communications options:
 - 2.4.2.1 Four built-in USB 2.0 ports.
 - 2.4.2.2 Built-in 10 Base-T Ethernet with four RJ-45 connectors.
 - 2.4.2.3 Built-in 9pin EIA-574 SP8 Port for GPS connection.
 - 2.4.2.4 Built-in 8MB Data key Port.
 - 2.4.2.5 Dedicated normally flashing red 'CPU Active' LED to indicate CPU failure.
 - 2.5 Power Supply
In addition to ATC 5.2b requirements, the Power Supply shall provide the following:

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- 2.5.1 Line Frequency Reference signal shall be generated by a crystal oscillator, which shall synchronize to the 60-Hz VAC incoming power line at 120 and 300 degrees. A continuous square wave signal shall be +5 VDC amplitude, 8.333 mS half-cycle pulse duration, and 50 +/- 1% duty cycle. The Line Frequency Reference shall compensate for missing pulses and line noise during normal operation. The Line Frequency Reference shall continue through 450 mS power interruptions.
 - 2.5.2 STANDBY voltage via supercapacitor for backup power during loss of service voltage shall be provided. Supercapacitor shall have a minimum of 15-farad nominal size. No batteries of any type are allowed.
- 2.6 Keyboard and Display
In addition to ATC 5.2b requirements, Keyboard and Display shall provide the following:
- 2.6.1 Removable by pulling off, installed by pushing on, with retaining screw.
 - 2.6.2 Emulation of terminal per Joint NEMA/AASHTO/ITE ATC Standard
 - 2.6.3 Key quantity and function per Joint NEMA/AASHTO/ITE ATC Standard.
 - 2.6.4 Liquid Crystal Display (LCD) with 16 lines of 40 characters.
 - 2.6.5 LCD contrast adjustment accomplished via the keypad, no contrast knob allowed.
 - 2.6.6 Light-emitting diode backlight for the LCD.
 - 2.6.7 Audible electronic bell.
 - 2.6.8 Connector compatible with C60 of Joint NEMA/AASHTO/ITE ATC Standard, with the addition of +5 VDC supplied by the controller on C60, Pin 1.
 - 2.6.9 Keyboard and display may be removed for cost savings by the Agency.
 - 2.6.10 In order to reduce errors, it shall be possible to view the active status screens simultaneously with other programming menu screens.
 - 2.6.11 It shall be possible to assign a specific menu screen to one of the available function buttons on the keyboard.
 - 2.6.12 The operator shall be able to evoke a context sensitive help screen using a clearly identified HELP button.
 - 2.6.13 For ease of operation for first responders and agency staff, the controller shall provide a clearly identified Auxiliary ON/OFF switch on the keypad.
- 2.7 Communications
In addition to ATC 5.2b requirements, the controller shall provide the following:

- 1 2.7.1 Built-in 10 Base-T Ethernet with five RJ-45 connectors
- 2 on controller front panel.
- 3 2.7.2 Built-in Internet Protocol (IP) address assigned by
- 4 Institute of Electrical and Electronic Engineers (IEEE),
- 5 two unique IP addresses for each controller.
- 6 2.7.3 Built-in 1200 bps Frequency Shift Keying (FSK) modem.
- 7 Modem is optional per Agency specification. Choice of 2
- 8 or 4 wire operation per Agency specification.
- 9 2.7.4 Built-in EIA-232 port for uploading and downloading
- 10 applications software, as well as to update the operating
- 11 system.
- 12 2.7.5 Built-in C60 connector for use with removable Keyboard
- 13 and Display, Personal Computer COM1 or Personal
- 14 Digital Assistant (PDA). C60 protocol per Joint
- 15 NEMA/AASHTO/ITE ATC standard.
- 16 2.7.6 Four built-in USB 2.0 ports on controller front panel.
- 17
- 18 2.8 Enclosure
- 19 In addition to the ATC 5.2b requirements, the controller housing
- 20 shall provide the following:
- 21 2.8.1 One slot with card guides for standard Joint
- 22 NEMA/AASHTO/ITE ATC modems. The mo- dems are
- 23 optional, per Agency specification.
- 24 2.8.2 Polycarbonate construction, except back panel, rear
- 25 mounting tabs and power supply mounting plate shall be
- 26 aluminum for electrical grounding.
- 27 2.8.3 Built-in carrying handle
- 28 2.8.4 Two adjustable front mounting feet, used to raise the
- 29 front cables and vary the display viewing-angle.
- 30

31 (*****)

32 **9-29.13(10)C NEMA Controller Cabinets**

33 Section 9-29.13(10)C is supplemented with the following:

34 **Cabinet Minimum Requirements**

35
36
37 The cabinet shall be completely wired and tested to the 2003 NEMA
38 Traffic Controller Assemblies specification with NTCIP Requirements
39 Version 02.06 (as amended here in). In addition, and at a minimum, the
40 following requirements shall be met:

41
42 City of Kirkland traffic signal cabinet specification shall supersede any
43 applicable parts of the State of Washington, Department of
44 Transportation Standard Specifications and Standard plans. This
45 specification shall apply to all controller cabinet types with noted
46 exceptions.
47

