CITY OF KIRKLAND
Fire Station 24
CIP NO. PSC 3002 200
JOB NO. 32-20-PW
9824 NE 132nd ST, Kirkland WA 98034

PROJECT MANUAL
Volume 2 (Divisions 09-34)

July 21, 2020

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END OF SECTION

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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

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 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 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."

1.5 SUBMITTALS

A. Submit under provisions of Section 01 3300

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B. Product Data: For each type of product listed in Part 2 of this section. Provide performance information as required.

C. LEED Submittals:

1. Product Data for Credit MR 4.1 **and Credit MR 4.2**: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

2. Product Certificates for Credit MR 5.1 **and Credit MR 5.2**: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

3. Product Certificates for Credit MR 5.1 **and Credit MR 5.2**: For products and materials required to comply with requirements for regionally manufactured **and regionally extracted and manufactured** materials. Include statement indicating cost for each regionally manufactured material.

a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.

b. Include statement indicating location of manufacturer and point of extraction, harvest, or recovery for each raw material used in regionally extracted and manufactured materials. Indicate distance to Project and fraction by weight of each regionally manufactured material that is regionally extracted.

4. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, documentation including printed statement of VOC content.

D. 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.

1.6 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.

1.7 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.

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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. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 11% percent.

B. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

C. Regional Materials: Gypsum panel products shall be manufactured within 500 miles (800 km) of Project site.

D. 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**

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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.

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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 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. Recycled Content of Blankets: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <**Insert number**> percent.

D. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

E. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

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2.8 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.

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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:

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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.

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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 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.

3.8 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.

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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

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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: 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 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 REFERENCES

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

1.5 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."

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C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

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, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
3. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.

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.

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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.

L. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for subtrates and for preparation by other trades.

M. Delivery, Storage, and Handling:

1. 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.
2. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
3. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
4. Store liquid materials in unopened containers and protected from freezing.

1.7 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.

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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 GENERAL

A. Or equal products shall meet the salient characteristics identified herein for that product.

2.3 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.

2.4 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 equal.

B. Ceramic Tile Type (CT-01): Glazed wall tile

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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) 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-butted square corners. For coved 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: ¼" (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) 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

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b) Profile Height: As required to coordinate with tile selection and tile setting system selected
c) Profile Length: As required

3) Basis of Design: Schluter – SHOWERPROFILE-R
a) Description: Two-part profile with an adjustable brushed stainless steel exposed surface for transition between the tiled floors and the linear drain.
b) Profile Height: As required
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) 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-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.5 THRESHOLD

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

1. Schluter Systems, LP
2. 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.

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2.6 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

1. Description: 4/53" (4 mm) thick shelf for installation with tile on walls surfaces
2. Configuration and Size: 8 ¼" (210 mm) by 8 ¼" (210 mm) triangle
3. Design: Curve
4. Material and Finish: EB- Brushed Stainless Steel Type 304 = V2A

2.7 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. Approved Equal

2. Thickness: 5/8 inch (15.9 mm)

2.8 WATERPROOFING MEMBRANE

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

1. Schluter Systems, LP
2. Approved Equal

B. Basis of Design: Schluter-KERDI

1. Description: 0.008" (8mil) this, orange polyurethane membrane with polypropylene flee 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

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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.

2.9 PREFABRICATED SHOWER COMPONENTS

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

1. Schluter Systems, LP
2. 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/m#0 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 Nation Standard Specification for load bearing, bonded, waterproof membranes for thin-et 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.

2.10 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 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.

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2.11 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 equal.

2.12 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.

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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. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

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F. 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.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Porcelain Tile: 1/4 inch (6.4 mm).

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

I. 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.

J. 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.

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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

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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 Allow- 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.

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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 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.

1.6 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. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
3. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.
4. Laboratory Test Reports for Credit EQ 4: 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.

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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.

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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 ¾ 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.

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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.

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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. 1. Design: FSorb

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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 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.

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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 access of 2,500 sq. ft..

2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING & PANALIZED 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

2.7 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.

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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.

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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.

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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.

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END OF SECTION

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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 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. 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. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Product Data: For chemical-bonding compounds, indicating VOC content.
5. Laboratory Test Reports: For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.

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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.

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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:

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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.

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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.

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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

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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 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. 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:

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a. For adhesives, indicating compliance with requirements for low-emitting materials.
b. For chemical-bonding compounds, indicating compliance with requirements for low-emitting materials.
c. For sealants, indicating compliance with requirements for low-emitting materials.
d. For flooring products, indicating compliance with requirements for low-emitting materials.

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 W/cm2

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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 ΔIIC*

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).

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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. Multipupose Sports flooring tiles

B. Vulcanized Rubber, Non-porous surface, 3/8-inch Thick, Interlocking edges, 27"x27" tiles .

C. Color: 936 DUSK.

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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.

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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 insturctions

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

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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 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Product Data: For each type of product specified.

C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of units showing the full range of colors.

D. 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.

E. Manufacturer and Installer Qualification data: Provide certificates of qualifications and references of completed work of similar size and complexity.

F. Maintenance Data: For fabric-reinforced resinous wall coating system to include installation instructions. Include procedures for stain removal, repairing surfaces and cleaning.

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1.4 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.

F. 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. 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. The mock-up shall include the butt fabric seam joint condition and demonstrate the final appearance of the wall coating at seamless joints. This mock-up shall serve as a job standard for the final installation.

1.5 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

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1. The Applicator shall be provided with adequate disposal facilities for non-hazardous waste generated during installation of the system.

1.6 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.

1.7 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.

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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. 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.

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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 09 85 10

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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.

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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 Fabrications"

3. Division 7 Section “Metal Roof Panels”
4. Division 7 Section “Exterior Siding and Trim”
5. Division 7 Section “Sheet Metal Flashing and Trim”
6. Division 8 Section "Hollow Metal Doors and Frames".

7. Division 8 Section "Access doors and Panels".
8. Division 8 Section "Sectional Overhead Doors" for prefinished interior finish and prepared exterior surface for site finishing.

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.

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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 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. 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.

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.

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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.

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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)

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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.

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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

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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.

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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.

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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.

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.

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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.

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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.

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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

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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.

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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**.

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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.

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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

END OF SECTION

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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 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. 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.

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3. Product data for Credit MR 4: 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.

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.

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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 4 total; 1 each at location (room 102, 108, 121, 130 and 131)
2. Provide at shower locations: B-5806 x48 and B-5806x24; 1 at each location (room 130 and 131)

2.4 TOILET PAPER DISPENSERS

A. Surface Mounted, Double Roll Toilet Paper Dispenser: Bobrick B-2740 (Provide 7 – one each at rooms, 102, 108, 121, 130, 131, 132 and 133)

2.5 SOAP DISPENSER (OFCI)

A. Manufacturer: TBD

B. Coordinate location and provide blocking for 13 locations

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2.6 PAPER TOWEL DISPENSER (OFCI)

A. Manufacturer: TBD

B. Coordinate location and provide blocking for 14 locations

2.7 TOILET SEAT COVER DISPENSER

A. Recessed Seat Cover Dispenser: Bobrick B-301. (Provide three - one each at rooms 102, 108 and 121

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, (4) locations. (rooms 130, 131, 132 and 133)

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, (4) locations. (rooms 130, 131, 132 and 133)

C. Shower Curtain Rod: B-6107x36, Provide 1 at each shower, (4) locations. (rooms 130, 131, 132 and 133)

2.10 MISCELLANEOUS ACCESSORIES

A. Rob Hooks: Bobrick B-6727 (Provide 8 total; 2 at rooms 130, 131, 132 and 133)

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

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B. Quantity: 4

C. Coordinate location and provide blocking

2.12 MOP/ BROOM HOLDER: (OFCI)

A. Manufacturer: TBD

B. Coordinate location and provide blocking

2.13 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 at each rooms 102, 108 and 121

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.

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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

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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 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. 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:

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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.

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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.

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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.

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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

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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 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 8113 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

1.5 SUBMITTALS

A. Product Data: For flagpole required. 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:

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1. Comply with requirements of Section 01 81 13
2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. 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.

D. Shop drawings of flagpole and base, showing general layout, jointing, grounding method and anchoring and support systems, if not covered in product data.

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

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

1.6 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.

1.7 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.

1.8 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

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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 and 35'-0" height exposed above grade.
3. 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.

2.3 FITTINGS

A. Beacon to match material and finish of pole, to house Integral flagpole light fixture and external halyard fittings.

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

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2. Quantity: 1

2.4 FLAGPOLE LIGHT

A. Down-light fixture and beacon combination.

1. 6 watt LED lamps
   a. Volt: 12
2. 25,000 hour rated.
3. White color light.
4. Revolve 359 degrees.
5. Dual Primary 115/230 VAC transformer with direct buried waterproof enclosure.
6. 50 feet, 18/3 electrical wire.

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 (Mechnical 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.

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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

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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 Mounted Wire Shelving Units – Fixed and 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. Corner Guards
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 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. 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

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2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

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: “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” 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: 28 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:

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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 structure: 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: ½" 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:

b. (1) 4'-0" unit at rooms wash alcove 116

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.

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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 Shelf Wall Kit; (2) shelves, 36-inches wide by 12-inches deep, Chrome Finish. Include shelf supports and mounting brackets. (1) set at Delivery 143, (1) set at Decon 145 and (1) set at Wash Alcove 149, (1) set at Wash alcove – BC Bay 124, (1) set at 006 Wash Alcove – see int. elev.
2. Erecta Adjustable Metal Wall Shelving; (4) 42” wide shelves – 7’-0” total shelving width per row, (2) rows high, (4) 55” mounting posts with intermediate post support, 12 inches deep, Chrome Finish. (1) complete adjustable system at Shop 114 – see int. elev.
3. Provide mounting fasteners into solid wood wall blocking and framing.

2.5 METAL STORAGE SHELVING

A. Basis of Design: Global Industrial Extra Heavy-Duty Shelving

B. Heavy Duty, steel, open shelving with (6) steel shelves or (3) steel shelves (including bottom and top shelves)

C. Welded box shape with lapped and welded corners for rigidity

D. Size: As shown in drawings.

1. 48”W x 18”D x 84”H.; (10) at room 112
2. 48”W x 18”D x 39”H, (3) at room 114

E. Finish: Powder coated, as selected from manufacturer’s standard colors.

F. Delegated Design to provide code required seismic attachments.

1. Provide (Washington State Licensed) Engineering and permitting

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: 1 at shop 114

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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: 2 at shop 114

2.8 BIKE HOOKS

A. Basis of Design: Huntco; “The Bantam Wall Mount Bike Rack” or Approved Equal

1. Materials
   a. Mild Steel, 3/16” Plate Steel Backer
   b. Mild Steel, 3/8”” Solid Round Steel Rod
   c. Vinyl Coated Security Cable

B. Finishes

1. Thermoplastic Coating (TGIC),
   a. Colors: Black Light Texture

C. Capacity: 1

D. Mounting: Wall Mount.

E. Quantity: 4

2.9 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

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2.10 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 103 and Office 104

2.11 WHITEBOARD (OFCI)

A. Manufacturer:

1. Clairidge

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.

2.12 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

2.13 CORNER GUARDS

A. Manufacturer - Arden Architectural Specialties, Inc. or approved equal.

1. 2”x2”x 48” 16 gauge, satin finish stainless corner guards with eased edge. Arden Architectural Specialties, Inc. or approved equal.
    a. Adhesive mount to corners.
    b. All locations unless noted otherwise
    c. Quantity: (24) Verify with floor plans

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2.14

2.15 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.

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.

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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

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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 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 8113 for Low-emitting Materials, Regional Materials and Recycled Content submittal requirements.

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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 ZES1227FLFS
2. Color: Stainless Steel trim
3. Quantity: 1

2.3 REFRIGERATORS

A. Manufacturer: ELECTROLUX

1. Model # & Type: ELECTROLUX E132AR80QS
2. Color: Stainless Steel trim
3. Quantity: 2

2.4 REFRIGERATOR / FREEZERS

A. Manufacturer: ELECTROLUX

1. Model # & Type: ELECTROLUX E127BS160S
2. Color: Stainless Steel trim
3. Quantity: 1

2.5 DISHWASHER

A. Manufacturer: GE MONOGRAM

1. Model # & Type: GE MONOGRAM ZDT925SPNFS
2. Color: Stainless Steel trim
3. Quantity: 1

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2.6 RANGE

A. Manufacturer: GE MONOGRAM

1. Model # & Type: GE MONOGRAM ZGP366LNF3
2. Color: Stainless Steel trim
3. Quantity: 1

2.7 WASHERS

A. Manufacturer: SPEED QUEEN

1. Model # & Type: AFNE9BSP116T, each with stacking kits,
2. Color:
3. Quantity: 1

2.8 DRYERS

A. Manufacturer: SPEED QUEEN

1. Model # & Type: ADE3RGS175T, stacked
2. Color:
3. Quantity: 1

2.9 WASHER EXTRACTOR

A. Manufacturer: Continental

1. Model # & Type: EH030I1102222000 (32"X32") w/ Auto Detergent
2. Color:
3. Quantity: 1

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.

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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

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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. Horizontal louver blinds with **aluminum** slats.

B. Related Requirements:

1. Division 01 Section “Sustainable Design Requirements” for applicable Sustainability requirements.

2. Division 05 “Cold Formed Metal Framing”

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 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For horizontal louver blinds, include fabrication and installation details.

C. Samples: For each exposed product and for each color and texture specified, 12 inches (300 mm) long.

D. Samples for Initial Selection: For each type and color of horizontal louver blind.

1. Include Samples of accessories involving color selection.

E. Product Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

F. Sustainable Design Submittals:

1. Comply with requirements of Section 01 81 13

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2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For horizontal louver blinds with polymer slats that have been tested for compliance with NFPA 701, for tests performed by **manufacturer and witnessed by a qualified testing agency**.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For horizontal louver blinds to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Horizontal Louver Blinds: Full-size units equal to 5 percent of quantity installed for each size, color, texture, pattern, and gloss indicated, but no fewer than t**wo** units.

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet-work and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where horizontal louver blinds are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed

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units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain horizontal louver blinds from single source from single manufacturer.

B. Manufactures: Subject to compliance with requirements, provide products by one of the following:
   1. Levelor Blinds
   2. Or Approved Equal

2.2 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Manufacturer/ Product:
   1. Levelor “Mark1 Cordless 1” Blind” Light Master
   2. Levelor “Mark1 Cordless 1” Blind” SheerView

B. Horizontal Blinds: 1” wide, adjustable tile horizontal blinds
   1. Conform to Federal Standard FS AA-V-00200, Type II
   2. Color Selections: As selected by Architect from manufacturers full range

C. Headrail: Manufacturer’s standard heavy duty 1”x1 ½” steel head rail headrail consisting of channel shaped section complete with tilting mechanism top and end braces, top cradles and accessory items required for type of blind and installation indicated. Finish to match slats.

D. Bottom Rail: Manufacturer; s standard tubular steel bottom rail, with closed ends same color as rail finished to match slats.

E. Slats: 1” wide, manufacturer’s standard spring tempered aluminum slates, 0.008: thick, rounded corners with forming burrs removed
   1. Support Ladders: Woven of braided polyester in color complementing slat color.
   2. Provide translucent slats at locations noted.
   3. Provide full blackout slats at locations noted.

F. Tilting Mechanism: Manufacture’s standard assembly including disengaging work and gear mechanism to eliminate overdrive, low friction gear tilter, drum and cradles at each ladder, tilt rod. Cords designed to hold slates at any angle and prevent movements of slats due to vibration, with clear plastic adjusting want of proper length for convenient operation.
   1. Located tilt rod on left side of windows.
   2. High windows: Provide extra length tilt adjustment wand to allow easer operation from floor level.

G. Lifting Mechanism: Manufacture’s cordless mechanism.

H. Installation Brackets: Manufacturers standard brackets designed for securing blind to window head, match color of slats

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I. Finish: Polyester backed enamel finish, antimicrobial, anti-static.
   1. Colors: As selected by Architect from manufacturer's full range.

J. Extent:
   1. SheerView
      a. Window types B, C, D and E
      b. Storefront Types S3, S4, S5 (A-E), S6, S7, S8, S9, S10, S14 and S15
      c. Hollow Metal Door & Door Frame Types 5 and 6.
   2. LightMaster
      a. Window type A

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb, aligned and centered on openings, and aligned with adjacent units according to manufacturer's written instructions.

   1. Locate so exterior slat edges are not closer than **1 inch (25 mm)** from interior faces of glass and not closer than **1/2 inch (13 mm)** from interior faces of glazing frames through full operating ranges of blinds.
   2. Install mounting and intermediate brackets to prevent deflection of headrails.
   3. Install with clearances that prevent interference with adjacent blinds, adjacent construction, and operating hardware of glazed openings, other window treatments, and similar building components and furnishings.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate free of binding or malfunction through full operating ranges.

3.4 CLEANING AND PROTECTION

A. Clean horizontal louver blind surfaces after installation according to manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

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C. Replace damaged horizontal louver blinds that cannot be repaired in a manner approved by Architect before time of Substantial Completion.

END OF SECTION

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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 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 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.

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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
2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

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”.

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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

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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. Provide required flow and tamper switches.
5. Interface system with building fire and smoke alarm systems.
6. 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:
1. 01 74 19 Construction Waste Management
2. 01 81 13 LEED Requirements
3. 01 81 19 Construction Indoor Air Quality
4. 01 91 00 General Commissioning 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.

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1.4 SUSTAINABLE DESIGN REQUIREMENTS

A. Comply with project requirements to achieve LEED v4 Gold Certification.

B. Comply with Construction Waste Management plan. Refer to Section 01 74 19.

C. LEED-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC, per referenced standards (SCAQMD Rule #1168 & #1113, Green Seal GS-03, GS-011, GS-036, etc.) Cleaning products used during construction and close-out procedures shall meet Green Seal standards GS-34, GS-37, and GS-40, or the California Code of Regulations. Title 17 Section 94509, VOC standards for cleaning products.

D. Refer to Section 01 81 13 for more information on related LEED Credits:
1. MR Credit: Construction Waste Management
2. IEQ Credit: Low Emitting Materials

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. **Submittals shall be complete in one PDF file with bookmarks for each Division. 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

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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.

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 Marshal or AHJ.**

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 inertia bases and locate vibration isolators, with static and dynamic load on each.

L. Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation.

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M. 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.

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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.

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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 1 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.

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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.

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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.

1.23 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.

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.

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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

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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.

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.

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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

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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. Double check valve, detector check or as jurisdiction requires. FDA approved epoxy coated cast iron check valve bodies with bronze seats. Furnish with bronze body ball valve test cocks. Suitable for supply pressures to 175 psi and water temperatures to 140

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degrees. Tamper switches on gate valves for monitoring. Ames, Watts, Apollo, FEBCO, Wilkins or approved.

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. ½ inch or ¾ inch outlet.
4. 175 psi / 300 psi maximum rated pressure.

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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 EXPANSION JOINTS

A. Manufacturers: Metraflex, Mason or approved equal.

B. Flexible Expansion Loop (seismic joint):
1. UL listed
2. Stainless steel hose & double stainless steel braid, carbon steel fittings.
3. Two flexible sections of hose and braid, two 90° elbows and a 180° return, assembled.
4. Support nut and drain plug at bottom of 180° return.
5. Provide nesting for multiple pipe runs.

C. Stainless Steel Bellows (expansion):
1. Low corrugation, non-controlled, two ply, 304 stainless steel.
2. ANSI class 150/300 flanges, grooved or welded ends.
3. 150/300 psi rated, maximum working temperature of 850 F.

D. External Ring Controlled Stainless Steel Bellows (expansion):
1. High Corrugation, self-equalizing, ring controlled, single ply, 304 stainless steel.
2. ANSI class 150/300 flanges, grooved or welded ends.
3. External sheet metal covers.
4. 300 psi rated, 500 F working.

2.9 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.

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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.

2.10 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 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.

2.12 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.

2.13 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.

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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.

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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 Ip = 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.

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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

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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, provide dry heads.

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.

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.

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.

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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 chrome plated or red enameled gong with pressure alarm switch.

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

2.3 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 buried shut-off valves in valve box. Furnish post indicator.

C. Install pressure gauges on each side of sprinkler alarm valve.

D. Install approved backflow assembly at sprinkler system water source connection.

E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.

F. Locate outside alarm on building exterior wall.

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

H. 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.

I. Install main piping in concealed spaces above finished ceilings or soffits; branch piping in joist space or other concealed space to sprinkler heads.

J. Center sprinklers in two directions in ceiling tile and install piping offsets.

K. Install guards on sprinklers exposed to potential damage.

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L. Provide drains at system low points.

M. Hydrostatically test entire system.

N. 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

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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 of Plumbing (Welsh)
22 11 00	Facility Water Distribution
22 13 00	Facility Sanitary Sewerage
22 14 00	Facility Storm Drainage
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:
01 60 00 Product Requirements
01 74 19 Construction Waste Management
01 81 13 LEED Requirements
01 81 19 Construction Indoor Air Quality
01 91 00 General Commissioning 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.

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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 v4 Gold Certification.

B. Comply with Construction Waste Management plan. Refer to section 01 74 19.

C. LEED-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC, per referenced standards (SCAQMD Rule #1168 & #1113, Green Seal GS-03, GS-011, GS-036, etc.). 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 Division 1 and 22 08 00.

E. Refer to Section 01 81 13 for more information on related LEED Credits:
1. EA Prerequisite 1: Fundamental Commissioning {for applicable sections}
2. MR Credit: Construction Waste Management
3. IEQ Credit: Construction IAQ Management Plan
4. IEQ Credit 4.1: Low Emitting Materials
5. WE Prerequisite: Water Use Reduction, 20%
6. WE Credit: Water Use Reduction

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
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 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.

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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. **Submittals shall be complete in one PDF file with bookmarks for each Division. 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.

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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 and 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 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.

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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.

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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.

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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.

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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 EXTRA MATERIALS

A. Furnish one set of mechanical seals for each pump where such seals exist.

1.22 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.

1.23 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.

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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 3 hours

1.24 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.

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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.

1.25 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.

1.26 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.

1.27 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.

1.28 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.

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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.

1.29 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.

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.

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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

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PART 1 GENERAL

1.1 SUMMARY

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

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1.6 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.

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 BUTTERFLY VALVES

A. Manufacturers: NIBCO or equal by Apollo, Hammond, Milwaukee, Stockham, Victaulic or approved equal.

B. 2-1/2 inches to 6": Lead-Free, MSS-SP67, 200 psi CWP, lug style ductile iron body, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. Aluminum-bronze disc, molded-in EPDM seat, geometric drive, one-piece stainless steel stem, copper bushing. Lever operated with 10-position throttling plate. For insulated piping provide 2" extended neck. Nibco LD-2000.

C. 2-1/2" to 6" Grooved-End Copper Butterfly Valve: rated to 300 psi with copper tubing sized grooved ends. Cast bronze body, elastomer encapsulated ductile iron disc, ASTM A-536, Grade 65-45-12, with integrally cast stem. Bubble tight, dead-end or bi-directional

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service, with memory stop for throttling, metering or balancing service. Valve may be automated with electric, pneumatic, or hydraulic operators. Victaulic Series 608.

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 Uretherne 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.

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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, LPG, Fuel Oil
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, 14 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.

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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.

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.

2.11 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.

2.12 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.

2.13 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.

2.14 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.

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2.15 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.

2.16 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.

2.17 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.

2.18 VIBRATION ISOLATORS

A. Manufacturers: 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.

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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. 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.

D. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

2.19 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.

2.20 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
Non-potable Water (NPW)	Yellow	Black	CAUTION: NONPOTABLE WATER, DO NOT DRINK

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Compressed Air	Blue	White	COMPRESSED AIR
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.

2.21 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color-coded head.

B. Color code plumbing valves green.

2.22 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.

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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.

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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.

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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 Ip = 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.

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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.

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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. 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.

3.16 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.

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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.

3.17 PROTECTION OF FINISHED WORK

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

3.18 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
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

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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

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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 more than 10 feet.

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.

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.

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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.

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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. 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.

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.

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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/Seattle Energy Code requirements.

		PIPE SIZE			
Service	**Insulation Type**	**<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	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''
Tempered Hot Water	Glass Fiber RIGID	1''	1''	1-1/2''	1-1/2''
Condensate Drains	RIGID / FOAM	1/2''	1/2''	1/2''	1/2''

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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

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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

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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

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Table - A: System Summary and Documentation Tracking

A	B	C	D	E	F	G
System Description / Documents Required	Responsible Contractor	Proposed Document Received	OK	Completed Document Received	OK	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				

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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:

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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:

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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.

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Table – B: Functional Test Summary Table

A	B	C	D	E	F	G
	Responsible Contractor	Proposed Test Forms Received	OK	Testing Complete	OK	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.

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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.

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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

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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

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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.

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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		

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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

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Domestic water piping.
2. Piping Accessories.
3. Circuit balancing valve.
4. Water pressure reducing valves.
5. Reduce pressure backflow assembly.
6. Thermostatic mixing valves.
7. 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.

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1.6 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.

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™

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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.

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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. 2-1/2 & 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 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.

2.11 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.

2.12 THERMOSTATIC MIXING VALVES

A. Manufacturers: Symmons, Lawler, Powers, Acorn or approved equal.

B. Valve: Lead-Free cast brass body with rough bronze finish, liquid filled thermal motor with bellows, stainless steel piston, integral temperature adjustment control.

C. Assembly: Valve and piping assembly with wall mounting bracket, pipe unions, check valve and strainer stop inlets, outlet dial thermometer, outlet ball valve. Factory assembled and tested. Certified to ASSE 1017 standard.

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2.13 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.

E. Accessories:
1. Cabinet

2.14 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, chrome finish. Certified to ASSE 1070 standard.

C. Accessories:
1. Cabinet

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.

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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.

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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 - METERS

A. Install positive displacement meters in accordance with AWWA M6, with isolating valves on inlet and outlet. [Provide full line size bypass with globe valve for liquid service meters.]

3.8 INSTALLATION - THERMOMETERS AND GAUGES

A. Install pressure gauges on each side of domestic water service assembly (i.e double check, PRV, etc.).

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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.

3.9 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.

3.10 FIELD QUALITY CONTROL

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

3.11 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.

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F. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.

END OF SECTION

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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. Backwater valves.
9. Interceptors.

1.2 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.

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 4000, Clamp-All 125 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 4000, Clamp-All 125 or approved equal.

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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 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 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.

2.5 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.

2.6 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.

2.7 CLEANOUTS

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

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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.

2.8 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.

2.9 BACKWATER VALVES

A. Manufacturers: Clean Check or approved equal.

B. Check: PVC tee-shaped valve body, top collar with stainless steel thumb screw and bottom collar with PVC flapper. Contractor to provide PVC access riser.

2.10 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.

2.11 FLASHING AND COUNTERFLASHING

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

2.12 TRAP PRIMER

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

B. Construction: Automatic, bronze body, integral vacuum breaker.

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C. See 221100 for trap primer piping.

2.13 TRAP PRIMER TAIL PIECE

A. Manufacturers: PPP or approved equal.

B. Construction: 1-1/2" tail piece trap primer assembly with ½" stainless steel flexible priming water line and chrome plated escutcheon.

C. See 221100 for trap primer piping.

2.14 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.

2.15 OIL AND SAND INTERCEPTOR

A. Manufacturers: Utility Vault or approved equal.

B. Construction: Precast concrete or welded steel construction with sludge retaining weir, two (2) oil retaining baffles, inlet and outet sampling tees and cover with galvanized diamond plate access covers. Where installed in vehicle traffic areas provide H-25 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.

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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.

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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.

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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 INSTALLATION – BACKWATER VALVES

A. Label all cleanouts upstream of a backwater valve with a permanent label which reads "Backwater Valve Downstream".

3.8 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

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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. Cleanouts.

1.2 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.

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 4000, Clamp-All 125 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 4000, Clamp-All 125 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

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(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.

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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.

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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. Roof drain flashing and counter flashing. 3lb. lead soldered joints and seams, 24 x 24 base pad.

D. 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 that 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 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

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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.

1.5 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.

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.

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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, 120 Volt.

C. Manual push button wall mounted reset. Coordinate with alerting system.

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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.

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.

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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.

I. Install trace wire continuous over top of pipe and plastic ribbon tape continuous 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 ¼" 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.

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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 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, ¾" 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'.

3.6 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

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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)

1.2 SCOPE

A. Provide plastic venting and combustion air for water heaters and boilers in this section.

1.3 COORDINATION

A. For equipment which requires metal venting coordinate required material and location with Division 23.

1.4 QUALITY ASSURANCE

A. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by Washington State Energy Code and scheduled on drawings.

1.5 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.

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.

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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.

2.2 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.

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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.

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.

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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. Where appropriate, lubricate pumps before start-up.

END OF SECTION

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. General Plumbing Fixtures: Water closets, Urinals, Lavatories, Sinks, Service sinks, Bathtubs, Showers, Drinking fountains, Electric water coolers.
2. Faucets and valves
3. Emergency Fixtures: Emergency showers, 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 (tank or flush valve)	1.6 GPF
2.	Urinals	0.125 GPF
3.	Shower heads	2.0 GPM
4.	Lavatory faucets (Public)	0.5 GPM
5.	Kitchen faucets	1.5 GPM
6.	Service faucets	1.5 GPM

1.4 LEED

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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.

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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.

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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 ELECTRIC WATER COOLERS

A. Manufacturers: Elkay, Oasis, Haws, Acorn, Murdock or approved equal.

B. Self-contained, wall hung, hi-low stations, barrier-free ADA compliant, front and side controls, lead-free, 8 GPH capacity, HFC-134a refrigerant, steel cabinet, mounting bracket, stainless steel basin, 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, 2.2 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.
2. 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: T&S or approved equal.

B. Polished chrome plated brass, backsplash mount, lever handles with spring checks & color coded indexes, 14" swing spout, pre-rise spray riser with wall bracket, finger hook, spray valve and stainless spring wound rubber hose.

2.13 SHOWER 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.

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2.14 SHOWER HEADS

A. Manufacturers: Speakman 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 2.0 gpm.

2.15 SHOWER HAND SPRAY

A. Manufacturers: Alsons or approved equal.

B. Personal hand held shower with push button, on-off control, 60" double spiral metal hose, 24" 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. 1/2 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. Wall mounted eye/face wash with 11" stainless steel bowl, wall bracket, twin soft anti-surge eyewash heads, stainless steel face spray ring, hand flag control, chrome plated waste tailpiece and trap, 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, 15 feet of 3/4" heavy duty EPDM hose with industrial rubber coated bronze nozzle.

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2.20 HOSE REELS

A. Manufacturers: Graco, Reelcraft or approved equal.

B. Heavy duty type, steel construction, dual pedestal frame, powder coat finish, hand crank retractable, ¾" inlet, ¾" outlet, 300 psi rated.

C. Hose: ¾" 125 psi rated.

D. Accessories:
1. Mounting bracket and stainless steel hardware.
2. Hose inlet kit.

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.

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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 sleaves, 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.

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.

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.

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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.

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

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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. Design Intent: Provide HVAC consisting of multi-zone VRF heat pump system, decoupled dedicated outside air energy recovery ventilation, general exhaust, localized electric heat and gas fire infrared heaters.

B. 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 01 00	LEED Requirements
23 05 00	Common Work Results for HVAC
23 05 93	Testing, Adjusting and Balancing
23 07 00	HVAC Insulation
23 08 00	Commissioning of HVAC (Welsh)
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	Vehicle Engine Exhaust System
23 37 00	Air Outlets and Inlets
23 38 00	Hoods
23 40 00	HVAC Filters
23 51 00	Chimneys and Stacks
23 55 00	Fuel-Fired Heaters
23 72 00	Energy Recovery Units

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23 81 43 Air-cooled, Variable Refrigerant Flow, Multi-Unit Heat Pump

23 83 16 Electric Duct Coils

23 83 23 Electric Terminal Heating Units

C. Related Sections:
01 60 00 Product Requirements
01 74 19 Construction Waste Management
01 81 13 LEED Requirements
01 81 19 Construction Indoor Air Quality
01 91 00 General Commissioning 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 – 2007 Edition, and ASHRAE Standard 52.2-1999

1.4 SUSTAINABLE DESIGN REQUIREMENTS:

A. Comply with project requirements to achieve LEED v4 Gold Certification.

B. Comply with Construction Waste Management plan. Refer to Section 01 74 19.

C. LEED-Compliant Products: Inside the building envelope, use materials that contain acceptable or lower levels of VOC, per referenced standards (SCAQMD Rule #1168 & #1113, Green Seal GS-03, GS-011, GS-036, etc.) 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 and 23 08 00.

E. Refer to Section 01 81 13 for more information on related LEED Credits:
1. EA Prerequisite: Fundamental Commissioning {for applicable sections}

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2. EA Prerequisite: Fundamental Refrigerant Management
3. EA Credit: Optimize Energy Performance
4. EA Credit: Enhanced Refrigerant Management
5. IEQ Prerequisite: Minimum Indoor Air Quality Performance
6. IEQ Credit: Enhanced Indoor Air Quality Strategies
7. IEQ Credit Construction IAQ Management Plan
8. IEQ Credit: Low Emitting Materials
9. MR Credit: Construction Waste Management
10. IEQ Credit: Indoor Air Quality Assessment (Building Flush-out)

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: **Submittals shall be complete in one PDF file with bookmarks for each Division. 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.

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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 per EA Prerequisite 1 and 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. Coordinate and assist with Building Flush-Out and installation of permanent MERV 13 filters.

D. 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.

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E. 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.

F. 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.

E. Piping Shop Drawings: Submit six (6) copies of hydronic piping system for approval prior to beginning work, drawn to scale not smaller than 1/8 inch equals 1 foot, including equipment, critical dimensions, flexible connectors, expansion joints and sizes.

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.

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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.

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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.

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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. Filter installation shall be coordinated with the building flush-out. Refer to section 01 81 19.

M. Coordinate trenching, excavating, bedding, backfilling of buried systems with requirements of this specification.

N. Coordinate wall openings, piping rough-in locations, concrete housekeeping pads, and electrical rough-in locations to accommodate Work of this Section.

O. Coordinate all equipment with building control work.

P. 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.

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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. 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.

C. 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.

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D. Power Wiring: By Electrical Contractor.

E. 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

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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.

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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.

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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.

1.30 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.

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.

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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

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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 in Divisions 23.

1.2 SCOPE OF WORK

A. Design Intent: This project will conform to the requirements of LEED Version 4 Certification as set forth by the US Green Building Council.

B. Provide labor, materials and appliances and perform operations in connection with satisfactory installation of mechanical work to conform to the requirements of LEED Certification as set forth in all sections of this Specification.

1.3 LEED COMPLIANCE POINTS

A. See Division 01 for LEED compliance points which will be created and/or verified by the mechanical contractor.

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.**

PART 2 EXECUTION

2.1 BUILDING COMMISSIONING

A. For complete description and delineation of commissioning responsibilities, refer to Section 23 08 00.

B. Mechanical Contractor's Responsibilities include but are not limited to:
1. Installs all equipment in conformance with design intent.
2. Provides ladders, scaffolding, additional dampers and clean filters as required.
3. Performs startup and testing of all equipment.
4. Puts all systems and equipment into operation and continues operation until all adjusting, balancing, testing, demonstrations, and instructions have been completed.
5. Provides equipment training to Owner's personnel.
6. Reviews and eliminates deficiencies noted in the initial Commissioning Report.
7. Reviews and eliminates deficiencies noted in the final Commissioning Report.

2.2 INDOOR AIR QUALITY MANAGEMENT – DURING CONSTRUCTION

A. During construction meet or exceed the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guideline for Occupied

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Buildings under Construction, 2008. Protect stored on-site or installed absorptive materials from moisture damage. Provide MERV 8 filtration at each return air grille and replace all filtration media immediately prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2.

1. HVAC Protection - shut down the return side of the HVAC system (which is, by definition, ductwork under negative pressure) during heavy construction or demolition. Do not operate the ventilation system during construction. Damper off the HVAC system in work areas and seal all duct openings with plastic.
2. Pathway Interruption – During construction, isolate areas of work to prevent contamination of clean or occupied spaces. Ventilate using 100% outside air to exhaust contaminated air directly to the outside during installation of VOC emitting materials. Pressure differentials can be utilized to prevent contaminated air from entering clean areas. Erect barriers between work areas and non-work areas.
3. Housekeeping – Institute cleaning activities concentrating on HVAC and building spaces to remove contaminants from the building prior to occupancy. Protect building materials from weather and store in a clean area prior to unpacking for installation. Clean all coils, air filters and fans before performing testing and balancing procedures and especially before conducting baseline air quality tests. Provide photographs of construction.

B. Provide photographs of construction IAQ management measures including protection of ducts and on-site stored or installed absorptive materials; covered return air openings in HVAC units; isolation barriers and exhaust fans for VOC control as listed above; and photographs of equipment properly stored.

C. Provide cut sheets of filtration media used during construction and installed immediately prior to occupancy with MERV values highlighted.

2.3 INDOOR AIR QUALITY MANAGEMENT – BEFORE OCCUPANCY

A. Perform building flush-out in support of IEQ Credit 4 Indoor Air Quality Assessment, Air Testing. See Division 01 and coordinate with the GC on duration of flush-out.

B. Building air flush-out:
1. Contractor schedule must accommodate the flush-out period.
2. If building HVAC equipment is used for the flush-out, contractor must ensure that flush-out causes no damage to HVAC equipment and voids no warranties. HVAC equipment must be reset to all design set-points after the flush-out.
3. Change filters frequently during flush-out and provide clean filters at start of normal operation.

2.4 LOW-EMITTING MATERIALS

A. The VOC content of adhesives and sealants used must be less than the VOC limits of the South Coast Air Quality Management District (SCAQMD) Rule #1168 and all sealants must meet or exceed the requirements of the Bay Area Air Quality Management District Regulation 8, Rule 51.

B. The VOC emissions from paints and coatings must not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements.

END OF SECTION

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hangers and Supports.
2. Vibration and Seismic Controls.
3. Firestopping.
4. Condensate Pumps
5. Access Panels
6. Tags and Identification.
7. 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 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.

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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.

1.6 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.

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.

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1. Manufacturer: Pipe Shields, INC or approved equal.
2. Material: Calcium Silicate or Uretherne 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.

E. 2"-6" pipe with expansion: Pyramid RL, thermoplastic rollers with galvanized supports, 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 guage 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.

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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 gage minimum; 16 gage 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 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.

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2.13 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.

2.14 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.
   1. Follow manufacturer's installation instructions.

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 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.

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2.17 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).

2.18 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.

2.19 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.

2.20 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. 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.

D. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches deflection with threaded insert.

2.21 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-

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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.

2.22 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 tag or valve chart is required.

2.23 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)

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.

2.24 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.

2.25 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.

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2.26 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.

2.27 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.

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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 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 23 07 00.

3.6 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.

3.7 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.

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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.

3.8 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.

3.9 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.

3.10 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.

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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 Ip = 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.

3.11 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 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.

3.12 INSTALLATION - FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. 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.

C. 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 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.

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3.14 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.

3.15 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.

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3.16 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.

3.17 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. For grooved piping systems the use of three flexible couplings followed by a rigid coupling shall be considered equivalent to a flexible pipe connector.

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. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to 0.05 inch maximum clearance. Provide other snubbers with clearance between 0.15 inch and 0.25 inch.

J. 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.

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3.18 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.

3.19 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.

3.20 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. Identity 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".

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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.

3.21 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.

3.22 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

3.23 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

B. Plastic and Ductile Iron Pipe Hanger Spacing:

PIPE MATERIAL	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches

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ABS (All sizes)	4	3/8
FRP (All Sizes)	4	3/8
Ductile Iron (Note 2)		
PVC (All Sizes)	4	3/8

C. Note 1:Refer to manufacturer's recommendations for grooved end piping systems.

D. Note 2: 20 feet maximum spacing, minimum of one hanger for each pipe section close to joint behind bell. Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents, limit span to maximum spacing for water service steel pipe.

3.24 SCHEDULES

A. Pipe Isolation Schedule:

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

END OF SECTION

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PART 1 GENERAL

1.1 SCOPE

A. Testing, adjusting and balancing of air systems.

B. Testing, adjusting and balancing of refrigerant systems.

C. Testing, adjusting and balancing of Division 22 domestic water systems.

D. Measurement of final operating conditions of above systems.

E. Duct pressure (leakage) testing as required by 23 31 00.

F. 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

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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

1.7 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.

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,

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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.

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

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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.

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:

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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.

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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

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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.
6. Ductwork insulation.
7. Ductwork insulation jackets.
8. 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 more than 10 feet.

B. External duct insulation shall be legibly printed or indentified 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 only at 75 F mean temperature difference.

D. For rigid or spray foam the aged R-value per inch shall be provided in submittals.

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.

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PART 2 PRODUCTS

2.1 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: reinforced facing, will accept paint. Seal with pressure sensitive tape.

2.2 POLYOLEFIN INSULATION

A. Manufacturers: IMCOA or similar.

B. Polyolefin or Polyethylene pipe insulation is **NOT ACCEPTABLE** for any application.

2.3 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.

2.4 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.

2.5 ELASTOMERIC CELLULAR FOAM DUCT LINER (SOUND LINER)

A. Manufacturers: Armacell AP/Coilflex or approved equal.

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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.

2.6 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.

2.7 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.

2.8 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.

2.9 GLASS FIBER DUCT WRAP

A. Manufacturers: Johns Manville Microlite XG 75 or equal by Owens-Corning, Knauf, Manson or approved equal.

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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, 3" R-8.3.
   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.

2.10 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.

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:

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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 for easy removal and replacement without damage.

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.

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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.

		PIPE SIZE			
Service	**Insulation Type**	**<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"	-

1. Note: Insulate Refrigerant Liquid lines same as Suction lines on all Mitsubishi brand equipment, where noted by manufacturer or called for on plans.
2. 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	Glass Fiber Duct Liner	3"	R-8	-
Supply, Return	Attic, crawlspace or uninsulated areas within building.	Glass Fiber Duct Wrap	2"	R-6	FSK
Supply, Return, Exhaust	Unconditioned Space Inside Bldg.	Glass Fiber Duct Wrap	2"	R-6	FSK
Supply	Concealed Space (3)	Glass Fiber Duct Wrap	1-1/2"	R-3.3	FSK
Supply	Exposed (4) in Space With Supply Air Temp ≤55 F or ≥105 F	Glass Fiber Duct Wrap / Duct Liner	1-1/2"	R-3.3	FSK
Supply	Exposed in Space With Supply Air Temp Between 56-104F	None, Except Duct Liner shown on Plans.			
Outside Air	Within Building <2800 cfm	Glass Fiber Duct Wrap / Duct Liner	3"	R-7	FSK

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Exhaust Air	Outside the Insulated Building Envelope	Glass Fiber Duct Wrap	2''	R-6	FSK
Exhaust Air	Between backdraft damper & building exterior.	Glass Fiber Duct Wrap	3''	R-7	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. Insulation required from exterior to shutoff damper or equipment. After damper provide R-7 insulation.

C. Equipment: Provide on equipment as listed below.

Service	Insulation Type	Thickness	R-Value	Jacket
Valves, Strainers and other piping accessories	Glass Fiber BLANKET	Per pipe schedule	-	Canvas bag with wire ties.

END OF SECTION

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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 13GENERAL 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.

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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.

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Table - A: System Summary and Documentation Tracking

A	B	C	D	E	F	G
System Description / Documents Required	Responsible Contractor	Proposed Document Received	OK	Completed Document Received	OK	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				
Ductwork Systems						

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A	B	C	D	E	F	G
System Description / Documents Required	Responsible Contractor	Proposed Document Received	OK	Completed Document Received	OK	Notes
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				

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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:

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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:

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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:

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Building Automation System Point-to-Point Verification Data Sheet

Unit	Point Description	Type	Analog Input				Ref	Analog Output						Binary Input				Binary Output				Note
			Cal 1		Cal 2			Cal 1		Cal 2		Cal 3		On		Off		On		Off		
			BAS	FV	BAS	FV		BAS	FV	BAS	FV	BAS	FV	BAS	FV	BAS	FV	BAS	FV	BAS	FV	

BAS = Building Automation System
FV = Field Verify or Measure
Cal # = Descrete Calibration Point
Ref = Reference standard used to measure

Project: ______________________ Date: __________ By: __________
Ref: ______________________
Notes: ______________________
____

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Building Automation System Sequence of Operations Confirmation – SAMPLE

Sequence	Programmed	Tested
ERVs		
Unoccupied mode		
Unoccupied limits high and low		
Occupant override mode		
Optimal Start		
Warm-up mode		
Freeze protection mode		
Occupied mode		
Heating valve leak test		
Cooling valve leak test		
Heating mode		
Cooling mode – including economizer		
Economizer lockout		
Heat recovery mode		
Frost protection mode		
VRF Indoor and Outdoor Units		
Unoccupied mode		
Unoccupied limits high and low		
Air flow sensor zero verification		
Air damper leak test		
Heating valve leak test		
Occupant override mode		
Optimal Start		
Warm-up mode		
Occupied mode		
Heating mode		
Cooling mode		
Exhaust Fans		
Thermostatically controlled		
Scheduled		
Switched		
Infrared Heat Units		
Ceiling Fans		
Miscellaneous		
Electric, gas and water meters displayed and trending		
Power and/or phase loss mode		
Freezer / Cooler monitoring and alarm		
Glycol level monitoring and alarm		
Shelter-in-place mode		
Domestic hot water circulation pumps and loop temp alarm		
Generator alarm		
Lighting control interface		

Sign-Off:

Team Member	Name	Date
Responsible Contractor (RC):		

Notes:

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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.

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Table – B: Functional Test Summary Table

A System Description	B Responsible Contractor	C Proposed Test Forms Received	D OK	E Testing Complete	F OK	G 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.

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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.

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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

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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

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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.

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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.

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Air Distribution 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.

Preliminary Activities:

The contractor shall be responsible for marking the motorized smoke control damper shaft ends with the damper blade orientation and providing access (ladders, lifts, etc.) to the motorized dampers during testing.

Testing:

Test Method	Plan & Data Sheets By:	Conducted By:	Demonstration Percentage	CxA Shall Sample or Witness
C.2	CxA	Contractor	N/A	100%

Fire and Smoke Control

1) Demonstrate and document the operation (open/close) of all motorized Fire/Smoke Dampers.

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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.

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**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

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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

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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

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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.

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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:					
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					

☐ Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

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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.
8.

Unoccupied Limits

ERV:					
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					

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Unoccupied High Limit

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:

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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:					
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:

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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:					
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:

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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.

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Cooling Control:

ERV:					
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					

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Limits

ERV:					
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					

☐ Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

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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:					
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					

☐ Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

Comments:

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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:			
CxA:			

Comments:

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ERV Hard Wire Shutdowns:

1. Mixed Air Low Temperature: Trip freeze stat and verify fan shuts down and dampers close.

ERV:					
Shutdown on freeze					
Reset OK					

☐ Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
CxA:			

Comments:

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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					

☐ Tests are complete and performance is acceptable.

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
CxA:			

END OF SECTION 23 08 00

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Thermostats.
2. Timers
3. Electric damper actuators.
4. Gas sensors

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 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.

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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.

1.6 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.

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 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.

D. Low Voltage Heating Thermostat (Electronic Non-Programmable): TH1100
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.

E. 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.

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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.

F. 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.

G. 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.

H. Electric Low Limit Duct Thermostat:
1. Snap acting, single pole, single throw, manual reset switch tripping when temperature sensed across any 12 inches of bulb length is equal to or below setpoint.
2. Bulb length: Minimum 20 feet.
3. Furnish one thermostat for every 20 sq. ft of coil surface.

2.2 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 CONTROL AIR DAMPERS

A. See Section 23 33 00.

2.4 ELECTRIC DAMPER ACTUATORS

A. Manufacturers: Belimo or approved equal.

B. Operation: Two-position or proportional as required for application. [Reversing type proportional motor], 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.

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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.

2.5 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)

2.6 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

2.7 ENCLOSURES

A. All enclosures to be UL listed and all metal construction. All controls and instruments logically assembled at one or more panels.

2.8 CONTROL RELAYS

A. 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.

2.9 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.

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2.10 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.

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 home runs between components without splices.

C. Install sleeves through concrete surfaces in minimum one inch sleeves, extended 6 inches above floors and one inch below bottom surface of slabs.

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D. Install thermostats, humidistat, space temperature sensors, and other exposed control sensors after locations are coordinated with other Work.

E. Provide separable sockets for liquids and flanges for air bulb elements.

F. Install thermostats in aspirating boxes in public areas and as indicated on Drawings.

G. 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.

H. 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 devises at 48” centerline above finished floor to comply with ADA accessibility per ANSI A117.1. Align thermostats and devises with light switches and other controls.

B. Coordinate wall location of thermostats and other wall mount devises with light switches and controls provided by others. All devises in the same vicinity should be grouped at a common elevation with regular horizontal spacing intervals.

C. Mount garage CO sensors at 48” centerline above finished floor.

D. Mount garage NO2 sensors at 18” centerline above finished floor.

E. 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 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.

3.6 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.

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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

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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. Provide receivers on systems as required by manufacturer's installation instructions, sized to accommodate pump down charge.

D. Provide receivers on systems with piping runs exceeding manufacturer's published limitations.

E. Flexible Connectors: Use at spring isolated air handlers and condensers greater than six tons.

F. 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.

1.5 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,

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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.

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

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, M, 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 ≤ perm.
6. Rated Class II Vapor Retarder
7. Tensile strength and Elongation for Vulcanized Rubber and Thermoplastic Elastomers ASTM D412.

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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 REFRIGERANT STRAINERS

A. Manufacturers: Alco Controls, Parker Hannifin, Sporlan Valve or approved equal.

B. Straight Line or Angle Line Type:
   1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass.

2.9 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.

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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. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

M. Flood refrigerant piping system with nitrogen during brazing. Keep piping open with nitrogen flow for zero pressure while brazing.

N. Install valves with stems upright or horizontal, not inverted.

O. Insulate piping and equipment.

P. Provide replaceable cartridge filter-dryers, with isolation valves and bypass with valve.

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Q. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

R. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

S. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

T. Fully charge completed system with refrigerant after testing.

U. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

V. 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.

D. Install pressure relief valves on ASME receivers. Install relief valve discharge piping to terminate outdoors.

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

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Ductwork
2. Kitchen Grease 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. Duct sealants shall comply with VOC limits of LEED IEQ Credit.

E. Paint must comply with VOC limits per Green Seal standards GS-03 (1997), GS-11 (1993), or SCAQMD Rule #1113 (2004).

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.

1.5 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.

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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 – 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

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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 Polymerics, 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 and ESP of 0.75" w.g. should be constructed per SMACNA 1" w.g. pressure standard.

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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 18 gage 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.

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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.

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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 of 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. Install residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.