1 All items not covered by these specifications shall conform to State of
2 Washington, Department of Transportation Standard Specifications and
3 Standard Plans. Traffic signal cabinets shall also comply with NEMA
4 specifications where applicable.
5
6 The controller cabinet shall be furnished and installed by the contractor.
7 The controller cabinet shall be equipped with all auxiliary equipment and
8 plug-ins required to operate 8 vehicle phases, 4 pedestrian phases and
9 4 overlap phases (NEMA TS-2, Type 1). Solid state switching devices
10 shall conform to the provisions in Section Solid State Switching Devices,"
11 of these Special Provisions and the following:
12
13 The cabinet manufacturer shall install and wire a 768 Opticom interface
14 panel.
15
16 The cabinet manufacturer shall install and wire the complete cabinet
17 portion of the Polara pushbutton system.
18
19 The cabinet manufacturer shall have pre-approval by the City of Kirkland
20 on any cabinet that they propose to provide to the City. Said pre-
21 approval shall have been obtained no less than 60 days prior to the
22 closing date of the bid.
23
24 All cabinets shall be pre-approved by the City of Kirkland prior to bid
25 letting.
26
27 The cabinet shall be designed for 16 channel operation. Load switch(s)
28 1-8 shall be vehicle phases 1-8; load switch(s) 9-12 shall be pedestrian
29 phases 2, 4, 6, 8; load switch(s) 13-16 shall be overlaps A, B, C & D.
30 These load switch sockets shall be configured in this manor without
31 rewiring the back side of the load-bay. BIU load switch drivers 1-16 shall
32 be wired to appropriate load switch sockets via a terminal block located
33 on the front side of the load bay so as to allow checking voltage inputs
34 to the load switch sockets without dropping the load bay.
35
36 The cabinet shall be wired for up to a minimum of (64) channels of
37 detection, (4) channels of Opticom™ preemption.
38
39 The use of PC boards shall not be allowed except in detector racks,
40 SDLC interface panels or BIU cages.
41
42 The use of plug and play modules shall not be allowed, with the
43 exception of detector rack(s).
44
45 The cabinet shall be wired to provide a 55-pin "A" connector.
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All cabinet 120VAC wires shall be 18AWG or greater, including controller “A” and MMU “A & B” cables.

The complete cabinet assembly with electronics shall undergo complete input/output function testing by the manufacturer before being released to the City of Kirkland. Testing shall be done via service feed to the 120VAC field terminal. Service power shall be routed through the generator bypass switch, UPS inverter before being connected to the power panel so that all service load circuits are tested.

The following additional test shall be required:

1. If the cabinet comes with a UPS system (BBS) and batteries; the entire controller cabinet assembly shall undergo a BBS field test procedure where the cabinet is run off battery power.

The wired cabinet facility shall use the latest technology applicable and shall be 100% compliant with Section 1605 of the American Recovery and Reinvestment Act of 2009, requiring the use of American iron, steel and manufactured goods.

The cabinet assembly shall be completely manufactured in the United States of America.

Cabinet Enclosure

At a minimum, the Stretched P cabinets shall meet the following criteria:

1. It shall have nominal dimensions of 70” high x 44” width x 25.5” depth and meet the footprint dimensions as specified in Section 7.3, table 7-1 of NEMA TS2 standards for a Type P cabinet. The cabinet base shall have continuously welded interior mounting reinforcement plates with the same anchor bolt hole pattern as the footprint dimensions.
2. Shall be fabricated from 5052-H32 0.125-inch thick aluminum.
3. The cabinet shall be double-flanged where it meets the cabinet door.
4. The top of the cabinet shall be sloped 1” towards the rear to facilitate water runoff. And shall bend at a 90° angle at the front of the cabinet. Lesser slope angles are not allowed.
5. The inside of the cabinet shall have (2) separate compartments. The main compartment shall be accessible from the front door and shall house the cabinet load facilities and electronics. The BBS compartment shall be accessible from the side door and shall contain the UPS system batteries. The UPS system inverter and ATS assembly shall be mounted in the BBS compartment but shall be accessible when the front door is open.

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6. The inside of the cabinet shall utilize C channel rails. (3) Welded on the back wall. The outer two are on 34" center. The third is 8.5" on center with the farthest right C channel. There are (4) welded on each side wall on 08" center with 04" between sets. The C channel rails shall on the back wall shall be 48" in length and start 5" from the bottom of the cabinet interior. The C channel rails on the side walls shall be 59" in length and start 5" from the bottom of the cabinet interior. Adjustable rails are not allowed.
 7. The Cabinet shall be supplied with the following finishes; the interior natural mill finish. The exterior natural mill finish.
 8. All external fasteners shall be stainless steel. Pop rivets shall not be allowed on any external surface.
 9. The front door handle shall be 3/4" round stock stainless steel bar. The side door shall use a recessed hexagonal socket in lieu of a door handle. All door handle mechanisms shall be interchangeable and field replaceable.
 10. The front door shall contain (2) flush mount locking recessed compartments. The upper compartment that houses a police door and a lower compartment that houses a generator bypass receptacle. A stiffener plate shall be welded to the inside of the front door to prevent flexing. It shall have a two-position, three-point door stop that accommodates open-angles at 90°, 125°, and 150°. A louvered air entrance located at the bottom of the main door shall satisfy NEMA rod entry test requirements for 3R ventilated enclosures. Bearing rollers shall be applied to ends of door latches to discourage metal-on-metal surfaces from rubbing. The main front door lock assembly shall be positioned so the door handle does not cause interference with the key when opening the door.
 11. The police door compartment shall come with a conventional police lock.
 12. The generator bypass receptacle compartment shall be equipped with a universal lock bracket capable of accepting a Best™ style lock and a Corbin #2 tumbler series lock. The lock shall be a tapered lock using a Best™ style lock or Corbin #2 series core. The door shall have an integrated door slide mechanism that allows the door to be closed and locked after a generator has been connected to the internal receptacle. This compartment is used by maintenance personnel for emergency generator operation in the absence of service power or BBS control.
 13. The side door shall be one piece construction without any recessed compartments. It shall have a three-position, two-point door stop that accommodates open-angles at roughly 80°, 100°, and 120°. A louvered air entrance located at the bottom of the side door shall satisfy NEMA rod entry test requirements for 3R ventilated enclosures. Bearing rollers shall be applied to ends of door latches to discourage metal-on-metal surfaces from

- 1 rubbing. Lock assembly shall be positioned so handle does not
2 cause interference with key when opening the door.
- 3 14. Closed-cell, neoprene gaskets shall be bonded to the inside of
4 the cabinet doors. The gaskets shall cover all areas where the
5 doors contact the double flanged cabinet housing exterior and be
6 thick enough to provide a watertight seal.
- 7 15. A complete set of keys shall be supplied providing access to the
8 cabinet front door, cabinet side door, the police door and the
9 generator receptacle door.
- 10 16. The cabinet shall be equipped with a universal lock brackets
11 capable of accepting a Best™ style lock and a Corbin #2 tumbler
12 series lock. The cabinet shall come equipped with a Best™ style
13 lock and green construction core.
- 14 17. The cabinet shall be supplied with three (3) door switches which
15 control the door and police door open status and the cabinet
16 interior lighting circuits.
- 17 18. All exterior seams shall be manufactured with neatly formed
18 continuously weld construction. The weld for the police box door
19 shall be done on the inside of the cabinet door. All welds shall be
20 free from burrs, cracks, blowholes or other irregularities.
- 21 19. The fan baffle panel seams shall be sealed with RTV sealant or
22 equivalent material on the interior of the cabinet.
- 23 20. The cabinet shall come with lifting ears affixed to the upper
24 exterior of the cabinet. These ears shall utilize only one bolt for
25 easy reorientation. (The cabinet lifting ears shall not be when the
26 batteries installed).
- 27 21. The cabinet shall come with two (2) dual-ply Dustlock™ Media
28 polyester, disposable air filter; and the filter performance shall
29 conform to listed UL 900 Class 2 and conform to MERV-8 &
30 ASHRAE Standard 52.2-1999. The filter element shall be
31 secured to louvered entrance on the main door with a metal filter
32 cover. The filter and metal cover shall be secured to entrance on
33 main door by two (2) horizontally-mounted restraints.
- 34 22. All cabinet doors shall be mounted with a single continuous
35 stainless steel piano hinge that runs the length of the door.
36 Attaching tamper resistant bolts shall also be stainless steel.
- 37 23. The cabinet enclosure shall be a SP+ style Western Systems
38 Part # 3017500000.
- 39 24. The cabinet shall be UL listed
- 40 25. All steel incorporated in the cabinet shell shall be manufactured
41 in the United States of America, and shall meet the requirements
42 of Section 1605 of the American Recovery and Reinvestment Act
43 of 2009.

44
45 **Labels**
46

1 A permanent printed thermo vinyl, engraved or silk screened label shall
2 be provided for all terminals and sockets. Labels shall be legible and
3 shall not be obstructed by cabinet wiring, panels or cables. All labels shall
4 conform to the designations on the cabinet wiring prints.
5

6 **Shelves**
7

8 Shall come with (3) double beveled shelves 10” deep that are reinforced
9 welded with V channel, fabricated from 5052-H32 0.125-inch thick
10 aluminum with double flanged edges rolled front to back. Slotted hole
11 shall be inserted every 7” for the purpose of tying off wire bundles. The
12 BBS compartment shall come with (4) shelves designed to hold batteries
13 and capable of supporting 75lbs each.
14

15 **Cabinet Layout**
16

17 The shelves shall be populated as follows. The controller and monitor
18 shall be placed on the bottom shelf. The power supply and four (4)
19 detector racks shall be placed on the middle shelf. The top shelf shall be
20 left empty for future electronics.
21

22 The roll out drawer shall be mounted under the bottom shelf just left of
23 center.
24

25 Load bay shall be mounted on the back wall with 7” of clearance to the
26 bottom of the cabinet.
27

28 A 12”x10” blank panel for the Polara iNavigator iN2-ICB interconnect
29 board shall be mounted on the lower left wall.
30

31 The detector panel for all field inputs shall be mounted on the left wall
32 above the Polara panel.
33

34 video panel shall be mounted on the left wall above the detector panel
35 One 120VAC quad convenience outlet shall be mounted on the left wall
36 above the top shelf.
37

38 The SDLC and power supply interface panels shall be mounted on the
39 left wall between the middle and bottom shelves.
40

41 The power panel shall be mounted on the lower right wall.
42

43 A 12”x36” blank panel shall be mounted on the right wall above the power
44 panel.
45

46 One 120VAC quad convenience outlet shall be mounted on the right wall
47 above the top shelf.

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The 768 panel shall be mounted on the right wall under the bottom shelf.

Ventilating Fans

The cabinet shall be provided with two (2) finger safe din rail mounted thermostatically controlled (adjustable between 4-176° Fahrenheit) ventilation fan. The fan shall be installed in the top right side of the cabinet plenum. The safe touch thermostat fuse holder and power terminal block(s) shall be din rail mounted on right side of cabinet plenum.

Computer Shelf

A slide-out computer shelf 16” length by 12” width by 2” depth shall be installed below the middle shelf underneath the controller. The shelf shall be mounted just right of center so that controller cables will not interfere with the operation of the shelf when equipment is installed. The shelf shall have a hinged cover that opens from the front and shall be powder-coated black. It shall be a General Devices Part # VC4080-99-1168. The drawer when fully extended shall hold up to 50lbs.

Main Panel Configuration (Load-Bay)

The design of the panel shall conform to NEMA TS2 Section 5, Terminals and Facilities, unless modified herein. This panel shall be the termination point for the controller unit (CU) MSA, (MMU) MSA & B cables, bus interface units 1 & 2 (BIU) and field terminal facilities. The terminal and facilities layout shall be arranged in a manner that allows all equipment in the cabinet and all screw terminals to be readily accessible by maintenance personnel.

The load-bay shall be fully wired and meet the following requirements:

- The load-bay shall have the following dimensions; constructed from aluminum with a nominal thickness of 0.125”, a maximum height of 24” and maximum width of 28.5”. The field terminals width shall be 31.5” including attached wiring bundles.
- The entire assembly shall roll down and provide access to all of the back of panel wiring. All solder terminals shall be accessible when the load-bay is rolled down. The assembly shall be able to roll down without requiring other components, cables or switches to be removed.
- The load-bay shall be designed so that all other cabinet screw terminals are accessible without removing cabinet electronics.