C. Kitchen hood exhaust ducts: Use stainless steel for ductwork exposed to view and stainless steel or black carbon steel where ducts are concealed indoors.

D. 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 witness 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 can 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

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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
Kitchen Hood Exhaust	Black Carbon Steel, Stainless Steel
Outside Air Intake	Galvanized Steel
Combustion Air	Galvanized Steel
Exterior	Aluminum

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

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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.

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.

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.

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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/ft^2 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/ft^2 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:

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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

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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. ± 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. 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 wg 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.

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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. Resetable 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.

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. 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.

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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.

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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.

3.3 INSTALLATION – PRESSURE INDEPENDENT VOLUME DAMPERS (PIVD)

A. Select devise volume setpoint closest to scheduled volume.

B. Provide devise dimension the same size as ductwork.

C. Trox VFC: Mark setpoint on scale and indicate cfm.

3.4 DEMONSTRATION

A. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

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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.

1.5 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.

PART 2 PRODUCTS

2.1 CENTRIFUGAL ROOF EXHAUST FANS

A. Manufacturers: Greenheck, Cook or approved equal.

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B. Construction: Spun aluminum with rigid internal support and aluminum birdscreen. 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. Insulated roof curb with liner; matched to roof slope.
   c. Curb seal.
   d. Aluminum birdscreen.
   e. NEMA disconnect switch.
   f. Speed Control

2.2 CENTRIFUGAL SIDEWALL 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 sidewall curb with liner.
   c. Curb seal.
   d. Aluminum birdscreen.
   e. NEMA disconnect switch.

2.3 CENTRIFUGAL SIDEWALL KITCHEN EXHAUST FANS

A. Manufacturers: Greenheck, Cook or approved equal. UL 762 Listed.

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:

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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 sidewall curb with liner.
2. Heat baffle
3. High temp curb seal.
4. NEMA disconnect switch.
5. Sidewall hinged curb kit.
6. Teflon non-stick wheel coating.
7. Clean out port on windband.
8. Sidewall grease trap with drain and absorbent material.

2.4 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

2.5 HVLS (HIGH-VOLUME LOW-SPEED) FAN

A. Manufacturers: MacroAir, Entrematic 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.

2.6 EQUIPMENT RAIL SUPPORTS

A. Manufacturers: Greenheck GESR or approved equal.

B. Prefabricated insulated galvanized steel equipment support. 6 inch width. Provide with same coating as fan, otherwise Polyester Urethane. Select height based on roofing and insulation requirements. Select length based on equipment supported.

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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 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.

3.4 CLEANING

A. Vacuum clean inside of fan cabinet.

3.5 DEMONSTRATION

A. Demonstrate fan operation and maintenance procedures.

3.6 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

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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 Rails, one per bay, sized for drive through operation with one (1) trolley and extraction assembly per rail. Configure so that a second trolley and extraction assembly can be added to each rail in the future.

B. Provide exhaust fan sized for the three (3) vehicle exhaust connections provided plus two (2) additional future 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.

C. Provide fan VFD with NEMA exterior rated enclosure.

D. Provide a minimum 36” long duct silencer on the discharge of the exhaust fan.

E. Provide extraction nozzles which match fire apparatus exhaust pipes, coordinate with Owner for type and quantity. Note both standard and dual pipe connections will be required.

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F. 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

G. Provide magnetic anchor plates and auto-start vehicle ignition transmitters for five (5) vehicles.

H. Provide a minimum of two (2) radio receivers for auto-start vehicle transmitters. Locate for coverage at both the north and south apparatus bay doors.

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.

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.

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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. Each open end of the suction rail shall be covered with an end cap.

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 Electro 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.

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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.

H. An electromagnet 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.

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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.

3.3 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 a 24 volt electromagnetic 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

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Diffusers, Registers & Grilles
2. Louvers
3. 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.

1.3 LEED

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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, Price SPJD 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.

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2.3 RADIAL SLOT INDUCTION CEILING DIFFUSER (Outside Air)

A. Manufacturers: Price RSD or approved equal.

B. Type: Radial swirl diffuser with high induction individually adjustable radial slots, square face. Adjustable air pattern controllers for variable direction one-way, two-way, three-way or four-way discharge patterns. Coated steel plenum and internal baffle. Round slot array pattern.

C. Frame:
1. 6" dia. - 12"x12" module for surface mount GWB ceiling or 24"x24" frame for lay-in T-bar ceiling.
2. 8"-12" dia. - 24"x24" module for lay-in T-bar ceilings or plaster frame for surface mount GWB ceiling.

D. Fabrication: Galvanized steel with white powder-coated finish. Black polycarbonate adjustable air pattern controllers.

E. Accessories:
1. Steel plenum, internal baffle and round side duct inlet assembly.

2.4 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.

2.5 SUPPLY REGISTER

A. Manufacturers: Titus, Price, Krueger or approved equal.

B. Type: Contoured and individually adjustable blades, 3/4" blade spacing, two-way deflection.

C. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.

D. Fabrication: Steel with factory white enamel finish.

2.6 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.

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E. Accessories:
   1. Opposed blade damper.
   2. Field fabricated steel plenum, internal baffle and round side duct inlet assembly.

2.7 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.

2.8 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.

2.9 SIDEWALL SUPPLY NOZZLE

A. Manufacturers: Air Concepts 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.

2.10 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.

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.

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2.12 CAPS

A. Wall Cap (round connection): Aluminum construction, aluminum finish, built in birdscreen with damper. Greenheck WC or approved equal.

B. Wall Cap (rectangular): Steel construction with black enamel 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 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

3.3 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

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PART 1 GENERAL

1.1 REQUIREMENTS

A. The equipment of this section shall be provided by a single vendor.

1.2 LEED

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PART 2 PRODUCTS

2.1 KITCHEN HOOD

A. Manufacturers: Accurex or approved equal.

B. Kitchen Ventilation hood shall be full compensating wall canopy with the capability to replace up to 90% of the exhausted air with fresh outside air. The hood shall be UL 710 Listed without fire damper for 400°F rated cooking appliances. Air shall be supplied through perforated panels in a manner that does not interfere with the cooking operations beneath the hood. Perforated panels shall be located on the face to ensure precise volume control and shall limit the throw to within several feet of the hood.

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 steel, 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, UL 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.

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PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with NFPA 96.

B. Ensure that hood operation is interlocked with cooking appliances by gas valve interlock.

C. 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

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PART 1 GENERAL

1.1 PERFORMANCE REQUIREMENTS

A. Conform to ARI 850 Section 7.4.

B. Dust Spot Efficiency: Plus or minus 5 percent.

1.2 LEED

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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 spunpolycaronate 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. 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

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type B double wall gas vents.
2. Single wall metal stacks.

1.2 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.

1.3 SCOPE

A. Provide plastic or metal venting for equipment in this Division.

B. Provide metal venting for equipment in Division 22.

1.4 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. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.

1.5 COORDINATION

A. Coordinate metal venting material and location for Division 22 equipment.

1.6 QUALITY ASSURANCE

A. Provide factory built vents and chimneys used for venting natural draft appliances complying with NFPA 211 and UL listed and labeled.

1.7 LEED

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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.

PART 2 PRODUCTS

2.1 TYPE B DOUBLE WALL GAS VENTS

A. Manufacturers: Metalbestos, Ampco or approved equal.

B. Fabrication: Inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, tested in compliance with UL 441.

C. Accessories: Complete stack system with fittings, thimble, storm collar, roof flashing and 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 PREPARATION

A. Install concrete inserts for support of breeching, chimneys, and stacks in coordination with formwork.

3.2 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. 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.

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I. Install flue / breeching with minimum of joints. Align accurately at connections, with internal surfaces smooth.

J. 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.

K. Pitch horizontal flue / breeching with positive slope up from fuel-fired equipment to chimney or stack.

L. For gas vents, maintain UL listed minimum clearances from combustibles.

M. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

N. Level and plumb flue piping, chimney and stacks.

O. Clean flue / breeching, chimneys, and stacks during installation, removing dust and debris.

P. Install slip joints allowing removal of appliances without removal or dismantling of breeching, breeching insulation, chimneys, or stacks.

END OF SECTION

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Tubular infrared heaters.

1.2 WARRANTY

A. Furnish five year manufacturer warranty for heat exchanger.

1.3 LEED

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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.

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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.
   4. Flue weather cap.

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. 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

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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.

1.6 LEED

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PART 2 PRODUCTS

2.1 WHEEL AIR TO AIR HEAT RECOVERY UNIT (ROOF-TOP) (ERV)

A. Manufacturers: Greenheck ERCH, Aaon 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 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 minimum14 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 ¾ 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.

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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. 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

O. Accessories:
   1. Seismic vibration isolation curb
   2. Modulating energy wheel economizer control with temp/enthalpy sensors

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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

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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 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.

1.4 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.

1.5 WARRANTY

A. System shall obtain Diamond ten (10) year extended warranty.

B. Warranties periods shall be from date of substantial completion.

1.6 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.

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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 UNIT:

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.

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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

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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.

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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

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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 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.

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2.12 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.

2.13 CITY MULTI Controls Network (CMCN)

A. The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and integrated system software communicating over a high-speed communication bus with optional interconnection and control via a BMS interface using either LonWorks® or BACnet interfaces. The CMCN shall support operation monitoring, scheduling, error e-mail distribution, personal browsers, tenant billing and maintenance support.

2.14 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.

2.15 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,

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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.

C. Analog Input (AI) Control Board
1. 2 analog inputs (0-10 VDC or 4-20 mA).
2. Monitor temperature, pressure and/or humidity sensors.
3. Interlock M-NET devices or output contacts according to input status.
4. Provide 24 VDC power.

2.16 CONDENSATE PUMPS

A. See Section 23 05 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordinate size and location of concrete pad 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.

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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.

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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

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Electric duct coils.

1.2 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.

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.

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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

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PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Electric radiant heaters.
2. Electric wall heaters.

1.2 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.

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. UL listed and labeled.

C. Ceiling Panels: 24x48 inch with baked enamel white finish.

2.2 FORCED AIR WALL HEATER

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.

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.

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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

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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.

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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.

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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.

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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.

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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 Contracted 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 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

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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.

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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.

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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.

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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

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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.

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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 complied 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.

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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.

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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.

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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.

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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.

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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

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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.

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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.

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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

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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.

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.

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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.

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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.

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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.

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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.

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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

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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 Division0 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.

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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.

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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.

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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

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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

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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.

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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.

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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

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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.

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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.

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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.

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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.

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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

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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 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. 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.

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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.

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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.

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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 0529.

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.

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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 0529.

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.

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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 0553.
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.

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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.

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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:

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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

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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, a nd 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 05010.

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:

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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.

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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.

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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.

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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.

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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.

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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

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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.

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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

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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.

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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

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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.

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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 met hods, 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.

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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

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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

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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

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Table - A: System Summary and Documentation Tracking

A	B	C	D	E	F	G
System Description / Documents Required	Responsible Contractor	Proposed Document Received	OK	Completed Document Received	OK	Notes
Occupancy Sensors						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Daylight Dimming/Switching Control						
Manufacturer Start-up Documentation						
Contractor Checklist		CxA Provided				
Lighting Control System						
Manufacturer Start-up Documentation						
Point to Point Verification		CxA Provided				
Contractor Checklist		CxA Provided				

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Sample Contractor Checklist

Contractor Checklist
Occupancy Sensor Control

For each space with an occupancy sensor:

1. Indicate the Specified Type (ST), Specified Delay (SD) and Programmed Delay (PD).
2. Field Verify Type (FVT) as installed in space.
3. Field Verify Range (FVR) and sensitivity settings are appropriate for space configuration.
4. Field Measured Delay (FMD): Leave space and measure and record the ACTUAL delay time to off and confirm as programmed.
5. Field Verify Switch (FVS) operation if applicable.

Space	ST OS/VS	SD Min.	PD Min.	FVT OS/VS	FVR OK	FMD Min.	FVS OK		RC Initial	CxA Initial	Note

ST = Specified Type (OS or VS) SD = Specified Delay (min) PD = Programmed Delay (min)
FVT = Field Verified Type, FVR = Field Verified Range/Sensitivity is appropriate for space, FMD = Field Measured Delay
FVS = Field Verified Switch operation if applicable

Sign-Off:

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

Notes:

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Daylight Dimming/Switching Sensor Calibration and Set-Up

Space	Specified FC	Configured FC	Sensitivity Adjusted?	Comment

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

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Lighting Control Panel Pont-to-Point Verification

PCG = Polarity, Continuity and Grounding verified

Panel	Relay	Zone Description	PCG	Sched. Set	On/Off Verified	Comment

Sign-Off:

Team Member	Print Name/Co.	Initial	Date
Installing Contractor:			
GC Cx Coordinator:			

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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:

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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.

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Table – B: Functional Test Summary Table

A System Description	B Responsible Contractor	C Proposed Test Forms Received	D OK	E Testing Complete	F OK	G Notes
Occupancy Sensors						
Daylight Dimming/Switching						
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.

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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.

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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

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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

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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.

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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:

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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:

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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

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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:

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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.

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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.

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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

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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

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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.

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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.

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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.

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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

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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.

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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:

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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

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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

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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.

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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

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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.

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C. Product Data: Submit manufacturer's technical product data for each type o

D. f 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.

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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.

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.

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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.

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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.

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END OF SECTION

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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.

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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.

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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.

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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.

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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

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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.

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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.

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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

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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.

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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,

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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:

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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.

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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

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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

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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 for the 3% renewable energy (2 points for 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

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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.

E. 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:

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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 warrantied. 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.

F. 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.

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G. 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.

H. 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.

I. 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)

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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:

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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.

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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.

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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.

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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

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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.

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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.

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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.

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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.

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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.

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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.

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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

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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: Dripproof.

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.

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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.

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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.

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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.

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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 Div 01.

3.9 FUEL FILL

A. Fill fuel storage system with fuel after all tests and demonstrations have been completed.

END OF SECTION

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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.

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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.

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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.

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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.

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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.

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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.

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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.

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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

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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.

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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

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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.

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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.

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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 Resign 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

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All construction shall be in accordance with Appendix A – 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. Junction boxes, conduits, and conductors

C. Related Sections include the following:

1. Appendix A – Traffic Signal and Illumination System Specifications.

2. Division 1 Section "Submittal Procedures" for submittal requirements.

3. 34 41 00 – Roadway Signaling and Control Equipment.

1.2 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.

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.

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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

2.1 ROADWAY SIGNALING AND CONTROL EQUIPMENT

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

PART 3 - EXECUTION

3.1 ROADWAY SIGNALING AND CONTROL EQUIPMENT

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

END OF SECTION

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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.

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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.

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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,

- Enclosed Offices shall be provided with multilevel control system to allow occupants to dim task lighting separately from ambient lighting.
- Multi-occupant Spaces shall be provided with multilevel control systems that allow each lighting type to be dimmed separately.

D. 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.

E. Electrical:
1. 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.
2. One or two output relays (model specific) shall provide a total combined power switching capacity of 20 amps per unit.
3. 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.
4. Each dimming output shall have a current sinking capacity of at least 30 mA.
5. 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.

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6. Where indicated, room controllers shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.
7. On loss of normal power the controller 0-10 volt dimming signal shall default to full light output.

F. Functional:

1. 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.
2. 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.
3. 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.
4. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
5. 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

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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.

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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

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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.

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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 wring 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.

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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

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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.

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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.

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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.

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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.

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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

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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.

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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.

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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 100Ω ±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

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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:

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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

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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:

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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

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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

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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.

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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-hold 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

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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

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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.

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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.

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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.

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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".

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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.

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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.

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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

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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.

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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 ration far-end (ACRF)
   i. Power sum Attenuation to crosstalk ration 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.

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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

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Supplementary Conditions, Division 01 sections and Section 26 05 00 apply to the 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. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install a television distribution system and other relevant components and accessories required to provide a complete operating system as specified herein and as shown on the drawings.

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, certifications, personnel training, manufacturer warranty, products, test equipment and calibration and similar items. Include index with the submittals.

D. Pre-construction Submittal:

1. Product Data:
   a. Organize by specification infrastructure component sections described in Part 2 of this section.
   b. Submit Product Data information sheets for coordination with item and model number.
   c. 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) Approved manufacturer classes satisfactorily completed
3. Test Equipment

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a. Submit test equipment to be used to perform all required tests and measurements.

4. 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 and taps.

b. Connections to other equipment/ systems not specified herein.

c. Prepare TV Distribution shop drawings using AutoCAD/ Revit software or as approved by the Owner and or A/E. Shop drawings shall be submitted as full size, in PDF format.

E. Record Drawings:

1. Keep complete set of TV distribution drawings in job-site office to show 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 reports, Record Drawings, product data, manufacturer warranty and Operation and Maintenance Manuals.

3. Test Reports:

a. Field test reports.

b. Submit completed copy of reports and include copy in the Operation and Maintenance Manual.

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 TV distribution 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

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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. TIA-568.4-D, Broadband Coaxial Cabling and Components Standard

2. National Electric Code (NEC): Latest Version

F. Qualifications:

1. Contractor shall be a certified reseller/ authorized dealer, installer, and pre-qualified by the manufacturer for the purpose of offering the services as specified herein, at the time of bid.

2. The contractor shall have furnished and installed similar systems continuously for no less than five years.

3. The contractor shall hold the necessary licenses as issued by the State of Washington for a low voltage electrical contractor. Installation shall be made by a licensed and bonded contractor holding a valid Washington State Electrical Contractor's License as described in Chapter 19.28 of the Electrician and Electrical Installation Revised Code of Washington State.

1.5 SYSTEM REQUIREMENTS

A. The system shall receive television signals from local cable TV provider, amplify these signals, and distribute them to TV outlets to permit simple connection of standard television receivers.

B. The system shall deliver at outlets color television signals without introducing noticeable effect on intelligence and color fidelity. System picture quality shall be equal to that received from the cable company and other modulated channels.

C. The system and all equipment shall be designed and rated for 24-hours-a-day continuous operation.

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 - EQUIPMENT

2.1 MANUFACTURER

A. Substitutions: The substitution of products shall adhere to the requirements defined in Division 01. Section 01 77 00 – Substitutions.

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1. TV Distribution equipment shall be from a manufacturer with at least 5 years of experience in the manufacturing of equipment.
    a. Approved manufacturers:
        1) Blonder-Tongue or approved equal

2.2 EQUIPMENT AND ACCESSORIES

2.3 MAIN AMPLIFIER

A. Main amplifier shall be provided for all available DTV channels. Each unit shall be of solid-state design, contain its own power supply, and have a manual gain control. The amplifier shall have a passive return path.
    1. The amplifier shall meet the following specifications:
    2. Amplifiers shall be of solid-state design with the following specifications:
        a. Gain: 31 dB minimum, 15 dB gain control range
        b. Frequency range: 47 to 860MHz
        c. 75-ohm input and output
    3. Manufacturer Blonder Tongue, Part No. ACA 30-86R.

2.4 LINE SPLITTERS

A. Line splitters shall be indoor solder back digital splitters with a frequency response 5 to 1000 MHz. The two-way line splitter shall have a signal loss of not more than 3.7 dB. The four-way splitter shall have a signal loss of not more than 7.5 dB.
    1. Unused outputs on the splitter and end of runs shall be terminated with 75-ohm terminators.
        a. Manufacturer Blonder Tongue:
            1) Two-way splitter, Part No. PBT
            2) Terminator, Part No. DGS series

2.5 DIRECTIONAL TAPS

A. Directional taps shall be indoor solder back low intermodulation digital taps with a frequency response 5 to 1000 MHz
    1. Taps shall be available in 1, 2, 4 and 8-port models with machine threaded F-connector ports.
    2. Taps values shall range from 6dB to 30dB
        a. Manufacturer Blonder Tongue, Part No. SRT series.

2.6 OUTLETS

A. Outlets shall be provided at each location shown on the plans, and mounted in 2" deep minimum flush electrical boxes as indicated on the plans. Outlets shall be designed to cover a frequency range of 10 MHz to 750 MHz. Insertion loss shall not exceed 1.0 dB at any

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frequency within the designated frequency range for 17 dB isolation network. Outlets shall have one F-type connector on the front, and two F-type trunk connectors.

1. Manufacturer Blonder Tongue, Part No. V-3889

2.7 CABLE

A. Cabling shall be a low radiation broadband coaxial CATV cable with a nominal characteristic impedance of 75 Ohms throughout the entire frequency spectrum utilized in this system.

B. RG 6/U coaxial cable for drop cabling shall be UL listed CMP for use in plenum rated. Cables shall have 18 AWG bare copper covered steel conductor and foam FEP insulation with nominal impedance of 75 Ohms. Cable shall be quad shielded. The first shield shall be Aluminum Foil-Polyester Tape-Aluminum Foil tape bonded to dielectric with the second shield a 60% aluminum braid. The third shield shall be an Aluminum Foil-Polyester Tape-Aluminum Foil tape and the fourth shield a 40% aluminum braid.

1. Manufacturer Belden, Part No. 1189AP

C. RG 11/U coaxial cable for intrabuilding backbone applications shall be UL listed CMP for use in plenum application. Cables have 14 AWG bare copper-covered steel conductor and gas-injected foam polyethylene core with nominal impedance of 75 ohms. Cable shall have aluminum polyester foil shield with 60% aluminum braid.

1. Manufacturer Belden, Part No. 1523AP

2.8 OPEN CABLING & DEVICE MOUNTING SUPPORTS

A. Provide all accessories and mounting hardware required for a complete and working installation of open cabling supports.

B. J-Hooks

1. J-hooks shall comply with TIA requirements for structured cabling systems and pathway supports. Galvanized finish. Provide all hardware and hanger rod supports necessary for secure mounting to the structure. Follow manufacturer's recommendations for quantity of cables supported.

a. Manufacturer Erico Caddy, Part No. CAT12HP

PART 3 - INSTALLATION

3.1 INSTALLATION

A. Provide all labor, tools, supplies, software, hardware, materials, and equipment required for the design, installation, configuration and testing of a complete and operational system for distribution of DTV signals from service provider.

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, cable tray or using open cabling methods when installed above accessible ceilings.

D. Where subject to mechanical damage, wiring shall be enclosed in metal conduits or surface metallic raceway.

E. Cabling shall not be enclosed in conduit or raceways containing AC power.

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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. Install coaxial cables in continuous lengths except for terminations. Splices not allowed. Install cable to avoid sharp bends and physical distortions.

3.2 OPEN CABLING SUPPORT INSTALLATION

A. All cable that is installed above suspended ceiling areas shall be run in j-hooks above the ceiling grid and will not be allowed to lay on the grid.

1. Provide all hanger supports and cable supports for cabling specified in this section, unless routed within conduit. All support structures shall adhere to the requirements in the National Electrical Code.

2. Cabling supports shall be spaced no further than 5'-0" apart.

3. Cabling bundles shall not sag or deflect more than 3" from the bottom of the cable support.

4. Cabling supports shall be installed on their own support system. The use of ceiling grid supports shall be prohibited.

B. Maintain the following distances between cabling and other building systems:

1. 12" from fluorescent lights.

2. 12" from electrical conduits and electrical equipment

3. 6'-0" from motors and transformers.

4. 3'-0" from water piping and mechanical equipment.

C. 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.

3.3 LABELING

A. Provide machine generated wrap around label on both ends of the cabling jacket no more than 4" from each termination point.

B. Tag cables terminating at amplifiers and splitters as to function and destination.

3.4 SYSTEM TESTING

A. On completion of the installation of the system, the subcontractor supplying equipment shall make available a qualified technician to perform the following tests:

1. The overall system shall be broadband tested with a field strength meter from the head-end location to the last outlet in each distribution leg of the system.

2. The system shall deliver a minimum signal level of +6 dBMV/2000 mv across 75 Ohms on each channel at each outlet.

3. Certify that no frequency drop- outs are present in the distribution system which would affect any of the VHF channels.

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4. Using a return loss bridge, certify that return loss of system shall be a minimum of 26 dB down. VSWR shall not exceed 1.4:1.

3.5 TRAINING

A. The Owner shall receive 4 hours of instruction in (2) 2-hour segments covering all aspects of operating the TV distribution system. Training shall be recorded on DVD and included in the close out documents.

END OF SECTION

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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

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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

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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):

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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.

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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:

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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.

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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.

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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;

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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:

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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.

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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.

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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

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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 journeyperson at all times and no more than two (2) apprentice electricians at any one time per journeyperson.
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.

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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.

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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.

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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.

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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.

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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.

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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 Creston 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.

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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.

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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

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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.

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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 of25W (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.

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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 Cycolac® 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

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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 Div 01.

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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

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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.

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:

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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:

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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.

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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.

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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.

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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.

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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

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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 1, 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.

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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 distributed voice evacuation, additional smoke detectors, heat detectors, manual alarm stations, speakers, horns, visual evacuation alarm devices, voice evacuation alarm devices, bells, door closers and holder controls, panels, power

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supplies, batteries, built in dual line Digital Communicator 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-1000. 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.

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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.

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J. Include connection from duct smoke detectors to fan starter control circuit. Fans shut down on local detection only. Include interface relay to control system.

K. 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.

L. 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.

M. Include fire alarm system power and general alarm release signal for magnetic door holders. Coordinate requirements with door hardware supplier.

N. 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 with Distributed Audio: 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. System must contain at least one Silent Knight VIP-50 50 watt amplifier and shall be expandable to 400 watts utilizing up to 7 additional amplifiers. Each amplifier shall be capable of adding a 4 zone splitter (Silent Knight VIP-CE4) to distribute the audio information to different locations in the facility. The system shall be capable of controlling up to 32 notification zones. The amplifiers must contain the capability of being remotely located through a four-wire communications circuit and two -wire VBUS circuit. The system shall have the capability of adding up to 2 remote supervised microphones.
2. 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.
3. 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.