- 1 • All the controller (CU) and malfunction management (MMU)
- 2 cables shall be routed through the back of the load-bay so
- 3 that they will not be subject to damage during load-bay roll
- 4 down.
- 5 • The top of the load-bay panel shall attach directly to “C”
- 6 channel and detach without the use of tools or loose
- 7 hardware for roll down purpose.
- 8 • The load-bay shall be balanced such that it will not roll
- 9 down when the top of the load bay is detached from the “C”
- 10 channel, even when fully loaded with BIUs load switches,
- 11 flasher and flash transfer relays.
- 12 • The load-bay facility shall be wired for 16 channels. Load
- 13 switch(s) 1-8 shall be vehicle phases 1-8; load switch(s) 9-
- 14 12 shall be pedestrian phases 2, 4, 6 & 8; load switches 13-
- 15 16 shall be overlaps A, B, C & D. Load switches 1-8 and
- 16 13-16 shall be routed through a flash transfer relay.
- 17 • (16) Load switch sockets in two rows of (8) spaced on 2”
- 18 center per NEMA TS2 section 5.3.1.2, figure 5-2.
- 19 • (6) Flash transfer relay sockets.
- 20 ○ Flasher socket.
- 21 • All load switches and flasher shall be supported by a
- 22 bracket extending at least ½ the length of the load switch.
- 23 ○ Bus interface unit rack slots for BIU’s 1 and 2. The
- 24 main panel BIU racks shall be left of the load
- 25 switches, placed vertically with BIU 1 on top and
- 26 BIU 2 on bottom.
- 27 • BIU wires connection to the PCB shall be two (2) 34 pin
- 28 connectors. These connectors shall have locking latches.
- 29 • All BIU wiring shall be soldered to backside of a screw
- 30 terminal. The screw terminals provide access to all
- 31 functions of BIUs.
- 32 • Wiring for one Type-16 MMU. All MMU wiring shall be
- 33 soldered to backside of a screw terminal. The screw
- 34 terminals provide access to all functions of the MMU.
- 35 • All 24 VDC relays shall have the same base socket, but it
- 36 shall be different from the 115VAC relays.
- 37 • All 115VAC relays shall have the same base socket, but it
- 38 shall be different from the 24VDC relays. (not applicable to
- 39 flash transfer relays)
- 40 • Shall have a relay that drops +24VDC to load switches
- 41 when the cabinet is in flash.
- 42 • The load bay shall have terminals to access the flash
- 43 circuits 1 and 2.
- 44 • There shall be a wire between the pedestrian yellow field
- 45 terminals and another terminal on the load bay. The MMU

- 1 channel 9-12 yellows shall terminate next to said
 2 pedestrian yellows terminal.
- 3 • The load-bay shall be silkscreened on both sides.
 4 Silkscreen shall be numbers and functions on the front
 5 side, and numbers only on the back side. The back side
 6 shall have labels upside down, so when load bay is rolled
 7 down labels will be right side up.
 - 8 • Field wiring terminations shall be per channel across the
 9 bottom of the load-bay. Each channel shall have 3
 10 terminations corresponding to the appropriate vehicle
 11 phase Green, Yellow and Red. Default wiring shall be left to
 12 right vehicle phases 1-8, pedestrian phases 2, 4, 6, 8 and
 13 overlap channels A, B, C, and D following the order of the
 14 load switches. Field terminals shall be #10 screw terminal
 15 and be rated for 600V.
 - 16 • All cable wires shall be terminated. No tie-off of unused
 17 terminals will be allowed.
 - 18 • Shall be 100% manufactured in the United States of
 19 America.

20
 21 All wiring shall conform to NEMA TS2 Section 5.2.5 and table 5-1.
 22 Conductors shall conform to military specification MIL-W-16878D,
 23 Electrical insulated high heat wire, type B. Conductors #14 or
 24 larger shall be permitted to be UL type THHN. Main panel wiring
 25 shall conform to the following colors and minimum wire sizes:

26		
27	Vehicle green load switch output	14 gauge brown
28		
29	Vehicle yellow load switch output	14 gauge yellow
30		
31	Vehicle red load switch output	14 gauge red
32		
33	Pedestrian Don't Walk switch	14 gauge orange
34		
35	Pedestrian Walk switch	14 gauge blue
36		
37	Pedestrian Clearance load switch	14 gauge yellow
38		
39	Vehicle green load switch input	22 gauge brown
40		
41	Vehicle yellow load switch input	22 gauge yellow
42		
43	Vehicle red load switch input	22 gauge red
44		
45	Pedestrian Don't Walk input	22 gauge orange
46		
47	Pedestrian Walk input	22 gauge blue

**CITY OF KIRKLAND
 FIRE STATION 27 REPLACEMENT
 KIRKLAND, WASHINGTON**

**APPENDIX A –
 PAVEMENT MARKINGS, SIGNING
 TRAFFIC SIGNAL, AND ILLUMINATION
 SYSTEM SPECIFICATIONS**

1		
2	Pedestrian Clearance input	22 gauge yellow
3		
4	Logic Ground	18 gauge white
5		with red tracer
6		
7	+24V DC	18 gauge red with
8		white tracer
9		
10	+12V DC	18 gauge pink
11		
12	AC+ Line	14 gauge black
13		
14	AC- Line	14 gauge white
15		
16	Earth Ground	16 gauge green
17		
18	AC line (load bay)	12/14 gauge black
19		
20	AC neutral (load bay)	12/14 gauge white
21		
22	Controller A cables	22 gauge blue
23		with the exception
24		of power wires
25		(AC+ Black, AC-
26		White & Earth
27		Ground Green)
28		these wires shall
29		be 18AWG
30		
31	MMU A & B cables	22 gauge orange
32		with the exception
33		of power wires
34		(AC+ Black, AC-
35		White & Earth
36		Ground Green
37		Start Delay Relay
38		Common Black,
39		Normally open
40		Black & Normally
41		Closed Black)
42		These wires shall
43		be 18AWG
44		
45	Four conductors will supply alternating current (AC) power to the	
46	load switch sockets. The load switch sockets shall be supplied 1-4,	
47	5-8, 9-12 & 13-16 by each conductor.	

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The vehicle field terminal blocks shall have a screw Type No. 10 post capable of accepting no less than 3 No. 12 AWG wires fitted with spade connectors. Four (4) 12-position terminal blocks shall be provided in a single row across the bottom of the main panel. Spade lugs from internal cabinet wiring are not allowed on field terminal screws. There shall be a second row of four (4) 12-position terminal blocks with screw type #10 above the field terminal blocks. These blocks shall operate the flash program. It shall be changeable from the front of the load bay.

The terminal block above the Pedestrian field blocks shall be tied to the Don't Walks and Walks with orange and blue 14AWG wire. This shall provide termination for pushbutton control wires without utilizing field terminals. There shall also be access to flash circuits 1 and 2.

The power terminal blocks shall have a screw Type No. 10 post capable of accepting no less than 3 No. 12 AWG wires fitted with spade connectors. One (1) 12-position terminal block and one (1) 6-position terminal block shall be provided vertically on the right side of the load bay. The placement of the power terminal block on any other panel shall not be allowed.

All load switches, flasher, and flash transfer relay sockets shall be marked and mounted with screws. Rivets and clip-mounting is unacceptable.

Wire size 16 AWG or smaller at solder joints shall be hooked or looped around the eyelet or terminal block post prior to soldering to ensure circuit integrity. All wires shall have lugs or terminal fittings when not soldered. Lap joint/tack on soldering is not acceptable. All soldered connections shall be made with 60/40 solder and non-corrosive, non-conductive flux. All wiring shall be run neatly and shall use mechanical clamps and conductors shall not be spliced between terminations. Cables shall be sleeved in braided nylon mesh and wires shall not be exposed.

Load-Bay and Panel Wire Termination

All wires terminated behind the main panel or on the back side of other panels shall be SOLDERED. No pressure or solder-less connectors shall be used. Printed circuit boards shall only be used on the load bay where connecting to the bus interface units (BIU).

Cabinet Light Assembly

1 The cabinet shall have two (2) LED lighting fixture with 15 high
2 power LEDs using a cool white color emitting 300lm min @
3 12VDC/750mA. The LED shall be a Rodeo Electronics TS-LED-
4 05M02. The LED fixture shall be powered by a Mean Well class 2
5 power supply LPV-20-12 that shall be mounted on the inside top of
6 the cabinet near the front edge. The cabinet light circuit shall be
7 designed for a second LED fixture to be installed in the cabinet
8 without the need a of a second power supply. It shall be attached
9 under the cabinet drawer so that it remains stationary when drawer
10 is extended. An on/off switch that is turned on when the cabinet
11 door is opened and off when it is closed shall activate the lighting
12 fixture(s) power supply.
13

14 **Convenience Outlet**

15
16 The cabinet shall be wired with one convenience outlet with a
17 ground fault interrupter and two quad convenience outlets without
18 ground fault interrupters. The ground fault outlet shall be mounted
19 on the right side of the cabinet on or near the power panel. The
20 two quad convenience outlets shall be near the top shelf on both
21 the right and left walls. No outlets shall be mounted on the door.
22 The GFI power shall be fed through the auxiliary breaker (CB2).
23 The two quad convenience outlets shall be fed through an EDCO
24 SHP300-10 transient voltage suppressor located on the cabinet
25 power panel.
26

27 **Auxiliary Panel**

28
29 The cabinet shall include an auxiliary switch panel mounted to the
30 interior side of the police panel compartment on the cabinet door.
31 The panel shall be secured to the police panel compartment by (2)
32 screws and shall be hinged at the bottom to allow access to the
33 soldered side of the switches with the use of only a Phillips
34 screwdriver. Both sides of the panel shall be silkscreened. Silk-
35 screening on the backside of the switch panel shall be upside
36 down so that when the panel is opened for maintenance the silk-
37 screening will be right side up. All of the switches shall be
38 protected by a hinged see-through Plexiglas cover.
39

40 At a minimum the following switches shall be included;

41
42 Controller ON/OFF Switch: There shall be a switch that
43 renders the controller and load-switching devices electrically
44 dead while maintaining flashing operations for purpose of
45 changing the controller or load-switching devices. The switch
46 shall be a general-purpose bat style toggle switch with .688-
47 inch long bat.

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Stop Time Switch: There shall be a 3-position switch labeled “Normal” (up), “Off” (center), and “On” (down). With the switch in the “Normal” position, a stop timing command shall be applied to the controller by the police flash switch or the MMU (Malfunction Management Unit). When the switch is in its “Off” position, stop timing commands shall be removed from the controller. The “On” position shall cause the controller to stop time. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Technician Flash Switch: There shall be a switch that places the field signal displays in flashing operation while the controller continues to operate. This flash shall have no effect on the operation of the controller or MMU. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Vehicle Test Switches: All eight vehicle phase inputs shall have momentary pushbutton test switches with black caps. The switches shall directly input a call to the related controller vehicle phase without routing the call through the detector rack(s) when pushed. These switches shall be labeled 1, 2, 3, 4, 5, 6, 7 and 8.

Pedestrian Test Switches: All eight pedestrian phase inputs shall have momentary pushbutton test switches with black caps. The switches shall directly input a call to the related controller pedestrian phase. These switches shall be labeled 1, 2, 3, 4, 5, 6, 7 and 8.

Pre-Empt Test Switches: All four preempt inputs shall have disconnect/test switches. These switches shall have 3 positions labeled “On” (up) which shall connect the Opticom output to the controller, “Off” (center) which shall disconnect the Opticom output to the controller, and “Test” (down) which shall provide a momentary true input to the controller. These switches shall be labeled 1, 2, 3, 4.

Police Panel

Behind the police door the following switches included;

Flash Switch: There shall be a switch for the police that puts the cabinet into flashing operations. The switch shall have two positions, “Auto” (up) and “Flash” (down). The “Auto” position shall allow normal signal operation. The “Flash” position shall

1 immediately cause all signal displays to flash as programmed
2 for emergency flash and apply stop time to the controller.
3 When the police flash switch is returned to “Auto”, the
4 controller shall restart except when the MMU has commanded
5 flash operation. The effect shall be to disable the police panel
6 switch when the MMU has detected a malfunction and all
7 controller and MMU indications shall be available to the
8 technician regardless of the position of the police flash switch.
9 The switch shall be a general-purpose bat style toggle switch
10 with .688-inch long bat.

11

12 **Cables**

13

14 All wire cable bundles shall be encased in flex or expandable
15 braided sleeving along their entire free length.

16

17 All SDLC cables shall be terminated on both ends, securely
18 terminated to the SDLC interface panel with screw type connection
19 and professionally routed in the cabinet interior to easily reach the
20 load bay, controller, malfunction management unit and detector
21 racks. All SDLC connectors shall be fully populated with 15 pins
22 each.

23

24 **Flashing Operation**

25

26 All cabinets shall be wired to flash for all vehicle channels.
27 Flashing operation shall alternate between the used vehicle
28 phases 1, 4, 5, 8, OLA, OLD and 2, 4, 6, 8, OLB, OLD. Flash
29 programming shall be either red, yellow or no flash simply by
30 changing wires on the front of the load-bay.