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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. Cooridinate 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 LEDI 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.

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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: The system shall include an automatic digital alarm communicator/ transmitter capable of reporting all zones or points of alarm, supervisory and trouble as well as all system status information such as loss of AC, low battery, ground fault, loss of supervision to any remote devices with individual and distinct messages to a central station or remote station.. The communicator shall have an answering machine bypass feature that will allow the panel to respond to communication even on phone lines that have other communication equipment present. The communicator must be capable of reporting via SIA and contact ID formats. The communicator shall have a delayed AC loss report function which will provide a programmable report delay plus a 10-25 min random component to help ease traffic to the central station during a power outage. No controls that use external modems for remote programming and diagnostics shall be accepted. Provide communicator programming hardware, software and services for SIA and contact ID reporting as requested by the Owner and AHJ. Coordinate all requirements with Owner selected alarm company and provide. Owner's alarm company shall

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be present during AES Radio programming. Conveyance of alarm signals shall be by AES Radio only.

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.

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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.

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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.

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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

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Excavation, subgrade protection and preparation, backfilling, grading, trenching, compaction, and excess material control.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 01 57 13 – Temporary Erosion and Sediment Control
2. 02 41 00 – Demolition
3. 32 12 00 – Flexible Paving
4. 32 13 00 – Concrete Paving
5. 33 10 00 – Water Utilities
6. 33 30 00 – Sanitary Sewer Utilities
7. 33 40 00 – Storm Drainage Utilities

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. The Northshore Utility District (NUD) Standard Specification and Details, February 2020.

C. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

D. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

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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. See Division 01 Submittal Procedures

B. Submit the samples of soil materials used onsite to the Owner's geotechnical engineer for review and approval prior to use.

1.6 QUALITY CONTROL

A. Soil Testing

1. The Contractor will engage a material testing company to test soil materials proposed for use in the work and for quality control testing during earthwork operations

2. Samples of materials shall be submitted to the Project geotechnical engineer by the Contractor at least one week before their anticipated use.

3. Under this contract, smooth out areas for density tests and otherwise facilitate testing work, as directed.

1.7 PROJECT CONDITIONS

A. Subsurface conditions have been investigated by HWA Geosciences Inc and documented in their geotechnical report dated June 8, 2020. See Project Manual Appendix for a copy of the geotechnical report. Contractor shall review all reports, assessments, and investigations to familiarize themselves with site conditions and requirements.

PART 2 - PRODUCTS

2.1 STRUCTURAL FILL

A. Structural Fill shall be imported fill and should be less than 4 inches in maximum particle dimension with less than 7 percent fines and shall meet WSDOT Standard Specifications Section 9-03.14(1)

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2.2 NON-STRUCTURAL FILL

A. Nonstructural Fill shall be on-site or imported well-graded granular material free of organics and debris. Maximum particle size 4 inches and no more than 30 percent fines (material passing No. 200 sieve). Material shall be capable of being compacted as specified under the weather conditions prevailing at time of construction.

2.3 CRUSHED SURFACING TOP COURSE (CSTC)

A. Crushed Surfacing Top Course below paving shall conform to WSDOT Standard Specifications Section 9-03.9(3).

2.4 CRUSHED SURFACING BASE COURSE (CSBC)

A. Crushed Surfacing Base Course below paving shall conform to WSDOT Standard Specifications Section 9-03.9(3)

2.5 PIPE BEDDING

A. Water and Sewer utility pipe bedding shall conform to NUD Standard Specifications Materials of Construction Section 9.7.

B. Storm drainage utility pipe bedding shall conform to COK pre-approved plan CK-D.02.

2.6 PIPE TRENCH BACKFILL

A. Water and Sewer utility pipe trench backfill shall conform to NUD Standard Specifications Materials of Construction Section 9.7.

B. Storm drainage utility pipe bedding shall conform to COK pre-approved plan CK-D.02

2.7 GEOTEXTILES

A. Non-woven construction geotextile for underground drainage shall meet WSDOT Standard Specifications Section 9-33.2(1), Table 1 for underground drainage application.

B. Geotextile for silt fence shall conform to COK pre-approved plan CK-E.03

2.8 QUARRY SPALLS

A. Quarry spalls shall conform to WSDOT Standard Specifications Section 9-13.1(5)

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2.9 GRAVEL BACKFILL FOR DRAINS

A. Gravel Backfill for Drains shall conform to WSDOT Standard Specifications Section 9-03.12(4)

2.10 GRAVEL BACKFILL FOR WALLS

A. Gravel Backfill for Walls shall be Structural Fill.

2.11 STORM CATCH BASIN AND MANHOLE BEDDING

A. Storm catch basin and manhole bedding shall conform to COK pre-approved plan CK-D.09.

2.12 CONTROLLED DENSITY FILL

A. Controlled Density Fill shall conform to WSDOT Standard Specifications Section 2-09.3(1)E

PART 3 - EXECUTION

3.1 EXCAVATION

A. Unauthorized excavation: Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the City of Kirkland Representative. Unauthorized excavation, as well as remedial work directed by the City of Kirkland Representative, shall be at no change in contract amount.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending the indicated bottom elevation of the footing or base to the excavation bottom. The bottom of the excavation must be at least as wide as the sum of the depth of unauthorized excavation and the footing width.

2. Elsewhere, backfill and compact unauthorized excavations with imported structural fill as specified herein

B. Overexcavation: In certain areas where soft spots or organics occur in the subgrade, or the subgrade at the planned bottom of excavation is otherwise inadequate, satisfactory sub-grade shall be achieved by overexcavation of up to 1 foot and replacement with imported structural fill

1. Location and extent of soft spot areas and replacement material to be determined by the project Geotechnical Engineer in the field.

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C. It is the Contractor's responsibility to protect the established subgrade from wasting and becoming unsuitable. Refer to WSDOT Standard Specifications Section 2-06.

D. Excavations: Shall meet the requirements of WSDOT Standard Specifications Section 2-03 and 2-09

E. Stability of Excavations: Slope the sides of excavations to conform to local, state and federal safety regulations. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Contractor is responsible for the stability of cut slopes and the safety of excavations.

F. Shoring and Bracing: Shoring and bracing shall conform to local, state, and federal safety regulations. Provide materials for shoring and bracing, such as piles, uprights, stringers, and cross-braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of the time period excavations will be open. Carry down shoring and bracing as the excavation progresses. Fill any voids behind lagging to prevent voids developing behind the shoring. Fill shall be free draining and is subject to the review and approval of the Geotechnical Engineer prior to placement.

G. Dewatering: Provide temporary dewatering systems as required to prevent surface water and subsurface or ground water from flowing into excavations and from flooding the project site and surrounding area.

1. Provided dewatering to maintain groundwater a minimum 3 feet below the bottom of excavation.

2. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations.

3. Establish and maintain temporary drainage ditches and other diversions outside excavation limits. Do not use trench excavations as temporary drainage ditches.

H. Material Storage: Temporarily stockpile excavated materials as required. Place, grade, shape, and cover stockpiles for proper drainage and to prevent accumulation of excess moisture.

1. Locate and retain soil materials away from edge of excavations.

2. Cover and protect stockpiles with plastic sheeting to prevent the contamination of site runoff.

3. Dispose of all excavated soil material and waste materials legally off site.

I. Excavation for Buildings and Retaining Walls.

1. Conform to elevations and dimensions shown on the Drawings, within a tolerance of plus or minus 0.10-foot, and extending a sufficient distance from footings and foundations to

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permit placing and removal of concrete formwork, installation of services, other construction, and inspection.

2. In excavating for footings and foundations, take care not to disturb the bottom of the excavation. Excavate by hand to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive concrete. Compact base to the density required and allow testing of compaction prior to constructing concrete forms.

3. Place footings and foundations on properly compacted imported fill material. Where existing soft or organic materials are encountered below footings and foundations, or the subgrade at the planned bottom of excavation is otherwise inadequate, overexcavate as required by the Geotechnical Engineer or until dense native soil is encountered and backfill with CDF or with material approved by the Geotechnical Engineer. The minimum lateral limits of the overexcavation and structural backfill beneath footings shall be defined by a line extending downward and out from the outer edge of the footing at an angle of 1H:1V. Maintain side slopes as required by authorities having jurisdiction

J. Excavation for Pavements: Cut surface under pavements to comply with cross-sections, elevations, and grades as shown within a tolerance of plus or minus 0.10-foot

K. Excavation for Planting Areas: Conform to cross-sections, elevations and dimensions shown, within a tolerance of plus or minus 0.10-foot

L. Excavation for Trenches:

1. Refer to WSDOT Standard Specifications Sections 7-08.3(1)..

2. Excavate trenches to the depth indicated or required. Carry the depth of trenches for piping to establish the indicated flow lines and invert elevations.

3. Where rock is encountered, carry the excavation 6 inches below the required subgrade elevation and backfill with a 6-inch layer of imported bedding material.

4. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for the entire body of the pipe. Minimize disturbance of trench subgrade

M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.2 SUBGRADE VERIFICATION AND PROTECTION

A. Subgrade preparation and protection shall be in conformance with WSDOT Standard Specifications Section 2-06. After the exposed subgrade has been inspected and approved by the Geotechnical Engineer, it is the Contractor's responsibility to protect the subgrade from deteriorating and becoming unsuitable.

B. Overexcavate any soft, organic, loose, or disturbed soils identified by the Geotechnical Engineer and replace with compacted imported structural fill.

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C. Following site preparation and excavation for the buildings, paved surfaces, roadways, walls and utilities, the exposed subgrades shall be observed and approved by the Geotechnical Engineer. If required by the Geotechnical Engineer, provide equipment and labor for proof rolling

3.3 BACKFILL AND FILL

A. For backfill of all excavations, use imported material sampled and tested by the Geotechnical Engineer.

B. All fill used for the following shall be imported structural fill:

1. Backfill against footings, foundations and structural walls.

2. Fill beneath building slabs, except gravel backfill for drains shall be placed beneath building slabs for foundation drainage.

3. Fill beneath the base of pavements.

C. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Acceptance by Owner's Representative of construction below finish grade including, where applicable, subgrade compaction, waterproofing, and piping.

2. Inspection, testing, approval, and recording locations of underground piping. Coordinate locations with surveyor for as-built survey.

3. Removal of concrete formwork.

4. Removal of shoring and bracing and backfilling of voids with satisfactory materials.

5. Removal of trash and debris.

6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

7. Removal of Support and Safety Systems

D. Ground Surface Preparation:

1. Remove vegetation, debris, unsatisfactory soil materials, obstructions and deleterious materials from ground surface prior to placement of fills. Refer to WSDOT Standard Specifications Section 2-01.

2. When existing ground surface has a density less than that specified in Section 3.4, Compaction for the particular area classification: break up the ground surface, pulverize, and moisture-condition to within 2 percent of the optimum moisture content, and compact to required depth and percentage of maximum density.

E. Placement and Compaction: Allowable thickness of fill lifts will depend on the material type and compaction equipment used. Do not place imported backfill and fill materials in layers more than 8 inches in loose depth for material compacted by heavy compaction equipment, layers more

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than 4 inches in loose depth for material compacted by hand-operated tampers, and layers more than 2 inches in loose depth for material compacted by small walk behind vibrating plate/sled compactors.

1. Before compaction, moisten or aerate each layer as necessary to provide the optimum moisture content.

2. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification.

3. Do not place backfill or fill material on surfaces muddy, frozen, or containing frost or ice.

4. Place backfill and fill materials in such a manner as to prevent wedging action of backfill against structures

3.4 COMPACTION

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area.

B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D 1557 ("Modified Proctor"):

1. Structures: Compact top 12 inches of subgrade where exposed, and each layer of backfill or fill material to 95 percent of maximum dry density.

2. Building Slabs and Steps: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.

3. Walkways: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.

4. Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent of maximum dry density.

5. Utility Bedding and Backfill: Compact each layer of bedding and backfill to 95 percent of maximum dry density

6. Crushed Surfacing Base Course: Crushed surfacing shall be compacted to 95 percent of the maximum dry density. Crushed surfacing shall be placed and compacted in conformance with WSDOT Standard Specifications Section 4-04.3.

7. Fill Placed Against Subgrade Walls: Compact between 90 to 92 percent of maximum with small hand-operated equipment to avoid over compaction

C. Compaction of subgrade for Pervious Concrete shall conform to COK pre-approved plan CK-L.07.

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D. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material. Prevent free water from appearing on surface during or subsequent to compaction operations. Remove and replace, or scarify and air dry, soil material too wet to permit compaction to specified density. Control the moisture content of the Fill Material to within 2 percent of the optimum moisture content

3.5 GRADING

A. General: Uniformly grade areas of work including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces shall be free from irregular surface changes.

C. Compact as specified and to the required elevation. Provide final grades within a tolerance of 1/2-inch when tested with a 10-foot straightedge.

3.6 EARTHWORK FOR UTILITIES

A. Trench excavation, bedding, and backfill for utilities shall conform to applicable sections of the WSDOT Standard Specifications and NUD Standard Specifications Methods of Construction.

B. Whenever a new Storm Drain clears an existing or new Sewer or Storm Drain by 6-inches or less, polyethylene plastic foam shall be placed between the pipes as a cushion prior to backfilling.

3.7 Wet Weather Provisions

A. Schedule earthwork operations to minimize the potential for erosion, siltation, and disturbance of site soils.

B. Perform earthwork operations in discrete areas as required to minimize the exposure of disturbed soils to wet weather

C. Compact exposed soil to reduce the infiltration of rainwater.

D. Direct surface water away from fills and excavations.

E. Provide temporary pumping equipment to keep excavations and construction free of water.

F. Soils that become too wet for compaction shall be removed and replaced with compacted structural fill.

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G. Review additional wet weather earthwork provisions provided in geotechnical report prepared HWA Geosciences Inc, dated June 8, 2020.

3.8 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. At the expense of Contractor, remove any unused excess excavated material from the site, and dispose of legally off the Owner's property, prior to final inspection.

B. Remove waste materials, including unacceptable excavated material, trash and debris, and dispose of legally off the Owner's property.

C. Compact exposed soil to reduce the infiltration of rainwater.

3.9 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Coordinate and allow the Geotechnical Engineer to observe, test and approve all building, pavement, trench and utility structure subgrades, backfill, and fill layers before further construction work is performed.

B. Subgrade for structures and retaining walls shall be observed by the Geotechnical Engineer for bearing capacity verification prior to concrete placement. Compaction control tests shall be performed, if in the opinion of the Geotechnical Engineer they are necessary. Refer to WSDOT Standard Specifications Section 2-03.3(14)D for compaction control tests.

C. If subgrades or fills that have been placed fail to meet the specified requirements for density, the Contractor shall provide corrective work as specified at no additional expense to the Owner

3.10 PROTECTION

A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, compact to required density and provide other corrective work as specified, with retesting, prior to further construction.

END OF SECTION

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Furnish, install and operate all necessary equipment for dewatering of excavation and trenches.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 01 57 13 – Temporary Erosion and Sediment Control

2. 31 00 00 – Earthwork

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

C. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.4 SUBMITTALS

A. See Division 01 Submittal Procedures.

B. Dewatering design and plans that require dewatering wells shall be prepared, stamped and signed by Professional Engineer registered in the State of Washington, who has expertise in dewatering facilities and shall be submitted to Owner's Representative.

1.5 QUALITY CONTROL

A. Disposal of water from dewatering activities shall comply with all local, state and federal laws and ordinances, including COK erosional control pre-approved plan, Policy E-1.

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1.6 PROJECT CONDITIONS

A. Subsurface conditions have been investigated by HWA Geosciences Inc and documented in their geotechnical report dated June 8, 2020. See Project Manual Appendix for a copy of the geotechnical report. Contractor shall review all reports, assessments, and investigations to familiarize themselves with site conditions and requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Provide and operate equipment adequate to keep all excavations and trenches free of water in order to install project elements. Do not cause settlement or damage to adjacent property. Dispose of water in a manner that will not damage adjacent property or the environment. Dewater from outside structural limits and from a point below the bottom of the excavation when possible. Dewatering from within the excavation will be permitted where the dewatering and shoring design are specifically coordinated for that expressed purpose. The dewatering system design shall prevent removal of fines from existing ground and shall be routed through Temporary Sediment Tanks for removal of sediments before discharge,

B. Contractor shall monitor dewatering operations on a daily basis and make changes as necessary based on site conditions.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Specifications Section apply to this Section.

B. Geotechnical Report:

1. A geotechnical report has been prepared for this Project and is available for review. The information contained in the report represents the Geotechnical Engineer's interpretation of the subsurface soil and groundwater conditions at the site, the results of laboratory testing, and conclusions and recommendations. Owner will not be responsible for interpretation or conclusions drawn by the Specialty Contractor.
2. The Geotechnical Report was prepared by HWA Geosciences, and is titled Geotechnical Report, Fire Station 24 Replacement, Kirkland Washington, HWA Project No. 2018-057-21, prepared for the City of Kirkland dated, June 8, 2020

    a. Note that the Geotechnical Engineering Report is not a Contract Document and is for only information of likely subsurface conditions

1.2 SUMMARY

A. Section Includes: Section includes design-build aggregate pier soil reinforcement which includes the stabilization of compressible soils which underlie the site, as outlined in the Geotechnical Report, through the use of Aggregate Piers.

B. This Specification Section includes minimum requirements for the Specialty Contractor to follow for the "design-build" process, including:

1. Minimum performance criteria for building foundations.
2. Minimum performance criteria for storm water vault foundations. (For alternate Bid)
3. Minimum requirements and considerations for design of Aggregate Piers system
4. Minimum requirements for installation of Aggregate Pier systems.

C. Scope of Work

1. Work shall consist of designing, furnishing, and installing monitoring and testing aggregate piers for all building and storm water vaults shown on the drawings, to the lines and grades designated on the project drawings and as specified herein. The aggregate pier elements shall be in a columnar-type configuration and shall be used to reinforce soils for the support structural spread footings and where indicated on the drawings
2. It shall be the Specialty Contractor's responsibility to determine and implement the systems and criteria to ensure that the specified performance is achieved.
3. The Specialty Contractor will be responsible for obtaining all necessary permits and approvals for the Aggregate Pier System from the authorities have jurisdiction over this project.

D. Related Requirements:

1. Section 03 10 00 "Concrete Forming and Accessories" for footing formwork affected by work of this Section
2. Section 03 30 00 "Cast-In-Place Concrete"

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3. Division 31 "Earthwork" for earthwork affected by and related to work of this Section

1.3 DEFINITIONS

A. Aggregate Piers: Columns of compacted aggregate used to reinforce the ground to increase bearing capacity and liquefaction resistance, and reduce settlement of a structure. The piers can be constructed with a down-hole vibrator or down-hole tamper.

B. Bottom Feed Vibrators: Down-hole vibrators which are equipped with a hopper and tremie pipe through which the aggregate is fed to the tip of the vibrator. The aggregate backfill is densified in 2 to 3 foot lifts. This equipment is most often used in soil conditions which are too soft or cohesionless to remain open when pre- drilled.

C. Down-hole Tampers: High-energy impact apparatus. The vertical tamping energy is provided by a hammer which is connected to a round, beveled tamper. The apparatus is lowered into a pre-drilled hole to the required treatment depth. If unstable ground conditions are present, then casing may be used in the pre-drilled hole.

D. Down-hole Vibrators: Specially-designed, high-energy depth vibrators. The horizontal vibrations are created by a motor and eccentric weight located near the tip of the vibrator. Extension tubes are bolted to the vibrator to allow it to be lowered to the necessary treatment depth.

E. Predrilling: This procedure consists of drilling an Aggregate Pier location prior to placing aggregate or the down-hole vibrators or tampers to loosen or remove the soil to facilitate compactor penetration.

F. Specialty Contractor: The specialty contracting firm, and any subcontractors or subconsultants who will assist in the design and installation of the Aggregate Pier system.

G. Stone Columns: Aggregate piers that are constructed with a down-hole vibrator. For soils and groundwater conditions in which the predrilled hole remains open and stable, the aggregate can be placed directly into the open hole and compacted in lifts using a down-hole vibrator. In unstable conditions, the hole stability must be maintained with a bottom feed down-hole vibratory, or other suitable method.

1.4 REFERENCES

A. Reference Standards: Conform to provision of Section 01 42 00.

B. ASTM International (ASTM):

1. ASTM D422 Standard Test Method for Particle Size Analysis of Soils
2. ASTM D1194 Standard Test Method for Bearing Capacity of Soil for Static Load and Spread Footings
3. ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load
4. ASTM D1241 Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses
5. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft lbf/ft^3 (2,700 kN m/m^3))
6. ASTM D 1586 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils (e.g. Standard Penetration Test [SPT] Sampling).

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7. ASTM D 5778 - Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils (e.g. Cone Penetration Test (CPT) probes).

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Conform to Section 01 31 00 for coordination with work of other Sections.

B. Sequencing and Scheduling: Conform to provisions of Section 01 32 00 to meet project construction schedule. Include provisions for delivery of long-lead items.

C. Where specifications and reference documents conflict, the Specialty Contractor shall make the final determination of the applicable document

1.6 ACTION SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Specialty Contractor shall submit the following with the bid documents:

1. A list of at least five previously completed projects of similar scope and purpose for approval by the Owner's Representative. The list shall include a description of the project, relative size, and contact person with phone number.

C. Specialty Contractor shall submit the following at least three weeks prior to the start of work:

1. Design Submittal as outlined in Part 2 of these Specifications consisting of
   a. Construction Drawings:
      1) Sign and seal plans and calculations by a professional engineer licensed in State of Washington.
      2) Indicate spacing, location, sizes, and depth of aggregate piers required to achieve criteria outlined in this specification per Performance and Design Criteria article.
   b. Calculations: Show adherence to design requirements including detailed explanation of design parameters for settlement.
   c. Specifications and Quality Control Methods: Outline of procedures for drilling and installing aggregate piers. Include:
      1) Proposed materials.
      2) Description of equipment to be used, including instrumentation (e.g. sensors, gauges, etc.) on equipment to be used for QA/QC processes. Complete equipment specifications should be submitted to the Engineer prior to commencement of field work.
      3) Description of methods for control of spoils, water, slurry, or other debris.
      4) Description of recommended QA/QC procedures.
2. Identification of potential spoils-contaminated or disturbed surfaces/subgrades which may result from the Aggregate Pier installation process and subsequently require removal or repair (e.g. overexcavation) by the General Contractor.
3. Notifications to Architect/Owner, Structural Engineer, and Geotechnical Engineer of changes from accepted specifications and quality control methods.

D. Specialty Contractor shall submit the following at least two weeks prior to the start of work:

1. Resumes of the management, supervisory, and key personnel.

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2. Field Quality Control Testing details, layout, and setup plans for Modulus Test or CPT/SPT tests to confirm that the installation procedure produces the Aggregate Pier modulus used in design.

E. Specialty Contractor shall submit the following at least one week prior to the start of work:

1. Aggregate: A 50-pound sample of aggregate to be used for Aggregate Pier backfill to be evaluated and tested (if necessary) for conformance with these Specifications and the Specialty Contractor's design. The sample should be delivered to the Geotechnical Engineer's Office.

F. Specialty Contractor shall submit the following within three working days of completion of the Field Quality Control Testing:

1. Modulus Test Reports - The Specialty Contractor shall furnish the Owner's representative a description of the installation equipment, installation records, 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 the direction of a licensed Professional Engineer.
2. CPT/SPT Test Reports - The Specialty Contractor shall furnish the Owner's representative a description of the equipment used, boring/CPT probe logs, analysis of the data and verification of the design parameter values based upon the CPT/SPT test results. The report shall be prepared under direction of a licensed Professional Engineer

G. Specialty Contractor shall submit the following on a daily basis during Aggregate Pier installation:

1. Daily progress reports collected as part of the Quality Control inspections.

H. Specialty Contractor shall submit the following within five working days of the completion of work:

1. A report documenting the as-built conditions of all Aggregate Piers and results of all tests. This report shall certify that the Aggregate Pier system was installed in conformance with these Specifications and the Specialty Contractor's design, and that Performance Criteria for static and seismic settlement and bearing capacity have been met.

1.7 INFORMATIONAL SUBMITTALS

A. Weight Certificates/Batch Tickets: For all aggregate materials delivered to the site.

B. Professional Liability Insurance: The Aggregate Pier designer shall have Errors and Omissions design insurance for the work. The insurance policy should provide a minimum coverage of $1,000,000 per occurrence and $2,000,000 in the aggregate. A certificate documenting such insurance shall be provided to the Owner.

C. Contractor's Liability Insurance: The Specialty Contractor shall have general liability insurance for the work. The insurance policy should provide a minimum coverage of $3,000,000 per occurrence. The project Owner, General Contractor, Architect, Engineer, and Geotechnical Engineer shall be named as "additional insured" parties. A certificate documenting such insurance and showing the additional insured parties shall be provided to all parties.

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1.8 RECORD SUBMITTALS

A. At the completion of the project the Specialty Contractor shall submit a record drawing confirming the as-built layout, size, spacing and extent, including depth, of the installed aggregate piers.

1.9 PRE-QUALIFIED DESIGN-BUILD CONTRACTORS

A. Geopier Foundation Company Northwest, Inc. Website http://www.geopier.com/

B. Hayward Baker, Inc. Website http://www.haywardbaker.com/

C. Substitution Requests: Submit for approval under provisions of Section 01 25 00.

D. Pre-qualification is not required. Other Specialty Contractors not listed above must show evidence of full compliance with the Specialty Contractor Qualifications listed below.