31

32

33 **Detector Racks**

34

35 At a minimum, the cabinet shall be wired to accommodate (64)
36 channels of detection. One detector rack shall be half width size
37 and support (16) channels of loop detection, one (1) Buss Interface
38 Unit (BIU) and (4) channel of Opticom™. Three detector racks
39 shall be half width size and support (16) channels of loop detection
40 and one (1) Buss Interface Unit (BIU). These racks shall be
41 capable of using half width four channel detection devices. The
42 loop cabling shall be connected via a 37 pin DB connector using
43 spring clips. The Opticom cable shall be connected via a 24 pin
44 connector using locking latches. The power cable shall be a 6 pin
45 connector. All power wires shall be 18AWG. The addressing of
46 detector racks shall be accomplished via dipswitches mounted to
47 the PCB. There shall be the capability to turn off the TS2 status to
the BIU for the uses of TS1 detector equipment via dipswitches

1 mounted to the PCB. There shall be a 34 pin connector using
2 locking latches that breaks the output from the detector to the input
3 of the BIU, there shall also be +24VDC and logic ground on this
4 connector. All racks shall have space at the bottom front for
5 labeling. All racks shall be designed for horizontal stacking.
6 Separate racks for detection and preemption are not allowed.
7

8 **768 Panel**

9
10 There shall be an Opticom™ GTT 768 interface panel installed in
11 the cabinet. At a minimum it shall be soldered to the load switch
12 green outputs and to the advanced vehicle preemption terminal
13 block on the detector panel. This panel shall have a protective
14 plastic cover. It shall be mounted on the lower right wall of the
15 cabinet, under the bottom shelf.
16

17 **Detection Panel**

18
19 The detection panel shall support (64) channels of vehicle
20 detection, (4) channels of emergency vehicle preemption, (8)
21 channels of pedestrian detection and (8) pedestrian returns on a
22 single panel. The loop wires shall be a 22AWG twisted pair, color
23 coded as follows. Channel one brown, channel two red, channel
24 three orange and channel four yellow. One of the twisted pair wires
25 of all colors shall have a white tracer and land on the second
26 position terminal of each loop. The emergency preempt wires shall
27 be color coded as follows. +24VDC orange, preempt inputs yellow
28 and ground blue. This panel will be mounted on the left side of the
29 cabinet below the bottom shelf. The panel shall also include a (19)
30 position solid aluminum, tin plated neutral and ground buss bars
31 with raised slotted & torque style screws heads. They shall be
32 mounted vertically at the bottom of the panel.
33

34 **Power Supply Interface Panel**

35
36 The power supply interface panel shall include terminations for all
37 the cabinet power supply inputs and outputs. It shall have a
38 protective plastic cover. This panel shall be mounted on the left
39 wall of the cabinet.
40

41 **Generator Bypass Compartment and Cable**

42
43 The cabinet front door shall have a locking generator bypass
44 compartment that shall be used to connect a generator to operate
45 the cabinet during extended loss of service line power. The
46 generator compartment shall be capable of being closed and
47 locked while a generator is connected. The mechanism for

1 allowing generator cable access, while the compartment is closed,
2 shall be an integral part of the generator bypass door, via a sliding
3 panel that will normally be in the closed position. Inside the
4 compartment there shall be a silkscreened panel housing a
5 Hubbell HBL2615 30A / 125V flanged inlet receptacle capable of
6 accepting a standard 30 amp generator plug, a BACO HC52DQG
7 cam switch with split 120VAC line and neutral feeds. The switch
8 shall be a break before make type. (2) LED lamps with sockets.
9 One LED shall be illuminated when the cabinet has service line
10 power available and the other when the cabinet has generator
11 power available. All LED's shall be field replaceable without putting
12 the intersection in flash and shall carry a 5-year manufacturer
13 warranty.

14
15 All wiring to and from the generator bypass compartment shall be
16 contained in a single cable bundle. The cable shall connect to the
17 backside of the electrical components and shall only be accessible
18 from the inside of the cabinet front door. All electrical components
19 on the inside of the front door that carry AC voltage shall be
20 covered by a see-through plexi-glass cover. The generator bypass
21 cable shall terminate at the same power panel location as service
22 line voltage.

23
24 **Additional Panels**

25
26 Sheet metal panels shall be installed in the available space on the
27 lower left and upper right & left sides of the cabinet. The lower left
28 side panel shall be 10" x 12". The upper right side panel shall be
29 36" x 12". The upper left side shall be as determined by City of
30 Kirkland.

31
32 **Supplemental Loads**

33
34 Vehicle phase 1, 3, 5, 7, 13, 14, 15 and 16 yellows and greens
35 shall be loaded with a 2K-ohm, 10-watt resistor. Pedestrian
36 phases 2, 4, 6 and 8 don't walks and walks shall be loaded with a
37 2K-ohm, 10-watt resistor. Each load resistor shall be soldered to
38 the backside of the load switch socket and easily accessed from
39 the back of the main panel (load-bay).

40
41 **Service Surge Suppression**

42
43 The cabinet shall be equipped with an EDCO model SHP300-10 or
44 approved equivalent surge arrestor mounted on the power panel.
45 Power to all cabinet electronic equipment and convenience outlets
46 shall come through this surge suppression circuit.
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Power Panel

The power panel shall handle all the power distribution and protection for the cabinet and shall be mounted in the bottom right side of the facility. All equipment shall be mounted on a 12" x 17" silkscreened aluminum panel and include at a minimum the following equipment:

- A 30-amp main breaker shall be supplied. This breaker shall supply power to the controller, MMU, signals, cabinet power supply, detector racks and auxiliary panels.
- A 15-amp auxiliary breaker shall supply power to the fan, light and GFI.
- A 15-amp auxiliary breaker wired for future use.
- A 60-amp, 125 VAC radio interference line filter.
- An EDCO model SHP300-10 surge arrestor.
- A normally open, 50-amp, solid-state relay. The relay shall have a green LED light that is on when energized. (No Mercury Contactors shall be allowed)
- One see-through Plexiglas cover on stand-offs to protect maintenance personnel from AC line voltages. This shall be removable by loosening screws but without removing screws.
- Two (19) position solid aluminum, tin plated neutral buss bar with raised slotted & torque style screw heads. No tube bars shall be allowed.
- One (19) position solid aluminum, tin plated ground buss bar with raised slotted & torque style screw heads. No tube bars shall be allowed.
- Two MOVs shall be terminated on the 120AC in field terminal. One tied between line and ground, the other between neutral and ground.