E. Any Specialty Contractor which does not meet the qualification requirements shall be removed from the job and replaced with one that does. The contractor shall bear full responsibility for cost and time impacts resulting from such change.

1.10 SPECIALTY CONTRACTOR QUALIFICATIONS

A. Specialty Contractor shall be a licensed contractor in the State of Washington

B. Certified by International Code Council and acceptable to authority having jurisdiction (AHJ).

C. Pre-qualified and approved by Owner, Architect, Structural Engineer of Record minimum two weeks prior to bid opening.

D. Able to demonstrate satisfactory experience with design and installation of Aggregate Pier Soil Reinforcement with minimum of 5 years' experience in installation of aggregate pier soil reinforcement and completion of at least 10 projects of similar scope magnitude, and/or soil conditions, and their work shall have resulted in construction with a record of successful in-service performance.

E. Employ a registered professional engineer to conduct and supervise design and installation and shall have a minimum five (5) years of design experience in the field and a minimum of five (5) projects of similar scope, magnitude, and/or soil conditions, and their work shall have resulted in a record of successful project performance.

F. The Specialty Contractor shall provide experienced management, supervisory, and key personnel as required to install the Aggregate Pier system, as follows:

1. Specialty Contractor shall provide at least one person (project manager or project superintendent) who shall be present at all times during execution of the portion of the work, shall be thoroughly familiar with the type of work being performed, and the best methods for its execution, and shall direct all work performed under this section.
2. The project manager shall have at least three years of experience in installation of Aggregate Piers using similar equipment and methodologies as proposed by the Specialty Contractor.
3. The project manager should have at least two years of full-time employment with the Specialty Contractor.

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4. The project superintendent shall have at least two years of experience in installation of Aggregate Piers using similar equipment and methodologies as proposed by the Specialty Contractor

1.11 QUALITY ASSURANCE

A. Quality Control Representative:

1. Maintain on site by aggregate pier contractor during course of work of this Section to verify and report work procedures.
2. Perform duties under supervision of a registered professional engineer employed by Aggregate Pier Contractor. Owner will retain Geotechnical Engineer of Record for third party quality assurance services.
3. Promptly report unusual conditions encountered during work to Structural Engineer, Contractor, and to Geotechnical Engineer of Record.

B. Daily Aggregate Pier Progress Report: Complete each day of installation. Include following:

1. Footing and aggregate pier locations.
2. Aggregate pier lengths and drilled diameter.
3. Planned and actual aggregate pier elevations at top and bottom of element.
4. Average lift thickness for each aggregate pier.
5. Soil types encountered at bottom of aggregate pier and along length of element.
6. Depth to groundwater, if encountered.
7. Documentation of unusual conditions encountered.
8. Type and size of densification equipment used.
9. Provide a Daily Aggregate Pier Progress Report to the on-site Geotechnical Engineer and General Contractor at the end of each work day.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Conform to provisions of Section 01 60 00, and manufacturer's instructions.

B. Deliver materials to jobsite in quantities and in a timely manner to assure conformity of activities with project schedule.

C. Aggregate: Deliver, store, and handle aggregate to prevent segregation of aggregate materials, and protect from dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 SYSTEM

A. Work consists of designing, furnishing, and installing aggregate pier elements as designated on the project foundation plan and as specified by this Section.

B. Construct aggregate pier elements by compacting aggregate in a hole created by drilling or by displacement of existing soils and using special high-energy impact densification equipment.

C. Use columnar-type aggregate pier elements to reinforce soils for support of high bearing pressure spread footings.

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2.2 PRODUCTS

A. Aggregate: The backfill aggregate should consist of relatively hard, angular to subangular durable rock fragments, with maximum particle size of 1 ½ inches. The material to be used should be approved by the Geotechnical Engineer. A gradation meeting the No. 57 (ASTM C33) criteria is typically acceptable.

B. Other Materials: All other materials not specifically described but required for proper completion of the work of this Section, shall be as selected by the Specialty Contractor subject to the approval of the Architect and/or Geotechnical Engineer.

2.3 EQUIPMENT

A. Specialty Contractor shall provide all equipment necessary to accomplish the required Aggregate Pier installation, including predrilling and casing if needed.

B. Equipment shall be adequate to function within the operating parameters outlined in the Specialty Contractor's design documents.

C. Down-hole Vibrator: Should the Specialty Contractor use a down-hole vibrator, the vibrator shall be capable of providing at least 80 HP of rated energy and centrifugal force of 15 tons. An appropriate metering device should be provided at such a location that inspection of amperage increase may be verified during operation of the equipment. The metering device may be an ammeter directly indicating the performance of the vibratory tip.

D. Down-hole Tamper: Should the Specialty Contractor use a down-hole tamper, the tamper shall have a diameter that is at least 90% of the predrilled hole diameter, and be long enough to reach the full depth of the predrilled hole. The tamper shall have an energy rating of at least 1,225 foot-pounds and shall apply direct downward impact energy to each lift of aggregate.

2.4 PERFORMANCE AND DESIGN CRITERIA

A. General: The design of the Aggregate Piers (e.g., layout, depth, diameter, spacing, etc.) shall be based upon the minimum loads, capacities, and settlement criteria in this Section, and upon the recommendations within the Geotechnical Report. Where conflicts exist between these Specifications and the Geotechnical Report, contact the Geotechnical Engineer for clarification

B. Loads and Capacities:

1. Fill Loads: The aggregate Pier design shall account for loading from the placement of the fills (including soils fill, aggregate base, and pavements) within the limits of the reinforced areas. Refer to the grading plans in the drawings to determine fill thicknesses.
2. Bearing Capacity: The Aggregate Pier design shall achieve:

   a. Building area - Allowable foundation soil bearing pressure for footing design of 5,000 pounds per square foot, with a one third increase for transient wind and seismic loading
   b. Storm Water Vault - Allowable foundation soil bearing pressure for footing design of 5,000 pounds per square foot, with a one third increase for transient wind and seismic loading

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3. The Specialty Contractor's design and layout of Aggregate Piers shall provide uniform sustained support for all structural loads identified in these Specifications. Aggregate Pier layout may extend beyond the indicated building envelope in order to provide uniform sustained support for specified loads. The exterior limits of the building footprint and planned foundation elements are shown on the Construction Drawings

C. Settlement Criteria:

1. Long-term static settlement for the building footings and storm water vault footings:

a. Total: < 1 inch.
b. Differential: = 1/ inch over a 50-foot distance

D. Provide guidelines for completing and backfilling excavations adjacent to aggregate piers in aggregate pier design submitted. In guidelines address distance and depth to which excavations can be made adjacent to piers and provisions for backfilling and compacting fill in excavations. In guidelines address repair of aggregate piers should surface of pier become disturbed during construction.

PART 3 - EXECUTION

3.1 GENERAL

A. Prior to all work of this Section, Specialty Contractor shall become thoroughly familiar with the site, site conditions, and all portions of the work falling within this Section.

B. Notify the Owner, Architect, General Contractor, and Geotechnical Engineer at least five full working days prior to commencing work.

C. Do not close or obstruct streets, walks, or other adjacent properties without permission from General Contractor, Owner, and authorities having jurisdiction.

D. Specialty Contractor shall perform pre-construction inspections of nearby buildings, utilities, and other improvements which may be affected by installation of Aggregate Piers. The Specialty Contractor is responsible for damages to buildings, utilities, or other improvements which are attributed to their work

3.2 AGGREGATE PIER INSTALLATION

A. Specialty Contractor shall develop the Aggregate Piers installation procedures in accordance with the standard of practice for similar projects. The use of compressed air is not permitted as part of the process for predrilling or insertion of bottom feed installation tools. In general, the installation procedures should be as follows:

1. Aggregate Piers:

a. Pre-drilling to the design depth will be performed with an auger of a diameter equal to the finished column diameter.
b. Down-hole Vibrator Method: If the hole will remain temporarily stable, the hole may be filled with aggregate to a level above the instability as long as the vibrator is still able to penetrate to within 1 foot of the predrilled depth. If the hole will not remain temporarily stable, a Bottom Feed Down-hole vibrator should be used. The vibrator will be raised and lowered repeatedly, such that

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on each re- penetration, the tip of the vibrator advances to within 12 inches of the previous penetration depth.

c. Down-hole Tamper Method: If the hole will not remain temporarily stable, a casing with a minimum outside diameter equal to the pier diameter can be advanced to the full treatment depth. The casing is extracted after each lift is compacted with the bottom of the casing always maintained below the top of the aggregate. Compaction and cycle or lift thickness shall adequately increase soil index properties to meet the Specialty Contractor's design requirements for Modulus and CPT/SPT testing, if such testing is included in the Specialty Contractors design and verification testing program.

2. Stone Columns:

a. If needed, pre-drilling to the design depth will be performed with an auger diameter equal to or smaller than the finished column diameter. If the hole will remain temporarily stable, the hole may be filled with aggregate to a level above the instability as long as the vibrator is still able to penetrate to within 1 foot of the pre-drilled depth. If the hole will not remain temporarily stable, a Bottom Feed Down-hole vibrator should be used. The vibrator will be raised and lowered repeatedly, such that on each re-penetration, the tip of the vibrator advances to within 12 inches of the previous penetration depth

3. Field Quality Control:

a. Testing of the Aggregate Pier system to verify the design assumptions shall consist of either Modulus Tests of individual Aggregate Piers or CPT/SPT testing on soils between the Aggregate Piers, as specified by the Specialty Contractor in their approved Quality Assurance/Quality Control plan and as described in Part 5 of this Section. The proposed tests shall be appropriate for confirmation of the design parameters/assumptions used by the Specialty Contractor's designer.

1) Modulus Test:
a) At least two Modulus Tests shall be completed at the site prior to the start of "production" Aggregate Piers.
2) CPT/SPT Testing:
a) At least four CPT/SPT tests shall be advanced at representative locations across the area to be treated prior to installation of Aggregate Piers, and again at the same locations after installation of Aggregate Piers.
b) CPT/SPT testing shall be performed in between Aggregate Pier locations at points which are equidistant from the nearby Aggregate Piers.

b. The Geotechnical Engineer shall approve of the location(s) of the Modulus and/or CPT/SPT Tests.

c. The costs of the testing shall be paid by the Specialty Contractor.

B. If testing indicates that the Aggregate Piers do not meet the design requirements, then the Specialty Contractor shall take whatever steps are necessary to redesign the Aggregate Pier ground improvement system until it meets the project requirements at no additional cost to the Owner.

C. Aggregate Piers should be reinstalled if cave-ins occur during the aggregate placement such that the volume of caved-in soil is greater than 10 percent of the aggregate being placed.

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D. The as-built center of each Aggregate Pier shall be within 6 inches of the locations indicated on the plans. Aggregate Piers installed outside of the above tolerances and deemed not acceptable shall be rebuilt at no additional expense to the Owner.

E. Unanticipated obstructions, such as boulders, timbers, concrete, bricks, utility lines, etc., encountered during excavation or drilling that will prevent installation of the Aggregate Piers to design depth or location shall be removed. To the extent the obstructions are identified in the Geotechnical Report or other Contract documents, removal of obstructions shall be performed by the Specialty Contractor at no additional cost to the Owner.

F. Installation of Aggregate Piers shall not disturb, damage, or alter Settlement Plates installed to document settlement mitigation. The Specialty Contractor shall bear the cost of restoring disturbed, damaged, or altered settlement plates. This may include material, surveying, contractor, and Geotechnical Engineering costs. If conflict arises between installed settlement plates and the layout of Aggregate Piers, the Geotechnical Engineer shall be notified

3.3 JOB CONDITIONS/CLEAN UP

A. Specialty Contractor shall use all reasonable means necessary to prevent surficial and airborne spread of soil spoils, slurry, water, oil, grease, and dust during performance of the work of this Section. Thoroughly moisten all surfaces as required to prevent dust from being a nuisance to the public, neighbors, and concurrent performance of other work on the site.

B. Unless otherwise negotiated with the General Contractor, Specialty Contractor shall remove all spoils, water, slurry, and other debris associated with installation of Aggregate Piers from the site.

3.4 PERMITS

A. The Owner will obtain a grading permit for this project. However, that grading permit will not include the work related to the Aggregate Pier design or installation. The Specialty Contractor shall be responsible for securing all necessary permits from the authorities having jurisdiction over the project for the Aggregate Pier system, including submitting all necessary material for review, paying for, and picking up the permits.

3.5 FIELD QUALITY CONTROL/QUALITY ASSURANCE

A. GENERAL

1. Due to the specialized nature of the Aggregate Pier design and construction, Quality Control shall primarily be the responsibility of the Specialty Contractor with limited review by the Geotechnical Engineer on the Owner's behalf. The Owner is responsible for retaining the Geotechnical Engineer to provide Quality Assurance services.

B. FIELD QUALITY CONTROL

1. The Specialty Contractor shall provide full-time Quality Control during installation of the Aggregate Pier system. The following represents the minimum field Quality Control data which should be maintained daily by the Specialty Contractor during the Aggregate Pier installation process:

    a. Date and time of installation.

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b. Materials and equipment used.
c. Specialty Contractor personnel on-site during installation.
d. Installation location of each Aggregate Pier.
e. Volume of aggregate backfill used for each Aggregate Pier.
f. Number of lifts of aggregate placed for each Aggregate Pier.
g. Amount of compactive energy (vibratory or tamping) used during installation and compaction.
h. Top and bottom elevations of each Aggregate Pier.
i. Obstructions or delays.
j. Unusual conditions observed or encountered.

2. The Specialty Contractor shall immediately report any unusual conditions encountered to the General Contractor, their design engineer, and the Geotechnical Engineer.
3. The Specialty Contractor shall provide field testing to determine compliance with these Specifications and the Specialty Contractor's design. The field testing shall consist of Modulus Tests or CPT/SPT testing.

   a. Modulus Test - The Modulus Test shall be performed as described in the Specialty Contractor's approved Design Submittal, and shall generally include:

      1) Loading a pre-production Aggregate Pier and measuring deflections of the Aggregate Pier under load.
      2) Load increments, decrements, and duration, shall be determined using ASTM D1143 as general guidelines.
      3) Surficial disturbance shall be compensated for by applying a seating load equal to 5% of the total load to the loaded steel plate before applying load increments.
      4) Deflections of the top of the test Aggregate Pier shall be measured by a suitable method.
      5) Deflections at the bottom of the test Aggregate Pier shall be measured by means of a telltale installed at the bottom of the test Aggregate Pier. Performance will be deemed acceptable when, at the specified design stress, deflection at the bottom of the pier does not exceed a specified percentage of the deflection at the top of the pier. The deflection ratio shell be determined by the Specialty Contractor, and shall be justified in their approved Design Submittal.
      6) The Specialty Contractor shall provide and install all dial indicators and other measuring devices required for the Modulus Test.

   b. CPT/SPT Testing - CPT/SPT testing shall be performed as described in the Specialty Contractor's approved Design Submittal, and shall generally include:

      1) Advancement of CPT probes in general accordance with ASTM D5778, or drilling of borings and collection of SPT samples in general accordance with ASTM D1586.
      2) The probes/borings shall extend to at least 5 feet below the depth of the Aggregate Piers.
      3) If drilled borings are used, the SPT samples should be collected at intervals no greater than 5 feet on center.
      4) Equipment and procedures used for pre- and post-production testing shall be the same, so that an accurate comparison of data may be made.

4. Rejection of Aggregate Piers:

   a. If an Aggregate Pier is installed in an incorrect location of exceeds the specified tolerances, the Specialty Contractor shall replace the pier. Pier replacement may be avoided if alternate remedial procedures are approved by the Specialty Contractor's licensed design engineer and the Geotechnical Engineer.

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b. Unless the rejection is caused by obstruction, refusal in rock or dense soil, or errors in the Owner's project drawings, the cost of all labor and material required for the replacement shall not be the responsibility of the Owner.
c. If field testing indicates that the Aggregate Piers or soil densification do not meet the criteria noted in the Specialty Contractor's design, than at no additional cost to the Owner the Aggregate Piers should be recompacted or replaced, and/or the design revised and supplemental Aggregate Piers installed by the Specialty Contractor.
d. The Geotechnical Engineer shall review any proposed revisions or mitigation work.

5. All Quality Control data shall be immediately available for review by the Architect, Engineer, and Geotechnical Engineer as it is collected by the Specialty Contractor. Copies of the daily records for each Aggregate Pier shall be provided to the Architect, Engineer, and Geotechnical Engineer on a daily basis.

3.6 FIELD QUALITY ASSURANCE

A. All Aggregate Pier operations shall be performed under the observation and documentation of the Geotechnical Engineer.

B. The Owner will employ the Geotechnical Engineer to observe and document the Aggregate Pier installation. This work may include the following: recording of Aggregate Pier depths, observance of the Specialty Contractor's procedures, recording of compaction energy information, and observation of Modulus Tests.

C. Specialty Contractor shall notify the Geotechnical Engineer at least five days prior to mobilization and start of Aggregate Pier installation, and then at least two days prior to the re-start of work after a delay of more than five days of at the start of each phase of the Aggregate Pier installation work.

D. The Geotechnical Engineer shall be considered the Owner's representative on the job during soil stabilization operations. Work which, in their opinion, does not meet the Specification requirements or Specialty Contractor's design documents, shall be removed or otherwise corrected as the Geotechnical Engineer directs.

E. The Geotechnical Engineer will observe Aggregate Pier installation work completed by the Specialty Contractor and submit a written report to the Owner stating whether or not the work was performed in accordance with the Specialty Contractor's design documents.

F. The presence of the Geotechnical Engineer does not relieve the Specialty Contractor of their duty to provide Quality Control services and meet these design and construction specifications.

3.7 SITE PREPARATION AND PROTECTION

A. The General Contractor shall be responsible for site preparation and protection and as follows:

1. The General Contractor shall locate and protect underground and aboveground utilities and other structures from damage during installation of the Aggregate Piers.
2. Site grades for Aggregate Pier installation shall be within 1 foot of existing grade. Ground elevations and bottom of footing elevations shall be provided to the Specialty Contractor in sufficient detail to estimate installation depth elevations to within 3 inches.

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3. Prior to, during and following Aggregate Pier installation, the General Contractor shall provide positive drainage to prevent surface ponding of water.

END OF SECTION

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Construction of asphalt pavement surfaces for road, bike path and site paving.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 31 00 00 – Earthwork

2. 32 17 23 – Pavement marking and signage

3. 33 13 00 – Concrete Paving

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

C. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

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. See Division 01 Submittal Procedures

B. Produce Data: For each type of product indicated.

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1.6 QUALITY ASSURANCE

A. Hot mix asphalt (HMA) pavement shall be mixed and tested per the WSDOT Specifications Section 5-04.3(6).

B. HMA pavement shall be installed in conformance with WSDOT Standard Specifications Section 5-04.3(1).

1.7 COORDINATION

A. Contractor shall coordinate limits of asphalt pavement restoration in the field based upon limits of excavation for utility construction.

B. Contractor shall coordinate limits of grind and overlay with City of Kirkland prior to commencing grind and overlay work.

C. Coordinate traffic control plans and site access with COK for work within the public right-of-way.

PART 2 - PRODUCTS

2.1 HOT MIX ASPHALT

A. Asphalt Concrete within property limits shall be Hot Mix Asphalt (HMA) Class 1/2 inch PG 58 H-22 per WSDOT Specifications Sections 5-04, 9-02.1 and 9-03.8

B. Asphalt Concrete within right-of-way limits shall be HMA Class 1/2 inch PG 64-22 per WSDOT Specifications Sections 5-04, 9-02.1 and 9-03.8

PART 3 - EXECUTION

3.1 HOT MIX ASPHALT

A. Prepare subgrade and base courses for paving in conformance with Section 31 00 00.

B. Hot Mix Asphalt pavement shall be constructed in conformance with the grades and elevations on the Drawings and WSDOT Standard Specifications Section 5-04.3.

C. Asphalt concrete pavement more than 3 inches thick shall be placed in multiple layers. Each layer shall not exceed 3 inches in thickness, or be less than 2 inches.

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D. New asphalt pavement sections shall conform to sections as shown in the Drawings and per geotechnical engineer recommendations. Asphalt pavement restoration in the right of way shall conform to COK pre-approved plans CK-R.12.

3.2 TRAFFIC CONTROL

A. Protect new onsite HMA paving from equipment and traffic, until the Owner Representative has inspected and approved the paving to be opened to traffic

B. Protect new offsite HMA paving from equipment and traffic, until the COK representative has inspected and approved the paving to be opened to traffic

END OF SECTION

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Construction of concrete pavement for roadways, sidewalk, driveways, curb ramp and pervious concrete sidewalk. Construction of concrete curbs, and curb and gutter.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 31 00 00 – Earthwork

2. 32 12 00 – Flexible Paving

3. 32 17 23 – Pavement marking and signage

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

C. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

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. See Division 01 Submittal Procedures.

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B. Design Mixtures: For each concrete pavement class, provide technical data demonstrating compliance with the COK roadway pre-approved plans WSDOT Standard Specifications.

C. Manufacturer's technical data demonstrating that materials meet the COK roadway pre-approved plans and WSDOT Standard Specifications.

1.6 QUALITY ASSURANCE

A. Quality controls shall be in conformance with WSDOT Standard Specifications Section 5-05.

B. Cold weather work shall be in conformance with WSDOT Standard Specifications Section 5-05.3(14).

1.7 COORDINATION

A. Coordinate traffic control plans and site access with COK for work within the public right-of-way.

PART 2 - PRODUCTS

2.1 CONCRETE SIDEWALKS

A. Concrete sidewalks onsite and in the right of way shall conform to COK pre-approved plans CK-R.23

2.2 CONCRETE CURB RAMPS

A. Curb ramps shall be type specified in Drawings and conform to WSDOT Standard Plans Section F curb, sidewalks and driveways.

B. Detectable warning surfaces shall conform to COK pre-approved plans CK-R.25B.

2.3 CONCRETE CURB AND CURB AND GUTTER

A. Concrete vertical curb shall conform to COK pre-approved plans CK-R.17C.

B. Concrete curb and gutter shall conform to COK pre-approved plans CK-R.17.

C. 2-foot wide dual-faced concrete traffic curb shall conform to WSDOT Standard Plan F-10.12-03.

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2.4 CONCRETE DRIVEWAY AND APRONS

A. Concrete driveway sections shall be per Drawings and conform to WSDOT Standard Specifications, Section 5-05.2.

B. Concrete aprons shall conform to WSDOT Standard Plans F-80.10-04.

2.5 PERVIOUS CONCRETE SIDEWALK

A. Pervious concrete sidewalk shall conform to COK pre-approved plans CK-L.06.

PART 3 - EXECUTION

3.1 CONCRETE SIDEWALK INSTALLATION

A. Installation shall conform to COK pre-approved plans CK-R.23

3.2 CONCRETE CURB RAMPS

A. Installation shall conform to WSDOT Standard Specification Section 8-14 and as shown on Drawings.

3.3 CONCRETE CURB AND CURB AND GUTTER

A. Concrete vertical curb installation shall conform to COK pre-approved plans CK-R.17C and WSDOT Standard Specifications Section 8-04.

B. Concrete curb and gutter installation shall conform to COK pre-approved plans CK-R.17 and WSDOT Standard Specifications Section 8-04.

C. 2-foot wide dual-faced concrete traffic curb installation shall conform to WSDOT Standard Specifications Section 8-04.

3.4 CONCRETE DRIVEWAY

A. Contractor shall submit control joint layout plan for review and approval to Owner's Representative prior to concrete driveway installation. Joint layout shall conform to geotechnical engineer's recommendations. Concrete driveway installation shall conform to WSDOT Standard Specifications Section 5-05.3.

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B. Concrete apron installation shall conform to WSDOT Standard Specifications Section 8-06.3.

3.5 PERVIOUS CONCRETE SIDEWALK

A. Installation shall conform to COK pre-approved plans CK-L.06.

END OF SECTION

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Furnishing, installing and removal of pavement markings and signage.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 32 12 00 – Flexible Paving
2. 33 13 00 – Concrete Paving

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

C. Manual of Uniform Traffic Control Devices (MUTCD), May 2012 edition.

D. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.4 SUBMITTALS

A. See Division 01 Submittal Procedures.

B. Produce Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Pavement marking and signage shall conform to material and installation shall conform to COK roadway pre-approved plans and WSDOT Standard Specifications and Plans.

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1.6 COORDINATION

A. Contractor shall coordinate final locations of relocated signage and location of pavement markings with COK and traffic engineer prior to installation.

PART 2 - PRODUCTS

2.1 PAINT

A. Paint for pavement markings shall comply with WSDOT Standard Specification Section 9-34.2

2.2 GLASS BEADS

A. Glass Beads for pavement markings shall comply with WSDOT Standard Specification Section 9-34.4

2.3 PLASTIC

A. Plastic for pavement markings shall comply with WSDOT Standard Specification Section 9-34.3

2.4 SIGNS

A. Signage and posts shall comply with COK pre-approved plan CK-R.43 and MUTCD.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING REMOVAL

A. Pavement marking removal shall comply with WSDOT Standard Specifications Section 8-22.3(6)

3.2 PAVEMENT MARKING

A. Pavement markings shall comply with COK roadway pre-approved plans CK-R.28 to CK-.R31.

B. Prepare pavement surface by removing all surface dirt and contaminants from the areas to receive pavement markings per WSDOT Standard Specifications Section 8-22.3(2).

C. Preliminary spotting and layout of the pavement markings shall be per WSDOT Standard Specifications Section 8-22.3(1).

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D. Apply pavement markings to clean, dry pavement surfaces in accordance with WSDOT Standard Specifications Section 8-22.3(3).

3.3 SIGNAGE

A. Street or traffic signs noted to be relocated shall be removed, salvaged and reinstalled. Final location of relocated sign shall be coordinated with the COK transportation and traffic department and installed per COK pre-approved plan CK-R.43.

END OF SECTION

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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. Chain-link fence including and related accessories.
2. Manual swinging gates.
3. Gate Hardware

B. Related Sections:

1. Division 01 Section "Sustainable Design Requirements" for applicable LEED requirements.
2. Division 03 Section for cast-in-place concrete.
3. Division 08 Section 08 7100 for additional hardware.
4. Division 26 Sections for electrical service and connections for motor operators, controls, limit and disconnect switches and safety features and system disconnect switches.
5. Division 32 Section for Motor Operated Gates and Ornamental Fences

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. Product Data: For each type of product indicated.

1. Fence and gate posts, rails, and fittings.
2. Chain-link fabric, reinforcements, and attachments.
3. Gate Hardware.
4. Finish.
5. Accessories.

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B. Warranty: Sample of special warranty (to be included in maintenance manuals per section 01 77 00).

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and structures. Verify dimensions by field measurements.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.

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

a. Deterioration of metals, finishes, and other materials beyond normal weathering.

2. Warranty Period: 5 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist. Comply with CLFMI Product Manual and with requirements indicated below:

1. Fabric Height: As shown on Drawings.

2. Steel Wire Fabric: Zinc-coated steel wire with an uncoated diameter of 0.120 inch (3.05 mm).

a. Mesh Size: 2 inch (50 mm) mesh.

b. Polymer-Coated Fabric: ASTM F 668, Class 2a over zinc-coated steel wire.

1) Color: black, complying with ASTM F 934.

3. Selvage: Knuckled top and bottom selvage.

2.2 FENCE FRAMING

A. Posts and Rails: Comply with ASTM F 1043 for framing, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 or ASTM F 1083 based on the following:

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1. Fence Height: As shown on Drawings.

2. Light Industrial Strength: Material Group IC-L, round steel pipe, electric-resistance-welded pipe.
   a. Line Post: 2.375 inches (60 mm) in diameter or as shown on drawing
   b. End, Corner and Pull Post: 4.0 inches (102 mm) or as shown on Drawings.
   c. Horizontal Framework Members: 1.66 inches (42 mm) in diameter or as shown on Drawings.
   d. Brace Rails: Comply with ASTM F 1043. 1.66 inches (42 mm) in diameter or as shown on Drawings.

3. Finish: Polymer coating over metallic coating.
   a. Color: black, complying with ASTM F 934.

2.3 SWING GATES

A. General: Comply with ASTM F 900 for gate posts and framing of single/double swing gate types.

1. Gate Leaf Width: As indicated.

2. Gate Fabric Height: As indicated.

B. Pipe and Tubing:

1. Zinc-Coated Steel: Comply with ASTM F 1043 and ASTM F 1083; protective coating and finish to match fence framing.

2. Gate Posts: Round tubular steel. as shown on Drawings.
3. Gate Frames and Bracing: Round tubular steel. 2.36 inches (60 mm) in diameter or as shown on Drawings.

C. Frame Corner Construction: Welded or assembled with corner fittings.

D. Hardware:

1. Hinges: Heavy Duty, Self-closing 180-degree swing (in direction indicated on drawings).
2. Latches permitting operation from both sides of gate. See division 08 71 00 Finish Hardware.
   a. Provide weldable mortise mounting – paint per 09 91 00

3. Keyless Lock: Where indicated, provide all required equipment and hardware for complete operation of keyless lock hardware including lever, latch, strike, with keypad. See division 08 71 00 Finish Hardware.
   a. Provide weldable mortise mounting – paint per 09 91 00
   b. Provide weather gaskets and keypad/cardreader shroud and mounting plates

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2.4 FITTINGS

A. General: Comply with ASTM F 626.

B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive top rail.

C. Tension and Brace Bands: Pressed steel

D. Tension Bars: Steel, length not less than 2 inches (50 mm) shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

E. Tie Wires, Clips, and Fasteners: According to ASTM F 626.

1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:

a. Hot-Dip Galvanized Steel: 0.106-inch- (2.69-mm-) diameter wire. .

F. Finish:

1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz. /sq. ft. (366 g /sq. m) zinc.

a. Polymer coating over metallic coating. Color to match fence fabric and framing.

2.5 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

PART 3 - EXECUTION

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3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, retaining wall work, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal 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.

3.3 INSTALLATION, GENERAL

A. Install chain-link fencing to comply with ASTM F 567 and more stringent requirements indicated.

1. Install fencing on established boundary lines inside property line or as indicated on drawings.

3.4 CHAIN-LINK FENCE INSTALLATION

A. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

B. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect above ground portion of posts from concrete splatter.

a. Concealed Concrete: Below grade 2-inches or as shown in drawings, to allow covering with surface material.

C. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment as indicated on Drawings.

D. Line Posts: Space line posts uniformly as shown in Drawings. No more than 8'-0" o.c.

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E. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.

1. Locate horizontal braces as shown in Drawings. Install so posts are plumb when diagonal rod is under proper tension.

F. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer. Install rails as indicated before stretching fabric

G. Bottom Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail terminating into rail end attached to each line or terminal posts fabricated to receive rail. Provide expansion couplings as recommended in writing by fencing manufacturer. Install rails as indicated before stretching fabric

H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches (50 mm) between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 12 inches (300 mm) o.c.

J. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.

1. Maximum Spacing: Tie fabric to line posts at 12 inches (300 mm) o.c. and to braces at 24 inches (610 mm) o.c.

K. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

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3.6 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption or malfunction, throughout entire operational range. Confirm that latches engage accurately and securely without forcing or binding.

B. Lubricate hardware, gate, and other moving parts.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate and maintain gates and operators.

END OF SECTION

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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 Cantilevered Sliding Gate.
2. Sliding Gate Operators.
3. Loop Detector, Controls and Pedestals.
4. Posts for Sliding and Swing Gates.
5. Concrete pads and post bases.
6. Paint finish.
7. PVC-coated, steel chain-link fabric.
8. Polymer-coated steel framework.
9. Emergency Radio Control Auxiliary Click2enter electromechanical door controller

B. Related Sections include the following:

1. Division 03 Section 03 30 00 for concrete pads and post footings.
2. Division 01 Section 01 81 13 for sustainability requirements.
3. Division 05 Section 05 50 00 for gate and gate support materials.
4. Division 08 Section 08 71 00 for compatibility with controls hardware.
5. Division 09 Section 09 91 00 for painting and finishing.
6. Division 26 for electrical service and connections.
7. Division 32 Section 32 31 13 for Chain Link Fence and other Gates.

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. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:

1. Chain-link fabric, reinforcements, and attachments.
2. Gates and hardware.

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3. Gate posts, rails, and fittings.
4. Controls.
5. Finishes.

6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
7. Electrical requirements and connections.

B. Shop Drawings: Show locations of fences, gates, posts, rails, details of extended posts, extension arms, gate movement, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, gate elevations, sections, details, details of post anchorage, attachment, bracing, and other required installation and operational clearances.

1. Gate Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
2. Control pedestals: Show location and details of mounting for each control.

3. Wiring Diagrams: Power and control wiring and access-control features.

C. Samples for Initial Selection: Manufacturer's color charts or 6-inch lengths of actual units showing the full range of colors available for components with factory-applied color finishes.

D. Field quality-control test reports.

E. Maintenance Data: For the following to include in maintenance manuals:

1. Finishes on gates and gate support structures.
2. Gate operator.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify layout information for gate shown on Drawings in relation to fences, curbs, electrical service, structures, finished grade elevation, landscape irrigation and planting. Verify dimensions by field measurements.

B. Interruption of Utility Service: Do not interrupt utility services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of utility services.
2. Do not proceed with interruption of utility services without Architect's written permission.

1.6 WARRANTY

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

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1. Failures include, but are not limited to, the following:
   a. Deterioration of metals, finishes, and other materials beyond normal weathering.
   b. Motor operation or controls.

2. Warranty Period: 5 years from date of Final Acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Custom Aluminum Cantilevered Sliding Gate System:
   a. Quality Fence Builders; Auburn, WA.
   b. Or Approved Equal.

2. Gate Operators (for cantilever sliding gate system):
   a. Model Slide Driver 15 UPS w/ smart controller and battery back-up by HySecurity
   b. Or Approved Equal.

2.2 CANTILEVERED SLIDING GATES

A. Custom design "Fast-Trac Aluminum Cantilever Gate" system by Quality Fence Builders.

B. Slide gates shall be Aluminum Horizontal Cantilever style. Gate sizes and design as shown on the Drawings and shall conform to the following:

1. Gate Frames: Fabricated in accordance with ASTM F 1184, Type II, Class 2, using 2 inch aluminum vertical frame members weighing 1.13 lb./ft, 3 inch x 4 inch aluminum bottom frame member weighing 1.73 lb./ft. and a one-piece aluminum track/frame member weighing a minimum of 4.62 lb./ft. and whose 2 inch square frame member has a wall thickness of not less than .250 inches on all four sides. Aluminum alloy used shall be 6061-T6 only. Internal uprights shall be 2-inch square aluminum spaced equally at no more than 6 feet o.c. subdividing the gate frame into panels. All members shall be welded to form a rigid one piece gate frame unit. No bolt on type tracks will be allowed.
2. Gate Fabric: as indicated.

3. Trussing: Each bay shall be cross-trussed by means of 1/4" cable or 3/8" truss rods with adjustable turnbuckles. Trusses will maintain the structural integrity of the gate while allowing for expansion and contraction of aluminum during various weather conditions.

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4. Truck Assemblies: Shall be swivel type, galvanized steel, with 6 factory-sealed and lubricated ball bearing rollers. Four main rollers shall be 2 inches diameter x 9/16-inch in width and two steel side rollers shall be 2 inches diameter x 7/16-inch in width to prevent lateral movement. Truck assemblies shall be mounted on post brackets using a 5/8-inch diameter swivel bolt.
5. Bottom Guide Wheel Assemblies: Two 3 inches diameter rubber wheels (one set) straddling the bottom horizontal gate rail shall be installed, one set on the gate post and one on the overhang post.
6. Stop Bracket / End Plug: After gate has been installed, both ends of the combination track/frame member shall be closed off with a shock absorbing plastic block that shall also serve as a stop bracket.
7. Hardware: Gate hangers, latches, brackets and guide assemblies shall be steel galvanized after fabrication.
8. Posts: Gate posts shall be 4" inches square bay height indicated on drawings, Schedule 40 galvanized pipe set in 16 inches min. x 36 inches deep footings or as recommended by the manufacturer. Concrete shall be troweled and sloped to shed water away from the posts.
    a. Provide (2) posts for battery back-up mounting, one of which is 8'-0" above grade to mount radio receiver.
9. Style: Shall be single panels, paired to meet at the center of the drive when in the closed position.

2.3 CHAIN-LINK FENCE FABRIC

A. PVC-Coated Fabric: ASTM F 668, Class 2a over metallic-coated steel wire.

1. Color: As selected by Architect from manufacturer's full range complying with ASTM F 934.

B. Selvage: Knuckled at both selvages.

C. Protective Coating for Steel: Posts, rails, and frames protected with an external coating of not less than **0.6 oz. of zinc/sq. ft. (183 g of zinc/sq. m)**, a chromate conversion coating, and a clear, verifiable polymer film; and an internal protective coating of not less than **0.6 oz. of zinc/sq. ft. (183 g of zinc/sq. m)** or 81 percent, not less than **0.3-mil- (0.0076-mm-)** thick, zinc pigmented coating.

2.4 FITTINGS

A. General: Provide fittings for a complete fence installation, including special fittings. Comply with ASTM F 626.

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2.5 GATE OPERATORS

A. General: Provide operators for coordinated paired gate and single operation. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for single gate, Project conditions, with remote-control stations, safety devices, and weatherproof enclosures, coordinated with the project electrical system.

1. Provide complete system for operation of gate operator.
2. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
3. Provide operator with UL approved components.
4. Provide electronic components with built-in troubleshooting diagnostic feature.
5. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.
6. Enclosure Finish: (OPERATOR AND BATTERY) powder coated, "Black" finish.

B. Comply with NFPA 70.

C. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and without exceeding nameplate rating or considering service factor. Comply with NEMA MG-1 and the following:

1. Service Factor: 1.15.

D. Gate Operators: Concrete base/pad Pedestal post mounted and as follows:

1. Hydraulic Slide Gate Operators:

a. Horsepower: 1 horsepower.
b. Duty: Heavy duty, commercial/industrial.
c. Voltage/Phase: 208v/3 phase (verify with specific manufacture and coordinate with electrical subcontractor to insure proper installation of power is provided)
d. Gate Speed: Minimum 60 feet per minute.
e. Maximum Gate Weight: 1500 pounds.
f. Frequency of Use: Continuous duty.
g. Locking: Hydraulic in both directions.
h. Heater: Manufacturer's standard track and roller heater with thermostatic control.
i. Operating Type: pivot arm wheel and rail drive with manual release.
j. Coordinate with keypad/proxy card operation per Division 08 "Finish Hardware".

E. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type 4 exterior enclosure for concrete base/pad pedestal mounting, and with space for additional optional equipment. Provide the following remote-control devices:

1. Digital Keypad/Proximity Card Reader Entry Unit: Pedestal mounted per plan with powder coated shroud.

a. Face-lighted unit with keypad visible at night

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b. To be compliant with building entry system card readers

2. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located per Architect prior to installation, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide (6) programmable transmitters with multiple-code capability permitting validating or voiding of not less than manufactures specified number of codes per channel. Configure for open and close functions. Coordinate type and function for compatibility with radio controls for the apparatus bay doors and the Owner's other door and gate controls.
3. Emergency Radio Control :

   a. Provide Auxiliary click2enter scanner receiver preemptive operator control by click2enter, inc. with regulated 12-24 V DC @ 500 mA transformer.

4. Vehicle Loop Detector: System including automatic closing timer with adjustable time delay before closing, and loop detector designed to open and close gate. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, as recommended in writing by detection system manufacturer for function indicated.

   a. Loop: Wire, in size indicated for field assembly, for pave-over installation.

F. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:

1. Action: Reverse gate in both opening and closing cycles and hold until clear of obstruction.

2. Sensor Edge: Provide contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using gate edge transmitter and operator receiver system.

   a. Along entire gate leaf leading edge.
   b. Along entire gate leaf trailing edge.

3. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.

G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions. Gates shall be not more than 2" apart when in the closed position.

H. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type of mechanism, permitting manual operation if operator fails. Design system so control circuit power is disconnected during manual operation.

1. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge.

I. Operating Features:

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1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features. Provide unit that is isolated from voltage spikes and surges.
2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
4. Automatic Closing Timer: With adjustable time delay before closing.
5. Open Override Circuit: Designed to override closing commands.

J. Accessories:

1. Battery Backup System: Battery-powered drive and access control system, independent of primary drive system: (Post Mounted)
   a. Basis of Design: DC power Supply with HyCharger DC by HySecurity
   b. Fail Secure: Gate cycles on battery power, then fail safe when battery is discharged.
   c. Provide powder coat finish on all exposed surfaces of battery enclosure. "Black"
2. Provisions for marking, labeling, and signage are in UL 325.

2.6 CAST-IN-PLACE CONCRETE

A. General: Concrete for post bases, pedestal bases and operator equipment pads.

B. Materials: See Specification Section 03 30 00 for concrete requirements.

2.7 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

2.8 POLYMER FINISHES

A. Supplemental Color Coating: Provide Gate components with polymer coating.

1. Metallic-Coated Steel Tension Wire: PVC-coated wire complying with ASTM F 1664, Class 2b.
2. Metallic-Coated Steel Framing: Comply with ASTM F 1043 for polymer coating applied to exterior surfaces and, except for tubular shapes, to exposed interior surfaces.
3. Polymer Coating: Not less than 10-mil- (0.254-mm-) thick PVC or 3-mil- (0.076-mm-) thick polyester finish.

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4. Fittings Post Rail and Brace Ends Top Rail Sleeves Tension and Brace Tie Wires, Clips, and Fasteners: Comply with ASTM F 626 for polymer coating applied to exterior surfaces and, except inside cap shapes, to exposed interior surfaces.

5. Color: Match adjacent Chainlink Fencing

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance.

1. Do not begin installation before final grading is completed, unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Stake locations of gate and terminal posts.

3.3 INSTALLATION, GENERAL

A. General: Install gate in compliance with ASTM F1184 and more stringent requirements specified.

1. Posts Set into Concrete in Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, and finished sloped to drain water away from post.

2. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1 inch (25.4 mm) between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
3. Tension or Stretcher Bars: Thread through fabric and secure to gate posts with tension bands spaced not more than 15 inches (380 mm) o.c.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

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3.5 GATE OPERATOR INSTALLATION

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to adjacent fence line and grade.

B. Excavation for Support Posts, Pedestals and Concrete Bases/Pads: Hand-excavate holes for bases/pads, in firm, undisturbed soil to dimensions and depths and at locations as required by gate-operator component manufacturer's written instructions and as indicated.

C. Concrete Bases/Pads: Cast-in-place, dimensioned and reinforced according to gate-operator and control component manufacturer's written instructions and as indicated on Drawings.

D. Vehicle Loop Detector System: Install in concrete pavement prior to casting concrete. Bury and seal wire loop according to manufacturer's written instructions. Coordinate with concrete forming, reinforcing and casting process. Connect to equipment operated by detector.

E. Emergency Radio Control: install click2enter system per manufacturer's installation instructions.

1. Mounting: Use security head screws

F. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.6 ADJUSTING

A. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.

B. Automatic Gate Operator: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices and limit switches.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lubricate hardware, gate operator, and other moving parts.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates. Refer to Division 1 Section "Closeout Procedures"

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END OF SECTION

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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. Ornamental fences.

B. Related Requirements:

1. Division 01 Section “Sustainable Design Requirements” for applicable Sustainability requirements.
2. Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete post footings.
3. Section 32 31 13 "Chain Link Fences and Gates" .
4. Section 32 31 15 "Motor Operated Gates" .

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 REFERENCES

A. ASTM - American Society for Testing and Materials:

1. ASTM B 221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

B. AAMA - American Architectural Manufactures Association:

1. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

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1.5 ACTION SUBMITTALS

A. General: Conform with requirements under Division 01 Section "Submittal Procedures".

B. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Fence and gate posts, rails, and fittings.

b. Gate operators, including operating instructions and motor characteristics.

C. Sustainable Design Submittals:

1. Comply with requirements of Section 01 81 13

D. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Include accessories, hardware, gate operation, and operational clearances.

E. Samples for Initial Selection: For each type of factory-applied finish.

F. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:

1. Powder-Coated Components: In 6-inch (150-mm) lengths for components and on full-sized units for accessories.

G. Product Certificates: For each type of ornamental metal fence, and gate, from manufacturer.

H. Operation and Maintenance Data: For the following to include in emergency, operation, and maintenance manuals:

1. Powder-coat finishes.

1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of ornamental fence, from manufacturer.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

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1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

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

B. Installer Qualifications: Installers experienced with type of construction involved and materials and techniques specified.

C. Single Source: Entire fence system, and all associated accessories, fittings, and fasteners shall be obtained from a single source.

D. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify layout information for ornamental fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.10 WARRANTY

A. Special Warranty: **Manufacturer agrees** to repair or replace components of ornamental fences and gates that fail in materials or workmanship within specified warranty period.

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

a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: **10** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Quality Fence Products, Auburn, WA; phone (253) 939-8533.

1. Or approved Equal.

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2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 ORNAMENTAL FENCING

A. Custom Heavy Industrial Aluminum Ornamental Fence System - Welded: System includes custom-fabricated fence posts, framework, and mounting accessories.

1. Grade: Industrial.
2. Style: Flush top rail, Three Rail system.
3. Aluminum:
    a. Tubular Pickets, Rails and Posts: Shall conform to ASTM B221.
    b. Extrusions for Posts, Pickets and Rails: 6063-T5.
    c. Rail Strength:
        1) Effective Wall Thickness: top wall of outer channel of the rail shall be 0.100 inch thick; side walls shall be 0.120 inch thick.
        2) Vertical Design Load, Per Rail, at .66 Fy:
            a) 6 Foot Span: 276 pounds.
        3) Horizontal Design Load, Per Rail, at .66 Fy:
            a) 6 Foot Span: 490 pounds.
4. Pickets: 1 inch square x 0.065 inch thick extruded aluminum tubing.
5. Panel Brackets: Provide stainless steel bracket;
6. Panels: Completed panels shall be capable of supporting a 300 pound load applied at midspan without permanent deformation.
7. Posts:
    a. Size: 2-1/2 inches by 2-1/2 inches with perimeter wall thickness of 0.080 inch and interior reinforcing web thickness of 0.080 inch w/ std. post cap.
    b. Heights: As indicated.

2.1 FABRICATION

A. Welding System:

1. Rails shall be pre-punched to accept pickets.
2. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture.
3. The aligned pickets and rails shall be joined at each picket-to-rail intersection by welding process, thus completing the rigid panel assembly.

2.2 FINISHES

A. Powder Coating: Thermal stratification coating process (high-temperature, in-line, multi-stage, multi-layer) including six-stage pretreatment/wash with zinc phosphate, an electrostatic spray application of epoxy base, and a separate electrostatic spray application of a polyester top coat finish.

1. Base Coat Coating Thickness: Thermosetting epoxy powder coating with minimum thickness of 2 to 4 mils.

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2. Top Coat Coating Thickness: No-mar TGIC polyester powder finish with minimum thickness of 2 to 4 mils.
3. Coating Performance Requirements: Coating meets or exceeds the following.
    a. Adhesion (ASTM D 3359, Method B): Adhesion over 90 percent of test area (tape and knife test).
    b. Corrosion Resistance (ASTM B 117, ASTM D 1654): Coated galvanized steel shall be capable of salt spray resistance for 3,500 hours without loss of adhesion on parts scribed per ASTM D1654 and tested in accordance with ASTM Test Method B117. Failure is considered to have occurred when there is either 1/8 inch coating loss from the scribed mark or an accumulation of medium #8 blisters.
    c. Impact Resistance (ASTM D 2794): 60 inch pounds, minimum.
    d. Weathering Resistance (ASTM D 822, D 2244, D 523 - 60 Degree Method): 1,000 hours, minimum (failure mode is 60 percent loss of gloss or color variance of more than 3 delta-E color units.)

B. Color: Custom color as selected by the Architect.
    a. Heater: Manufacturer's standard track and roller heater with thermostatic control.

2.3 GROUT AND ANCHORING CEMENT

A. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for **a certified survey of property lines and legal boundaries,** site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.

1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

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B. Prepare the grade and remove surface irregularities, if any, which may cause interference with the installation of fencing.

C. If preparation and condition is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.3 ORNAMENTAL FENCE INSTALLATION

A. Install ornamental fencing in accordance with manufacturer's written instructions, and in accordance with the approved shop drawings

1. Install fencing on established boundary lines inside property line.

B. Panels shall be attached to posts using mounting brackets and tamperproof security fasteners supplied by the manufacturer.

C. When cutting rails immediately seal the exposed surfaces by:

1. Removing all metal shavings from cut area.
2. Apply manufacturer approved primer to thoroughly cover cut edge and drilled hole; allow to dry.
3. Apply 2 coats of custom finish spray paint matching fence color.
4. Failure to seal exposed surfaces in accordance with manufacturer's instructions will negate manufacturer's warranty.

D. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

E. Post Setting: Set posts **in concrete** at indicated spacing into firm, into sleeves and grout.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   a. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with **nonshrink, nonmetallic grout**, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain ornamental fences and gates.

3.5 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch.

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B. Maximum Offset From Indicated Position: ½- inch.

3.6 CLEANING

A. Leave immediate work area neat at end of each work day.

B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.

C. Clean fence with mild household detergent and clean water rinse well. Mortar should be removed from exposed posts and other fencing material using a 10% solution of muriatic acid followed immediately by several rinses with clean water.

D. Touch up scratched surfaces using materials recommended by manufacturer. Match touchup paint color to fence finish.

3.7 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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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. Sprinklers.
4. Quick couplers.
5. Controllers.
6. Boxes for automatic control valves.

B. Related Sections:

1. Section 329300 Plants.

C. Alternates: Refer to Section 012300.

1.3 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

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1.4 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 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.

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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. 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.

1.7 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.

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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.

1.8 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.

1.9 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.

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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 MANUAL VALVES

A. Isolation Ball Valves:

1. Description: As described on plan.

B. Master Valve:

1. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-VAC solenoid – Hunter IBV brass.

C. Control Valves:

1. Description: Hunter ICV plastic, size per valve key.

D. Double Check Backflow Assembly: Zurn 950 XLT2 , size as detailed.

2.4 QUICK COUPLERS

A. Description:

1. General: As described on plan.
2. Quick coupler keys and hose swivel ells, brass, size and type to fit quick coupler.

2.5 SPRINKLER HEADS

A. General: As described on the Equipment Legend.

2.6 CONTROLLER

2.7 FLOW SENSOR

A. Flow Sensor: Weathermatic SLFSI-T10

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2.8 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.

2.9 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.

2.10 OTHER MATERIALS

A. Trench Backfill: Masons sand.

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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 backfield 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.

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.

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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.