Manuals & Documentation

The cabinet shall be furnished with (3) complete sets of cabinet prints. All cabinet wiring, and layout shall come on (1) E1 size sheet, multiple pages shall not be allowed. Upon request (1) CDROM with AutoCAD v2008 cabinet drawing for the cabinet wiring.

Malfunction Management Unit (MMU)

The cabinet shall come with a (MMU) that meets all the requirements of NEMA TS2-2003 while remaining downward compatible with NEMA TS1. It shall have (2) high contrast LCD displays and an internal diagnostic wizard. It shall come with a

1 10/100 ethernet port. It shall come with software to run flashing
2 yellow arrow operation. The MMU shall be an Eberle Design, Inc.
3 model MMU-16LEip.
4
5 **Load Switch**
6
7 The cabinet shall come with (16) load switches. All load switches
8 shall be cube type and have LED indications for both the input and
9 output side of the load. The load switches shall be PDC model
10 SSS87 I/O.
11
12 **Flasher**
13
14 The cabinet shall come with (1) flasher. The flasher shall be cube
15 type and have LED indications. The flasher shall be PDC model
16 SSF87.
17
18 **Flasher Transfer Relay**
19
20 The cabinet shall come with (6) heavy duty flash transfer relays.
21 The relays shall be Detrol Controls model 295.
22
23 **Bus Interface Unit (BIU)**
24
25 The cabinet shall come with (6) bus interface units (BIU). These
26 shall meet all the requirements of NEMA TS-2 1998 standards. In
27 addition, all BIUs shall provide separate front panel indicator LED's
28 for DC power status and SDLC Port 1 transmit and receive status.
29 The BIU's shall utilize only 1 rack position. The (BIU)'s shall be
30 Eberle Design, Inc. model BIU700H.
31
32 **Power Supply (PS)**
33
34 The cabinet shall come with a shelf mounted cabinet power supply
35 meeting at minimum TS 2-2003 standards. It shall be a heavy duty
36 device that provides +12VDC at 5 Amps / +24VDC at 2 Amps /
37 12VAC at .25 Amp, and line frequency reference at 50 mA. The
38 power supply shall provide a separate front panel indicator LED for
39 each of the four outputs. Front panel banana jack test points for
40 24VDC and logic ground shall also be provided. The power supply
41 shall provide 5A of power and be able to cover the load of four (4)
42 complete detector racks. The (PS) shall be Eberle Design, Inc.
43 model PS250.
44
45 **Loop Detector**
46

1 The cabinet shall come with (16) 4-channel rack mounted loop
2 detectors. These devices shall have LCD displays and be capable
3 of monitoring the call strength from (2) of the channels
4 simultaneously. These devices must have the capability to perform
5 directional logic and 3rd car queuing for protected/permissive
6 operation. Each 4 channel loop amplifier card shall utilize only (1)
7 card rack position. The loop detectors shall be Reno A&E model
8 E/2-1200-SS.

9
10 **Opticom**

11
12 The cabinet shall come with (1) 4-channel rack mounted
13 Opticom™ phase selector. These devices shall be capable of
14 receiving encoded signals from Opticom series 700 emitters and
15 detectors. The Opticom™ phase selectors shall be Global Traffic
16 Technologies model 764 or approved equivalent. (1) Opticom™
17 768 auxiliary interface panels shall be supplied for each Opticom™
18 phase selector supplied.

19
20 **BBS System**

21
22 The cabinet shall come with a complete uninterruptable power
23 system (BBS) which shall include at a minimum a UPS module
24 with SNMP, ATS assembly, batteries, battery heater mats, battery
25 cables and a battery management system. All other ancillary
26 equipment for a complete functioning UPS system shall be
27 included.

28
29 The key BBS system components include:

30
31 **UPS Module**

32
33 The cabinet shall come with (1) FXM 1100W uninterruptible
34 power supply that supplies clean reliable power control and
35 management. It shall have Automatic Voltage Regulation
36 (AVR), an Ethernet SNMP interface and a control and power
37 connection panel that is rotatable for viewing in any vertical or
38 horizontal orientation. It shall have nominal dimensions of
39 5.22" x 15.5" x 8.75" and come with mounting brackets. The
40 UPS module shall be an Alpha model 017-201-23.

41
42 **UATS/UGTS Assembly**

43
44 The cabinet shall come with (1) universal automatic transfer
45 switch and universal generator transfer switch connected
46 between the UPS module and the batteries. It shall have surge
47 protection, have dimensions of 3.25" x 15.5" x 6.00" and come

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with mounting brackets. The ATS module shall be an Alpha model 020-168-25.

UPS Batteries

The cabinet shall come with (4) high performance silver alloy sealed valve regulated lead acid AlphaCell™ GXL Gel Cell batteries with 109Ah runtime. The BBS batteries shall be Alpha model 220GOLD-HP.

UPS Battery Harness

The cabinet shall come with (1) battery cable (10) foot long wired for (4) batteries. The battery harness shall be Alpha model 740-628-27.

Battery Management System

The cabinet shall come with AlphaGuard™ battery charge management system and Remote Battery Management System which extends and monitors the battery operational life. It shall be an AlphaGuard model 012-306-21 and Remote Battery Management System 0370260-001.

(*****)

9-29.18 Vehicle Detector

Section 9-29.18 is supplemented with the following:

Video Detection

The Video Detection System shall be Iteris Vantage Next and associated central control unit. The Video Detection System and the Hybrid Radar/Video Detection System shall utilize the same central control unit.

Hybrid Radar/Video Detection

The Hybrid Radar/Video Detection System shall be Iteris Vantage Vector Hybrid and associated central control unit. The Video Detection System and the Hybrid Radar/Video Detection System shall utilize the same central control unit.

Warranty

The supplier shall provide a limited three-year warranty on the detection system.

During the warranty period, technical support shall be available from the supplier via telephone within 4 hours of the time a call is made by a user, and this support shall be available from factory-certified personnel or factory-certified installers.