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3.5 IRRIGATION HEADS

A. General: Install all heads as detailed on drawings, adjusting location as necessary to achieve maximum coverage as intended. Heads adjacent to walks, walls or curbs and other paved areas shall be set 4-inches from edge of paving. Balance and adjust all nozzles after entire system is operable. Set heads perpendicular to finish grade unless otherwise indicated.

B. Adjustment: All nozzles on stationary sprinklers or spray heads shall be tightened after installation. All sprinklers having an adjusting screw, adjusting stem or adjusting friction collars shall be adjusted on a lateral line of circuit as required for proper arc, coverage, radius, diameter, and/or gallonage discharge.

3.6 AUTOMATIC IRRIGATION CONTROL SYSTEM

A. Equipment Mounting: Wall mount controller(s) as directed by Owner's Representative.

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.

3.7 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.

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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.

3.8 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

3.9 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

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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, Regional Materials and Recycled Content 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.

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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.

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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. 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. 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.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

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. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

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1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

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.

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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-inchdepth 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-inchdepth 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 MATERIALS

A. Regional Materials: Acquire imported soil and soil amendments and fertilizers within 100 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

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2.2 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.

2.3 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.

2.4 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.

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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. 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.

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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.

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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

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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. 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.

1.3 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 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.

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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 ACTION SUBMITTALS

A. 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.

1.7 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.

1.8 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.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Experience: Three years' experience in turf installation in addition to requirements in Section 01 40 00 "Quality Requirements."

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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.

1.10 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.

1.11 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.

B. Seed Species: See plans.

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2.2 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.

2.3 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.

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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.

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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 HYDROSEEDING

A. Hydroseeding: Mix specified seed and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with fiber-mulch manufacturer's recommended tackifier.
2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
3. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

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.

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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 DETENTION POND MAINTENANCE

A. Maintain and establish detention pond by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable planting. Replant bare or eroded areas and remulch. 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 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 detention pond 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 detention pond-watering equipment to convey water from sources and to keep detention pond uniformly moist.

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.

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2. Water detention pond with fine spray at a minimum rate of 1/2 inch per week for eight weeks after planting unless rainfall precipitation is adequate.

3.9 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.

3.10 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

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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, Regional Materials and Recycled Content 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.

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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.
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.

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.

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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.

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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.

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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.

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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.

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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 as medium bark manufactured by Carpinito Brothers, Tacoma, Washington, 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. Guy and Tie Wire: ASTM A 641/A 641M, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 inch in diameter.

C. Guy Cable: 5-strand, 3/16-inch diameter, galvanized-steel cable, with zinc-coated turnbuckles, a minimum of 3 inches long, with two, 3/8-inch galvanized eyebolts.

D. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 inch in diameter, black, cut to lengths required to protect tree trunks from damage.

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.

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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.

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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 tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree. 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.

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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

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Furnishing and installing water service, fire service, fire hydrants, meters and vaults.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 31 00 00 – Earthwork

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. The Northshore Utility District (NUD) Standard Specification and Details, February 2020.

C. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

D. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.4 SUBMITTALS

A. See Division 01 Submittal Procedures.

B. Product Data: For each type of product indicated

1.5 QUALITY ASSURANCE

A. Water utility work shall comply with NUD Standard Specifications.

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1.6 COORDINATION

A. Contractor shall coordinate water utility connections with building point of connections and connections to existing water main.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. All pipes and fittings shall conform to NUD Standard Materials of Construction Specifications, Section 9.5.

2.2 WATER METERS AND VAULTS

A. Water meters and vaults shall be per Drawings and shall conform to NUD Standard Water Details.

2.3 BACKFLOW ASSEMBLY

A. Backflow assembly shall be per Drawings and shall conform NUD Standard Water Detail 14.

2.4 FIRE HYDRANTS ASSEMBLY

A. Fire Hydrants shall conform NUD Standard Water Detail 3 and Materials of Construction Specifications, Section 9.5(f).

B. Fire Hydrants guard posts shall conform NUD Materials of Construction Specifications, Section 9.5(j).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to pipe installation, field verify invert elevation and location of services at utility crossings and points of connections to building and public water system. Notify owner's representative of any conflicts.

B. Field verify location of existing utilities.

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3.2 INSTALLATION OF WATER SYSTEM

A. Water service installation shall include meter and vault, all fittings excavation, and backfill. NUD representative shall be present for connection procedure.

B. Water service installation shall conform to NUD Standard Methods of Construction Specifications, Section 10.20, 10.23, 10.15, and 10.16.

C. Fire Hydrant installation shall conform to NUD Standard Methods of Construction Specifications, Section 10.13.

D. Fire Hydrant guard post installation shall conform to NUD Standard Methods of Construction Specifications, Section 10.14.

3.3 CLEANING AND TESTING

A. Water system shall flushed, sterilized and tested in conformance with NUD Standard Methods of Construction Specifications, Section 10.21 and 10.22. NUD and Owner's Representative shall be present for system flushing, sterilization and testing.

END OF SECTION

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Furnishing and installing sanitary sewer pipes, cleanouts and fittings

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 31 00 00 – Earthwork

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. The Northshore Utility District (NUD) Standard Specification and Details, February 2020.

C. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

D. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.4 SUBMITTALS

A. See Division 01 Submittal Procedures

B. Product Data: For each type of product indicated

1.5 QUALITY ASSURANCE

A. Sanitary sewer work shall comply with NUD Standard Specifications.

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1.6 COORDINATION

A. Contractor shall coordinate sanitary sewer connections with building point of connections and connections to existing sewer main.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. All pipes and fittings shall conform to NUD Standard Materials of Construction Specifications, Section 9.2.

2.2 CLEANOUTS

A. Cleanouts shall conform to NUD Standard Sewer Detail 9 and Materials of Construction Specifications, Section 9.4.

2.3 MANHOLES

A. Manholes shall conform to NUD Standard Sewer Details and Materials of Construction Specifications, Section 9.3.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to pipe installation, field verify invert elevation and location of services at utility crossings and points of connections to building and public sanitary system. Notify owner's representative of any conflicts.

B. Field verify location of existing utilities.

3.2 INSTALLATION OF SEWER SYSTEM

A. Installation shall conform to NUD Standard Methods of Construction Specifications, Section 10.5.

3.3 CLEANING AND TESTING

A. Cleaning and testing of sanitary system shall conform to NUD Standard Methods of Construction Specifications, Section 10.7. NUD and Owner's Representative shall be present for system testing

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END OF SECTION

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Furnishing and installing storm drainage structures, pipes, and other appurtenances of the storm drainage system as shown on the Drawings.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections

1. 31 0000 – Earthwork

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

C. King County Surface Water Design Manual (KCSWDM), 2016 edition, and COK Policy D-10, Addendum to 2016 KCSWDM.

D. NPDES Stormwater Discharge Permit for Construction

E. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

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. See Division 01 Submittal Procedures

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B. The following shall be submitted for review and approval prior to commencing Work:

1. Manufacturer's technical data that demonstrates that the product meets the requirements of the Specifications for the following:
   a. Pipe and fittings: including joint and gasket materials.
   b. Catch basins, inlets, manholes, frames, lids, and grates.
   c. Cleanouts
2. Shop Drawings: Submit Shop Drawings for the following:
   a. Catch Basin, Inlets and Manholes - include plans, elevations, sections, details and frame and covers
   b. Flow control structure catch basin with flow restrictor.
   c. Water Quality Structure – Oldcastle BioPod Biofilter

1.6 QUALITY ASSURANCE

A. Storm drainage structures and pipe material and installation shall conform to COK storm drainage pre-approved plans.

1.7 COORDINATION

A. Contractor shall coordinate drainage connections with building roof drain locations, foundation drainage, storm pond inlet, and bid alternate storm vault structure penetrations and to existing storm main.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPE

A. PVC storm drainage pipe shall be PVC 3034

B. Ductile iron storm drainage pipe shall be Class 50.

2.2 STORM CATCH BASINS, INLETS AND MANHOLES

A. Catch basins, inlets and manholes shall conform to COK pre-approved plans CK-D.07 and CK-D.09.

B. Vaned grates and frame shall conform to COK pre-approved plans CK-D.14 and CK-D.16A.

C. Manhole frame and cover shall conform COK pre-approved plans CK-D.18.

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2.3 FLOW CONTROL STRUCTURE CATCH BASIN

A. Flow control catch basin with flow restrictor shall conform to COK pre-approved plans CK-D.10. Inlet and outlet pipes elevations and flow restrictor riser pipe, orifice, and notch sizes and elevations shall be per Drawings

2.4 STORM DETENTION BID ALTERNATE VAULT

A. Storm detention vault shall be per storm detention vault structural Drawings. Inlet and outlet pipe, flow restrictor, and access covers size and locations shall be per civil Drawings.

B. Handholds and steps shall conform to COK pre-approved plans CK-D.12.

C. Circular cover and frame shall conform to COK pre-approved plans CK-D.18.

D. Flow restrictor shall conform to COK pre-approved plans CK-D.10. Flow restrictor riser pipe, orifice, and notch sizes and elevations shall be per Drawings

2.5 CLEANOUT

A. Cleanout shall conform to COK pre-approved plans CK-D.05B.

2.6 WATER QUALITY STRUCTURE – OLDCASTLE BIOPOD BIOFILTER

A. Water quality structure shall be Oldcastle Biopod Biofilter and conform to manufacturer's specifications. Biopod size, model and invert elevations shall be as shown on the Drawings

2.7 FITTINGS, COUPLINGS AND JOINTS.

A. Fittings, tees, and joints shall conform to COK pre-approved plans storm drainage design criteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to pipe installation, field verify invert elevation and location of services at utility crossings and points of connections to building and public storm main. Notify owner's representative of any conflicts.

B. Field verify location of existing utilities.

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3.2 STORM DRAINAGE PIPE INSTALLATION

A. Installation shall conform to storm trench detail per COK pre-approved plans CK-D.02

3.3 STORM DRAINAGE CATCH BASIN, INLET, AND MANHOLE INSTALLATION

A. Installation shall conform to COK pre-approved plans storm drainage design criteria.

3.4 STORM DETENTION BID ALTERNATE VAULT INSTALLATION

A. Installation shall conform to storm detention vault structural Drawings.

3.5 CLEANOUTS

A. Installation shall conform to COK pre-approved and manufacturer's recommendations.

3.6 WATER QUALITY STRUCTURE – OLDCASTLE BIOPOD BIOFILTER

A. Water quality structure shall be installed per manufacturer's recommendations and specifications. Manufacturer's representative shall be present for installation of water quality structure.

B. Contractor shall obtain maintenance manual and requirements from manufacturer and provide a copy to Owner's representative.

3.7 CLEANING AND TESTING

A. Cleaning and testing of storm pipe shall conform to WSDOT Standard Specifications Section 7-04.3(1)

END OF SECTION

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work includes but is not limited to: Furnishing and installing foundation drainage.

1.2 RELATED SECTIONS

A. Coordinate and comply with the following sections:

1. 31 00 00 – Earthwork

2. 33 41 00 – Storm Drainage Utilities

1.3 REFERENCE STANDARDS

A. The City of Kirkland (COK) pre-approved plans and policies, January 1, 2020 edition.

B. Washington Department of Transportation (WSDOT) Standard Specifications and Standard plans for Road, Bridge and Municipal Construction, 2020 edition.

C. The Standard Specifications apply only to the construction requirements and materials and how they are to be incorporated into the Work. If referenced standards conflict the more stringent specification shall apply. The legal/contractual relationship sections and the measurement and payment sections do not apply to this document.

1.4 SUBMITTALS

A. See Division 01 Submittal Procedures

B. Produce Data: For each type of product indicated.

1.5 QUALITY ASSURANCE

A. Foundation drainage material and installation shall conform to WSDOT Standard Specifications and Plans.

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1.6 COORDINATION

A. Prior to construction, Contractor shall verify all points of crossings between foundation drainage system and building utility services. Notify Owner if conflicts exist.

PART 2 - PRODUCTS

2.1 FOUNDATION DRAINAGE PIPE

A. PVC perforated foundation drainage pipe shall be Schedule 40 PVC pipe with perforations per Drawings.

2.2 CLEANOUT

2.3 Cleanout shall conform to COK pre-approved plan CK-D.05B.

PART 3 - EXECUTION

3.1 FOUNDATION DRAINAGE PIPE INSTALLATION

A. Installation shall conform to WSDOT Standard Specifications Section 7-01.3(2)

3.2 CLEANOUTS

A. Installation shall conform to COK pre-approved plans and manufacturer's recommendations.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All construction shall be in accordance with Appendix A – 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. LED luminaire fixtures
3. Traffic signal controller and electrical service cabinets and foundations
4. Vehicle signal heads
5. Pedestrian signal heads and pushbuttons
6. Vehicle detection systems
7. CCTV camera systems
8. Communications systems
9. Junction boxes, conduits, and conductors

C. Related Sections include the following:

1. Appendix A – Traffic Signal and Illumination System Specifications.
2. Division 1 Section "Submittal Procedures" for submittal requirements.
3. 26 57 00 – Roadway Lighting.

1.2 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.

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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

2.1 ROADWAY SIGNALING AND CONTROL EQUIPMENT

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

PART 3 - EXECUTION

3.1 ROADWAY SIGNALING AND CONTROL EQUIPMENT

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

END OF SECTION

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KIRKLAND FIRE STATION 24

SPECIAL PROVISIONS

APPENDIX A – TRAFFIC SIGNAL AND ILLUMINATION SYSTEM SPECIFICATIONS

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INTRODUCTION

This Contract shall be constructed in accordance with the 2020 Standard Specifications for Road, Bridge, and Municipal Construction.

SPECIAL PROVISIONS

Several types of Special Provisions are included in this contract; General, Region, Bridges and Structures, and Project Specific. Special Provisions types are differentiated as follows:

(date)	General Special Provision
(******)	Notes a revision to a General Special Provision and also notes a Project Specific Special Provision.
(Regions[1] date)	Region Special Provision

General Special Provisions are similar to Standard Specifications in that they typically apply to many projects, usually in more than one Region. Usually, the only difference from one project to another is the inclusion of variable project data, inserted as a "fill-in".

Region Special Provisions are commonly applicable within the designated Region. Region designations are as follows:

Regions[1]	
ER	Eastern Region
NCR	North Central Region
NWR	Northwest Region
OR	Olympic Region
SCR	South Central Region
SWR	Southwest Region
WSF	Washington State Ferries Division

Project Specific Special Provisions normally appear only in the contract for which they were developed.

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DIVISION 8 MISCELLANEOUS CONSTRUCTION

8-20 Illumination, Traffic Signal Systems, Intelligent Transportation Systems, and Electrical

8-20.1 Description

(******)

8-20.1(1) Regulations and Code

Section 8-20.1(1) is supplemented with the following:

All electrical work on this project shall be accomplished in accordance with the Standard Specifications for Road, Bridge, and Municipal Construction, 2020 edition (Standard Specifications), and the Standard Plans for Road, Bridge, and Municipal Construction, latest edition (Standard Plans), and the Amendments to the Standard Specifications, all as published by the Washington State Department of Transportation unless supplemented otherwise by these Special Provisions and the Plans.

Where applicable, materials and installation procedures shall conform to the Washington State Department of Labor and Industries and City of Kirkland standards.

Safe wiring labels and an Electrical Work Permit per the State Department of Labor and Industries are required for this project, as well as an Electrical Permit from the City of Kirkland.

Prior to the start of work, the Contractor shall obtain all necessary licenses, permits, and approvals including a City of Kirkland electrical permit. The Contractor shall comply with all laws, ordinances, rules, orders, and regulations relating to the performance of the Work, the protections of adjacent property, and the maintenance of all facilities. The Contractor shall be required to comply with all of the provisions of these instruments and shall save and hold the City of Kirkland harmless from any damage that may be incurred as a result of the Contractor's failure to comply with all of the terms of these permits.

8-20.2 Materials

8-20.2(1) Equipment List And Drawings

Section 8-20.2(1) is supplemented with the following:

(******)

The Contractor shall also be required to submit product data for the following:

- Ethernet switch
- Video detection equipment and mounting hardware
- Video detection cabling
- CCTV cameras, mounting hardware, and cabling

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- Conduit and innerduct
- Conductors
- Junction boxes and cable vaults
- Service cabinets and service connections
- APS pushbuttons, control unit, and mounting hardware

Approval of submittals may require up to 20 calendar days from the date the Engineer receives the submittals until they are returned to the Contractor. The actual time required for approval is dependent upon the completeness and appropriateness of the drawings as submitted.

Any deficiencies will require additional time for approval based on the degree of the deficiency and the additional review time required. If the submittals are returned to the Contractor to correct deficiencies, an additional 20 calendar days may be required for the approval process.

If more than 20 calendar days are required for routine approval of submittals that are completed and accurate, the Contractor will be granted an extension of time equal to the additional review time.

Materials not approved by the Engineer will not be permitted on the jobsite.
All materials for review shall be submitted in a single package.

(March 13, 1995)
Pole base to light source distances (H1) for lighting standards with pre-approved plans shall be as noted in the Plans.

Pole base to light source distances (H1) for lighting standards without pre-approved plans will be furnished by the Engineer as part of the final approved shop drawings, prior to fabrication.

(March 13, 1995)
If traffic signal standards, strain pole standards, or combination traffic signal and lighting standards are required, final verified dimensions including pole base to signal mast arm connection point, pole base to light source distances (H1), mast arm length, offset distances to mast arm mounted appurtenances, and orientations of pole mounted appurtenances will be furnished by the Engineer as part of the final approved shop drawings prior to fabrication.

8-20.3 Construction Requirements

8-20.3(1) General

Section 8-20.3(1) is supplemented with the following:

(******)
Signal turn-ons shall be limited to Tuesdays through Thursdays, 7AM to 2PM only. The City of Kirkland prefers that cabinet turn-ons be scheduled on Tuesdays, if

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possible. All wires are to be pulled and brought to the terminal cans when possible, prior to scheduling a switch over to ensure all pathways are usable and cables are of the proper length. Signal turn-on and flash-out will be coordinated with the City of Kirkland's Signal Technicians a minimum of 5 working days in advance of performing the turn-on. Flash-out will be scheduled approximately 2 working days prior to signal turn-on between 7AM and 2PM. Upon completion of flash-out, contractor will have 2 working days to address issues. During this period, contractor will conduct Ohms test for APS pushbuttons per Section 8-20.3(14)G and City Traffic Engineer will confirm all head directionality, signage, and channelization. Signal turn-on will then be performed.

All equipment shall be handled and protected so as to prevent damage. Damaged equipment, if any, shall be repaired or replaced by the Contractor to the satisfaction of the Engineer at no additional cost to the Owner.

No new fixtures shall be constructed as part of this Contract, which are in conflict with any existing utilities, or the code required thereby. It shall be the Contractor's responsibility to locate all utilities whether above, on, or below the ground, and to protect against any and all damages arising from work under this project. At least 48 hours before digging, the Contractor shall call the Utilities Underground Locator Center (telephone 1-800-424-5555). Contractor must maintain locates during the duration of the project once they have been identified.

All manufacturers' warranties or guarantees on all electrical and mechanical equipment, consistent with those provided as customary trade practice, shall be assigned to the City of Kirkland.

8-20.3(2) Excavating and Backfilling

Section 8-20.3(2) is supplemented with the following:

(******)

Backfill for all electrical trenches shall consist of crushed surfacing top course meeting the requirements of Section 9-03.9(3) of the Standard Specifications.

All trenches shall be mechanically compacted by a power operated mechanical tamper or other mechanical compaction device approved by the Engineer. Compaction shall be in conformance with Section 2-30.3(14), Method C of the Standard Specifications. The temporary restoration of conduit trenches shall be as directed by the Engineer.

The Contractor warrants and represents awareness of the statutory provisions contained in RCW 19.122.010 through .900, that the Contractor has read and fully understands the same, and will comply with the requirements of these provisions, which are incorporated by reference herein. The Contractor agrees that all trenching as well as excavating for all pole foundations shall be an "excavation" as defined under RCW Chapter 19.122 and that such utilities constitute underground facilities. The parties agree that remedies affected under RCW Chapter 19.122 are also

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incorporated by reference herein. Any cost to the Contractor as a result of this law shall be at the Contractor's expense.

Add the following new sub-sections:

(******)

8-20.3(2)A Resolving Utility Conflicts

Underground utilities of record will be shown on the construction plans insofar as it is possible to do so. These, however, are shown for convenience only and the City and Engineer assumes no responsibility for improper locations or failure to show utility locations on the construction plans.

The location of existing underground utilities, when shown on the plans, is approximate only, and the Contractor shall be responsible for determining their exact location. The Contractor shall check with the utility companies concerning any possible conflict prior to commencing excavation in any area, as not all utilities may be shown on the plans.

The Contractor shall be entirely responsible for coordination with the utility companies and arranging for the movement or adjustment, either temporary or permanent, of their facilities within the project limits.

If a conflict is identified, the Contractor shall contact the Engineer. The Contractor and City shall locate alternative locations for cabinet or junction boxes. The Contractor shall get approval from the Engineer prior to installation. The Contractor may consider changing depth or alignment of conduit to avoid utility conflicts. Potholing alternative locations, as directed by the Engineer, will be paid for by a separate bid item with approval of the engineer.

Before beginning any excavation work for foundations, vaults, junction boxes or conduit runs, the contractor shall confirm that the location proposed on the Contract Plans does not conflict with utility location markings placed on the surface by the various utility companies. If a conflict is identified, the following process shall be used to resolve the conflict:

1. Contact the Engineer and determine if there is an alternate location for the foundation, junction box, vault or conduit trench.
2. If an adequate alternate location is not obvious for the underground work, select a location that may be acceptable and pothole to determine the exact location of other utilities. Potholing must be approved by the Engineer.
3. If an adequate alternate alignment still cannot be identified following potholing operations, the pothole area should be restored and work in the area should stop until a new design can be developed.

The Contractor shall not attempt to adjust the location of an existing utility unless specifically agreed to by the utility owner.

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8-20.3(4) Foundations

Section 8-20.3(4) is supplemented with the following:

(******)
The foundations for the traffic signal controller cabinet with service cabinet shall conform to Kirkland Standard Plan CK-TS.04.

8-20.3(5) Conduit

Section 8-20.3(5) is supplemented with the following:

(******)
Each empty conduit run shall contain a 200-pound breaking strength polyolefin pull cord, which shall be tied off at both ends. Pull rope or tape removed from fiber optic conduit runs shall be replaced with new pull tape as described in 9-29.27 of these special provisions.

All conduits that are not in use shall be plugged with a watertight duct plug designed specifically to prevent entrance of water and debris.

All conduit installed underground shall have polyethylene Underground Hazard Marking Tape, 6 inches wide, red legend "Caution-Electric Line Buried Below," placed approximately 12 inches above the conduit.

The location of the conduit within the junction box shall be such that the side of the junction box through which the conduit enters shall indicate from which direction the conduit came.

Where intercepting and splicing to an existing conduit is called out on the plans, the Contractor shall verify the conduit size and schedule before ordering the new conduit sections. The size provided on the plans is an estimation.

8-20.3(5)B Detectable Pull Tape

Section 8-20.3(5)B is supplemented with the following:

(******)
For all conduits that do not contain electrical conductors, the Contractor shall add a detectable pull tape as indicated on the plans. The pull tape shall be in conformance with Section 9-29.27 of these Special Provisions.

8-20.3(6) Junction Boxes, Cable Vaults, and Pull boxes

Section 8-20.3(6) is supplemented with the following:

(******)

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Junction boxes shall be located and oriented as shown on the Plans but may be adjusted in the field by the Engineer to better fit existing conditions. No junction boxes shall be located in pedestrian ramp areas.

8-20.3(8) Wiring

Section 8-20.3(8) is supplemented with the following:

(March 13, 1995)
Field Wiring Chart

501	AC+ Input	516-520 Railroad Pre-empt
502	AC- Input	5A1-5D5 Emergency Pre-empt
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
Vehicle Head									
Red	611	621	631	641	651	661	671	681	691
Yellow	612	622	632	642	652	662	672	682	692
Green	613	623	633	643	653	663	673	683	693
Spare	614	624	634	644	654	664	674	684	694
Spare	615	625	635	645	655	665	675	685	695
AC-	616	626	636	646	656	666	676	686	696
Red Auxiliary	617	627	637	647	657	667	677	687	697
Yellow Auxiliary	618	628	638	648	658	668	678	688	698
Green Auxiliary	619	629	639	649	659	669	679	689	699
Pedestrian Heads & Dets.									
Hand	711	721	731	741	751	761	771	781	791
Man	712	722	732	742	752	762	772	782	792
AC-	713	723	733	743	753	763	773	783	793
Detection	714	724	734	744	754	764	774	784	794
Common-Detection	715	725	735	745	755	765	775	785	795
Spare	716	726	736	746	756	766	776	786	796
Spare	717	727	737	747	757	767	777	787	797
Spare	718	728	738	748	758	768	778	788	798
Spare	719	729	739	749	759	769	779	789	799
Detection									
AC+	811	821	831	841	851	861	871	881	891
AC-	812	822	832	842	852	862	872	882	892
Common-Detection	813	823	833	843	853	863	873	883	893
Detection A	814	824	834	844	854	864	874	884	894
Detection B	815	825	835	845	855	865	875	885	895
Loop 1 Out	816	826	836	846	856	866	876	886	896
Loop 1 In	817	827	837	847	857	867	877	887	897
Loop 2 Out	818	828	838	848	858	868	878	888	898
Loop 2 In	819	829	839	849	859	869	879	889	899
Supplemental Detection									

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Loop 3 Out	911	921	931	941	951	961	971	981	991
Loop 3 In	912	922	932	942	952	962	972	982	992
Loop 4 Out	913	923	933	943	953	963	973	983	993
Loop 4 In	914	924	934	944	954	964	974	984	994
Loop 5 Out	915	925	935	945	955	965	975	985	995
Loop 5 In	916	926	936	946	956	966	976	986	996
Loop 6 Out	917	927	937	947	957	967	977	987	997
Loop 6 In	918	928	938	948	958	968	978	988	998
Spare	919	929	939	949	959	969	979	989	999

8-20.3(10) Services, Transformer, Intelligent Transportation System (ITS) Cabinets

Section 8-20.3(14) is supplemented with the following:

(******)
Connection to Puget Sound Energy power source shall be where shown on the plans. All connections and interfacing with Puget Sound Energy shall conform to Puget Sound Energy requirements.