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During the warranty period, updates to detection software shall be available from the supplier without charge.

Maintenance and Support

The supplier shall maintain an adequate inventory of parts to support maintenance and repair of the detection system. These parts shall be available for delivery within 30 days of placement of an acceptable order at the supplier's then current pricing and terms of sale for said parts.

The supplier shall maintain an ongoing program of technical support for the detection system. This technical support shall be available via telephone, or via personnel sent to the installation site upon placement of an acceptable order at the supplier's then current pricing and terms of sale for on site technical support services.

Installation or training support shall be provided by a factory-authorized representative and shall be a minimum IMSA-Level II Traffic Signal Technician certified.

All product documentation shall be written in the English language.

4-Channel Loop Detector

The induction loop detectors shall be Reno A&E 4-channel loop detectors, model E/2-1200-SS.

Manufacturer:

Reno A&E
4655 Aircenter Circle
Reno, NV. 89502
Tel: (775) 826-2020
www.renoae.com

9-29.19 Pedestrian Push Buttons

Section 9-29.19 is supplemented with the following:

(*****)

Accessible Pedestrian Signal (APS) Pushbuttons

When required in the Contract, APS Pushbuttons shall be provided. Each accessible pedestrian signal (APS) shall be a complete APS pushbutton system at each pedestrian pushbutton location shown in the Plans. Equipment shall be the following system:

1. Polara Engineering: iNavigator 2-Wire (iNS2); Part Number: iNS29VN1

Each pushbutton station shall include the following:

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1. Flat black colored housing.
2. High contrast pushbutton arrow (dark on a light background or light on a dark background). White on silver or silver on white are not acceptable as high contrast.
3. Integral 9" x 12" R10-3 Sign. Braille shall not be included. Adaptor plates shall be included if required to accommodate the sign.
4. Appropriate controller module equipped in the traffic signal controller cabinet:
 - a. Polara: iCCU-S2 SDLCCP Shelf Mount Control Unit
5. Percussive tone / rapid tick walk indication.
6. Voice messages, as specified below, pre-installed. Voice shall be male.

The following shall be provided at each intersection:

1. One USB flash drive with copies of all voice message audio files for that intersection, placed in the traffic signal cabinet drawer or drawing envelope. A separate flash drive is required for each intersection.
2. One USB cable of the appropriate type (A to A, A to B, male/female, etc.), placed in the traffic signal cabinet drawer or drawing envelope.

Provide one Polara iNavigator iN-DGL Bluetooth Dongle for the entire Contract.

Dual button adaptor brackets are required for all installations with two APS pushbuttons on the same Type PPB, Type PS, or Type I Signal Standard. Where dual button adaptor brackets or extension brackets are required, they shall be obtained from the same manufacturer as the pushbutton station. Brackets and extensions from other manufacturers shall not be used.

APS Speech Messages

Speech messages shall be provided in the following format:

- "Wait."
- "Wait to cross ___ (A) ___ at ___ (B) ___."
- "Walk sign is on to cross ___ (A) ___."

The following table lists the entries for (A) and (B) above, as well as quantities for button and arrow orientations:

PPB	(A)	(B)	Quantity	Arrow Orientation
28	121st Ave NE	NE 132nd St	1	Right
29	121st Ave NE	NE 132nd St	1	Left
48	NE 132nd St	121st Ave NE	1	Right
49	NE 132nd St	121st Ave NE	1	Left
68	121st Ave NE	NE 132nd St	1	Right
69	121st Ave NE	NE 132nd St	1	Left
88	NE 132nd St	121st Ave NE	1	Right
89	NE 132nd St	121st Ave NE	1	Left

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Order forms shall be completed by the Contractor using the information presented above.

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9-29.24 Service Cabinets

Section 9-29.24 is supplemented with the following:

New contractor furnished service cabinet shall meet the requirements of Kirkland Pre-Approved Plans CK-TS-05A through C. The cabinet shall be a Skyline Electric & Mfg. Company Series #62460 or approved equivalent.

(*****)

Add the following new section:

9-29.26 CCTV Camera Equipment

Television Camera Assembly

The CCTV camera shall consist of Siquira PD910 system equipment, software and mounting components.

The following CCTV camera components shall be manufactured by Siquira:

1. CCTV Camera Equipment:

Siquira PD910 CCTV Camera (Part Number: 6399989965)

61W PoE Injector (Part Number: 6399991001)

The following CCTV camera mounting equipment shall be manufactured by Western Systems:

1. CCTV Camera Mounting Equipment:

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Mast Arm Camera Mount Adapter Channel for TKH Gooseneck Mount
(Part Number: 6349000505)

Luminaire Arm “L” Mount with Base (Part Number: 6349000000)

Adapter 2” x 1.5” Galv. Threaded Pipe Adapter for TKH Camera Mount
(Part Number: 6349000520)

Adjustable Bracket to level Out Camera on Mast Arm (Part Number:
6349000490)

The Contractor shall submit catalog cuts with the Request for Approval of Material
prior to ordering this material for review and approval by the Project Engineer.

CCTV System Cabling

Cable connections between the camera control cabinet and the traffic signal cabinet
shall be provided per the manufacturer’s recommendation to support the Siqura
PD910 model provided.

(*****)

Add the following new section:

9-29.27 Detectable Pull Tape

The Contractor shall furnish and install a flat polyester woven pre-lubed tape that
contains a 22-gauge wire. The tape will be marked with sequential footage markings
and be continuous. The tape shall meet or exceed a breaking strength of 900 lb.,
with a width of 1/2 inch.

(*****)

Add the following new section:

9-29.28 Video and Data Transmission and Distribution

If any equipment specified in this section has been superseded by a newer product
that is interchangeable, the newer product shall be supplied. If the product is no
longer available and has no replacement, the Contractor shall propose a different
product meeting the same performance and material specifications as the
discontinued one.

The following data distribution equipment shall be by Cisco Systems, Inc.

1. Equipment Model Numbers:

Ethernet Switch	IE-3000-8TC
Power Supply	PWR-IE3000-AC

2. Manufacturer:

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Cisco Systems Inc.
170 West Tasman Dr.
San Jose, CA 95134
Telephone: 1 (800) 553-6387

END OF DIVISION 9