8-20.3(14) Signal Systems

Section 8-20.3(14) is supplemented with the following:

8-20.3(14)A Signal Controllers

Section 8-20.3(14)A is supplemented with the following:

(******)
The persons performing the controller cabinet installation and wiring and their Supervisor shall be personally experienced in traffic signal and controller cabinet systems and shall have been engaged in this work for a minimum of three years. Qualifications shall be submitted to the Engineer at least 30 calendar days prior to the start of the first controller cabinet replacement. These qualifications shall include:

1. The name of each person who will be performing controller cabinet and traffic signal wiring work and their employer's name, business address and telephone number.
2. The name and addresses of 5 similar projects that the foregoing people have worked on during the past 3 years.
3. All information required showing the experience criteria have been met.

8-20.3(14)C Induction Loop Vehicle Detectors

Section 8-20.3(14)C is supplemented with the following:

(******)
Construction Requirements

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Install loop detectors during conditions of zero precipitation and when the pavement temperature is between 40 degrees F and 100 degrees F.

Clean roadway surface of debris, standing water, or other material which may enter the saw cut and thereby degrade the quality of the installation.

Loops shall be installed as shown in the Plans.

Loop wires shall be connected to lead –in cable using uninsulated butt splices. The connection shall be soldered and the connection shall then be encapsulated using approved heat shrinkable, thin wall, flexible, polyolefin tubing or 3M Scotch 2200 Vinyl Mastic Pads wrapped in 3M Scotch Super 88 Vinyl Electrical Tape.

In areas where no conduit exists between the junction box and the edge of the roadway, conduit stub outs shall be installed. This installation may require curb and/or side walk replacement to install the required conduit sweeps. Holes greater than 3.5 inches in diameter may require an asphalt patch. Existing stub outs not being re-used shall be plugged or removed from the junction box. Install a 2-inch conduit between each saw cut in the pavement surface and the junction box.

Saw Cutting Round Loops

Round loops shall be constructed in accordance with requirements of Method A (Circular Saw). Construction shall conform to WSDOT Standard Plans J-50.12 and J-50.15, as modified by the following:

1. Round saw cuts shall be 6 feet in diameter and shall be constructed using equipment designed for cutting round loops. The equipment shall use a concave, diamond-segmented blade. The saw cuts shall be vertical and shall be a minimum of 0.25 inches wide. The saw cut depth shall be a minimum of 2.5 inches measured at any point along the perimeter. Other methods of constructing the saw cut, such as anchoring a router or flat blade saw, will not be allowed.
2. The bottom of the saw cut shall be smooth. No edges created by the differences in saw cut depths will be allowed.
3. All saw cuts corner shall be rounded to a minimum 1.6 inches radius.
4. All saw cuts shall be cleaned with a 1000-psi high pressure washer. Wash water and slurry shall be vacuumed out. Saw cuts shall be blown out dry with compressed air.
5. Loops shall be installed after paving the final lift of asphalt.
6. The loops shall be constructed using three turns of conductor if its home run is less than 400 feet, and four turns of conductor if its home run is greater than 400 feet. The conductor shall be installed one turn on top of the previous turn. All turns shall be installed in clockwise direction.

Loop Materials

Loop sealant shall be MSI 34271. Loop sealant shall be installed in two layers. The first layer shall be allowed to cool before the second layer is applied.

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Installation of the sealant shall completely encapsulate the loop conductors. A minimum of 1-inch of sealant shall be provided between the top conductors and the top of the saw cut. All sealant shall be installed per manufacturer recommendations using equipment recommended by the manufacturer.

Electrical conductors shall conform to the requirements of Section 9-29.3 Conductors, Cable of the Standard Specifications, unless otherwise noted. Electrical wiring shall conform to the requirements of Section 8-20.3(8) Wiring of the Standard Specifications.
Loop wire shall be No. 12 AWG Class B stranded copper wire with cross-linked polyethylene type USE insulation. Loop lead-in wire shall be IMSA loop cable specification 50-2-1984, #14 AWG

Loop Wire Installation
A minimum of 2-inch-diameter PVC conduit shall be used to contain the loop lead-in from the saw cut in the roadway to the junction box.

The Contractor shall coil at least 10 feet extra wire at the junction box prior to placing it in the saw cut so that the loop wire will not require any splices.

The loop wires shall be placed in the saw cut so that at no time is any tension placed on the wires. The wires shall not bind against the pavement at any point in the saw cut.

The loop wires in the lead-in saw cut and loop conduit shall be twisted in a symmetrical fashion with a minimum of 3 twists per foot at a uniform rate of turns per foot between the loop saw cut and the junction box. The twisted loop wire shall be pulled into the junction box through the conduit placed between the saw cut and the junction box. Unless specified by the Engineer there shall be wiring for no more than 3 (three) loops (6 twisted loop wire conductors) in each lead-in (home run) saw cut.

Loop Testing
Loop installation shall be tested in accordance with Section 8-20.3 (14) D Test for Induction Loops and Lead-in Cable of the Standard Specifications. In addition, prior to installing the loop sealant material the Contractor shall perform the required inductance testing. The inductance reading shall not be less than 60 nor greater than 120 microhenries. If any of the installation fail to pass all tests, the installation shall be repaired or re-tested until satisfactory results are obtained.

(******)
Add the following new section:
8-20.3(14)F Video Detection

The Contractor shall furnish, install, and test a complete Video Detection System capable of providing presence vehicle detection at locations defined in the Contract Plans. All Video Detection System configurations will be completed by

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the City's signal technicians after installation. The Contractor shall coordinate with the City of Kirkland Signal Shop for all video detection system configurations. The Video Detection System shall be comprised of components from the same manufacturer, with the exception of the LED monitors.

Permanent Installation

Video 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. Video 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. If the installation cannot be completed in one day, the controller shall be put on fixed time operation by the Contracting Agency.

The video detection system shall consist of the following:

- Video detection cameras, including camera enclosure, filter, sunshield and connector kit
- Camera mount assemblies, including extensions as specified in the Plans
- Video detection processors, control unit, and extension modules
- Remote monitoring board
- 8-inch Video Monitor, including cable
- Programming devices, configuration tools, and/or software
- Camera lens(es) and lens adjustment module
- Surge Suppressor
- Video and power cables
- Video System Communication Module
- All other equipment necessary for a fully operational video detection system.

Video detection cameras shall be mounted at a sufficient height to prevent occlusion from cross traffic. The Contractor shall provide and install the camera mounts, camera, and cable per the Plans. A factory-certified representative of the equipment manufacturer shall install controller cabinet video camera 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 video 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 video 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,

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make fully operational, and test the system as indicated in the Plans and in these Special Provisions.

The equipment manufacturer shall provide 2 days training to Contracting Agency personnel in the operation, setup, and maintenance of the permanent video detection system. Instruction and materials shall be provided for a maximum of 10 persons and shall be conducted at a location selected by the Contracting Agency. The Contracting Agency shall be responsible for travel, room and board, and other related expenses for its own personnel.

(******)

Add the following new section:

8-20.3(18) CCTV Camera

Add the following new sub-section:

8-20.3(18)A CCTV Camera

The CCTV cameras shall be furnished and installed by the Contractor as shown in the mounting details in the Plans. CCTV cameras shall be mounted 90 degrees from attachment point (i.e. mast arm). The Contractor is responsible for installing cameras and mounts per manufacturer recommendations, including correct sealing to make camera housing watertight.

The City of Kirkland uses Cohu 4260HD RISE cameras with Faceplate Wiper NetWay1E Single Port PoE++ Injector and RJ45 IP67 Coupler.

After all cameras are installed the Contractor shall arrange an interactive session with the Engineer to fine-tune and test the cameras in the field. The Contractor shall test the CCTV system using a Contractor-supplied control device such as a laptop computer running Vendor-supplied software. All test cables and connections shall be the responsibility of the Contractor. The Contractor shall demonstrate to the Engineer the following features of the camera installation:

1. Display camera video on the Contractor-provided monitor.
2. Pan and tilt the camera with no detectable delay.
3. Zoom and focus the camera in both fast and slow modes.
4. Turn the camera off and on.
5. Change the iris to auto and manual.
6. Demonstrate faceplate wiper operation.

The Contractor is required to document video output for the following video level measurements and show their results in comparison to the required range provided by the camera manufacturer:

1. Signal-to-noise ratio
2. Horizontal resolution
3. Vertical phase

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4. Color and black and white Lux levels
5. Video output

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.

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DIVISION 9 MATERIALS

9-29 Illumination, Signal, Electrical

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)

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)

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**
3. Thermion, SafTrax TH604 Grade #1 – Coarse: **T1**

(******)

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

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Add the following new sub-sections:

(******)

9-29.3(2)J Cat6 Ethernet Cable

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.

9-29.6 Light And Signal Standards

Section 9-29.6 is supplemented with the following:

(January 7, 2019)

Light Standards with Type 1 Luminaire Arms

Lighting standards shall be fabricated in conformance with the methods and materials specified on the pre-approved Plans listed below, provided the following requirements have been satisfied:

(a) Light source to pole base distance (H1) shall be as noted in the Plans. Verification of H1 distances by the Engineer, prior to fabrication, is not required. Fabrication tolerance shall be ±6 inches.

(b) All other requirements of the Special Provisions have been satisfied.

Pre-Approved Plan	Fabricator	Mounting Hgt.
Drawing No. DB01164 Rev. B Sheets 1, 2, 3, 4 & 5 of 5	Valmont Ind. Inc.	30', 35', 40' & 50'
Drawing No. WA15LT3721 Rev. A Sheet 1 and 2 of 2	Ameron Pole Prod. Div.	20',25',30',35',40', 45' & 50'

(April 1, 2019)

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.

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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 and applicable characteristics 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	Drawing No.
Valmont Ind. Inc.	DB01165 Rev. B Sheet's 1, 2, 3 & 4 of 4
Ameron Pole Prod. Div.	WA15TR10-1 Rev. C and WA15TR10-3 Rev. B

Type PS Pedestrian signal standards shall conform to Standard Plan J-20.16 or to one of the following pre-approved plans:

Fabricator	Drawing No.
Valmont Ind. Inc.	DB01165 Rev. B Sht. 1, 2, 3 & 4 of 4
Ameron Pole Prod. Div.	WA15TR10-1 Rev. C and WA15TR10-2 Rev. C

Type I Type I vehicle signal standards shall conform to Standard Plan J-21.15 or to one of the following pre-approved plans:

Fabricator	Drawing No.
Valmont Ind. Inc.	DB01165 Rev. B Sht. 1 2, 3 & 4 of 4
Ameron Pole Prod. Div	WA15TR10-1 Rev. C and WA15TR10-2 Rev. C

Type FB Type FB flashing beacon standard shall conform to Standard Plan J-21.16 or the following pre-approved plan:

Fabricator	Drawing No.
Valmont Ind. Inc.	DB01165 Rev. B Sht. 1 2, 3 & 4 of 4
Ameron Pole	WA15TR10-1 Rev. C and

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		Prod. Div.	WA15TR10-2 Rev. C

Type RM — Type RM ramp meter standard shall conform to Standard Plan J-22.15 or the following pre-approved plan:

Fabricator	Drawing No.
Valmont Ind. Inc.	DB01165 Rev. B Sht. 1, 2, 3 & 4 of 4
Ameron Pole Prod. Div.	WA15TR10-1 Rev. C and WA15TR10-2 Rev. C

Type CCTV — Type CCTV camera pole standards shall conform to one of the following pre-approved Plans:

Fabricator	Drawing No.
Valmont Industries, Inc.	DB 01166 Rev. B Sheet 1, 2, 3 and 4 of 4
Ameron Pole Product Div.	WA15CCTV01 Rev. B Sheet 1 and 2 of 2

Type II — Characteristics:

Luminaire mounting height	N.A.
Luminaire arms	N.A.
Luminaire arm length	N.A.
Signal arms	One Only

Type II standards shall conform to one of the following pre-approved plans, provided all other requirements noted herein have been satisfied. Maximum (x) (y) (z) signal arm loadings in cubic feet are noted after fabricator.

Signal Arm Length (max)	Fabricator-(x) (y) (z)	Drawing No.
65 ft.	Valmont Ind. Inc.-(2894)	DB01162 Rev. B, Shts. 1, 2,3, 4 & 5 of 5
65 ft.	Ameron Pole-(2900) Prod. Div.	WA15TR3724-1 Rev. C and WA15TR3724-2 Rev. D Sheet 1 and 2 of 2

Type III — Characteristics:

Luminaire mounting height	30 ft., 35 ft.,

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	40 ft., or 50 ft.
Luminaire arms	One Only
Luminaire arm type	Type 1
Luminaire arm length (max.)	16 ft.
Signal arms	One Only

Type III standards shall conform to one of the following pre-approved plans, provided all other requirements noted herein have been satisfied. Maximum (x) (y) (z) signal arm loadings in cubic feet are noted after fabricator.

Signal Arm Length (max)	Fabricator-(x) (y) (z)	Drawing No.
65 ft.	Valmont Ind. Inc.-(2947)	DB01162 Rev. B, Shts. 1, 2, 3, 4 & 5 of 5 and "J" luminaire arm
65 ft.	Ameron Pole-(2900) Prod. Div.	WA3724-1 Rev. C and WA3724-2 Rev. D and "J" luminaire arm

Type IV — Type IV strain pole standards shall be consistent with details in the plans and Standard Plan J-27.15 or one of the following pre-approved plans:

Fabricator	Drawing No.
Valmont Industries, Inc.	DB01167, Rev. B Sheets 1 and 2
Ameron Pole Prod. Div.	WA15TR15 Rev. A Sheet 1 and 2 of 2

Type V — Type V combination strain pole and lighting standards shall be consistent with details in the plans and Standard Plan J-27.15 or one of the following pre-approved plans:

Fabricator	Drawing No.
Valmont Industries, Inc.	DB01167, Rev. B Sheets 1 and 2
Ameron Pole Prod. Div.	WA 15TR15 Rev. A Sheet 1 and 2 of 2

The luminaire arm shall be Type 1, 16 foot maximum and the luminaire mounting height shall be 40 feet or 50 feet as noted in the plans.

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Type SD — Type SD standards 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:

1. A 115 mph wind loading shall be used.

2. The Mean Recurrence Interval shall be 1700 years.

3. Fatigue category shall be III.

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.

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.

Details for handholes and luminaire arm connections are available from the Bridges and Structures Office.

Foundations for various types of standards shall be as follows:

Type PPB	As noted on Standard Plan J-20.10
Type PS	As noted on Standard Plan J-21.10
Type I	As noted on Standard Plan J-21.10
Type FB	As noted on Standard Plan J-21.10
Type RM	As noted on Standard Plan J-21.10
Type CCTV	As noted on Standard Plan J-29.15
Type II	As noted in the Plans.
Type III	As noted in the Plans.
Type IV	As noted in the Plans and Standard Plan J-27.10
Type V	As noted in the Plans and Standard Plan J-27.10
Type SD	As noted in the Plans.

9-29.10 Luminaires

9-29.13(1) Conventional Roadway Luminaires

(******)

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9-29.10(1)B Light Emitting Diode (LED) Conventional Roadway Luminaires

Section 9-29.10(1)B is supplemented with the following:

The LED Conventional Roadway Luminaire shall be as noted on the Plans.

9-29.13 Control Cabinet Assemblies

Section 9-29.13 is supplemented with the following:

(******)

9-29.13(3) Traffic Signal Controller

Section 9-29.13(3) is supplemented with the following:

Controller Unit (CMU)

1 General Description

This specification describes the minimum requirements for a traffic controller. The controller shall be configurable to meet, at a minimum, all applicable sections of the referenced NEMA Standards.

2 Hardware

2.1 Required Standards

Siemens M62 control equipment shall be used in this contract. All traffic signal controllers shall be furnished with Siemens SEPAC Version 3.5x local intersection software. Traffic signal controller shall meet the applicable standards as described herein. Equipment supplier shall provide a letter from an independent testing laboratory certifying controller compliance to the standards and specifications referred to in this section.

2.1.1 NEMA TS2 Standard.

2.1.2 ATC 5.2b Specification

2.2 Configurations

2.2.1 It shall be possible to configure the controller for multiple configurations:

2.2.1.1 ATC NEMA Configuration.

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

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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:

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 batter- ies of any type are allowed.

2.6 Keyboard and Display

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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 but- tons 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:

2.7.1 Built-in 10 Base-T Ethernet with five RJ-45 connectors on controller front panel.

2.7.2 Built-in Internet Protocol (IP) address assigned by Institute of Electrical and Electronic Engineers (IEEE), two unique IP addresses for each controller.

2.7.3 Built-in 1200 bps Frequency Shift Keying (FSK) modem. Modem is optional per Agency specification. Choice of 2 or 4 wire operation per Agency specification.

2.7.4 Built-in EIA-232 port for uploading and downloading applications software, as well as to update the operating system.

2.7.5 Built-in C60 connector for use with removable Keyboard and Display, Personal Computer COM1 or Personal Digital Assistant (PDA). C60 protocol per Joint NEMA/AASHTO/ITE ATC standard.

2.7.6 Four built-in USB 2.0 ports on controller front panel.

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2.8 Enclosure

In addition to the ATC 5.2b requirements, the controller housing shall provide the following:

2.8.1 One slot with card guides for standard Joint NEMA/AASHTO/ITE ATC modems. The mo- dems are optional, per Agency specification.

2.8.2 Polycarbonate construction, except back panel, rear mounting tabs and power supply mounting plate shall be aluminum for electrical grounding.

2.8.3 Built-in carrying handle

2.8.4 Two adjustable front mounting feet, used to raise the front cables and vary the display viewing-angle.

(******)

9-29.13(10)C NEMA Controller Cabinets

Section 9-29.13(10)C is supplemented with the following:

Cabinet Minimum Requirements

The cabinet shall be completely wired and tested to the 2003 NEMA Traffic Controller Assemblies specification with NTCIP Requirements Version 02.06 (as amended here in). In addition, and at a minimum, the following requirements shall be met:

City of Kirkland traffic signal cabinet specification shall supersede any applicable parts of the State of Washington, Department of Transportation Standard Specifications and Standard plans. This specification shall apply to all controller cabinet types with noted exceptions.

All items not covered by these specifications shall conform to State of Washington, Department of Transportation Standard Specifications and Standard Plans. Traffic signal cabinets shall also comply with NEMA specifications where applicable.

The controller cabinet shall be furnished and installed by the contractor. The controller cabinet shall be equipped with all auxiliary equipment and plug-ins required to operate 8 vehicle phases, 4 pedestrian phases and 4 overlap phases (NEMA TS-2, Type 1). Solid state switching devices shall conform to the provisions in Section Solid State Switching Devices," of these Special Provisions and the following:

The cabinet manufacturer shall install and wire a 768 Opticom interface panel.

The cabinet manufacturer shall install and wire the complete cabinet portion of the Polara pushbutton system.

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The cabinet manufacturer shall have pre-approval by the City of Kirkland on any cabinet that they propose to provide to the City. Said pre-approval shall have been obtained no less than 60 days prior to the closing date of the bid.

All cabinets shall be pre-approved by the City of Kirkland prior to bid letting.

The cabinet shall be designed for 16 channel operation. Load switch(s) 1-8 shall be vehicle phases 1-8; load switch(s) 9-12 shall be pedestrian phases 2, 4, 6, 8; load switch(s) 13-16 shall be overlaps A, B, C & D. These load switch sockets shall be configured in this manor without rewiring the back side of the load-bay. BIU load switch drivers 1-16 shall be wired to appropriate load switch sockets via a terminal block located on the front side of the load bay so as to allow checking voltage inputs to the load switch sockets without dropping the load bay.

The cabinet shall be wired for up to a minimum of (64) channels of detection, (5) channels of Opticom™ preemption.

The use of PC boards shall not be allowed except in detector racks, SDLC interface panels or BIU cages.

The use of plug and play modules shall not be allowed, with the exception of detector rack(s).

The cabinet shall be wired to provide a 55-pin “A” connector.

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

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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.
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 ¾" 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

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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 rubbing. Lock assembly shall be positioned so handle does not cause interference with key when opening the door.
14. Closed-cell, neoprene gaskets shall be bonded to the inside of the cabinet doors. The gaskets shall cover all areas where the doors contact the double flanged cabinet housing exterior and be thick enough to provide a watertight seal.
15. A complete set of keys shall be supplied providing access to the cabinet front door, cabinet side door, the police door and the generator receptacle door.
16. The cabinet shall be equipped with a universal lock brackets capable of accepting a Best™ style lock and a Corbin #2 tumbler series lock. The cabinet shall come equipped with a Best™ style lock and green construction core.
17. The cabinet shall be supplied with three (3) door switches which control the door and police door open status and the cabinet interior lighting circuits.
18. All exterior seams shall be manufactured with neatly formed continuously weld construction. The weld for the police box door shall be done on the inside of the cabinet door. All welds shall be free from burrs, cracks, blowholes or other irregularities.

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19. The fan baffle panel seams shall be sealed with RTV sealant or equivalent material on the interior of the cabinet.
20. The cabinet shall come with lifting ears affixed to the upper exterior of the cabinet. These ears shall utilize only one bolt for easy reorientation. (The cabinet lifting ears shall not be when the batteries installed).
21. The cabinet shall come with two (2) dual-ply Dustlock™ Media polyester, disposable air filter; and the filter performance shall conform to listed UL 900 Class 2 and conform to MERV-8 & ASHRAE Standard 52.2-1999. The filter element shall be secured to louvered entrance on the main door with a metal filter cover. The filter and metal cover shall be secured to entrance on main door by two (2) horizontally-mounted restraints.
22. All cabinet doors shall be mounted with a single continuous stainless steel piano hinge that runs the length of the door. Attaching tamper resistant bolts shall also be stainless steel.
23. The cabinet enclosure shall be a SP+ style Western Systems Part # 3017500000.
24. The cabinet shall be UL listed
25. All steel incorporated in the cabinet shell shall be manufactured in the United States of America, and shall meet the requirements of Section 1605 of the American Recovery and Reinvestment Act of 2009.

Labels

A permanent printed thermo vinyl, engraved or silk screened label shall be provided for all terminals and sockets. Labels shall be legible and shall not be obstructed by cabinet wiring, panels or cables. All labels shall conform to the designations on the cabinet wiring prints.

Shelves

Shall come with (3) double beveled shelves 10” deep that are reinforced welded with V channel, fabricated from 5052-H32 0.125-inch thick aluminum with double flanged edges rolled front to back. Slotted hole shall be inserted every 7” for the purpose of tying off wire bundles. The BBS compartment shall come with (4) shelves designed to hold batteries and capable of supporting 75lbs each.

Cabinet Layout

The shelves shall be populated as follows. The controller and monitor shall be placed on the bottom shelf. The power supply and four (4) detector racks shall be placed on the middle shelf. The top shelf shall be left empty for future electronics.

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The roll out drawer shall be mounted under the bottom shelf just left of center.

Load bay shall be mounted on the back wall with 7" of clearance to the bottom of the cabinet.

A 12"x10" blank panel for the Polara Navigator interconnect board shall be mounted on the lower left wall.

The detector panel for all field inputs shall be mounted on the left wall above the Polara panel.

video panel shall be mounted on the left wall above the detector panel
One 120VAC quad convenience outlet shall be mounted on the left wall above the top shelf.

The SDLC and power supply interface panels shall be mounted on the left wall between the middle and bottom shelves.

The power panel shall be mounted on the lower right wall.

A 12"x36" blank panel shall be mounted on the right wall above the power panel.

One 120VAC quad convenience outlet shall be mounted on the right wall above the top shelf.

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.

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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.
- All the controller (CU) and malfunction management (MMU) cables shall be routed through the back of the load-bay so that they will not be subject to damage during load-bay roll down.
- The top of the load-bay panel shall attach directly to "C" channel and detach without the use of tools or loose hardware for roll down purpose.
- The load-bay shall be balanced such that it will not roll down when the top of the load bay is detached from the "C" channel, even when fully loaded with BIUs load switches, flasher and flash transfer relays.
- The load-bay facility shall be wired for 16 channels. Load switch(s) 1-8 shall be vehicle phases 1-8; load switch(s) 9-12 shall be pedestrian phases 2, 4. 6 & 8; load switches 13-16 shall be overlaps A, B, C & D. Load switches 1-8 and 13-16 shall be routed through a flash transfer relay.
- (16) Load switch sockets in two rows of (8) spaced on 2" center per NEMA TS2 section 5.3.1.2, figure 5-2.
- (6) Flash transfer relay sockets.
    - Flasher socket.
- All load switches and flasher shall be supported by a bracket extending at least ½ the length of the load switch.

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    - Bus interface unit rack slots for BIU's 1 and 2. The main panel BIU racks shall be left of the load switches, placed vertically with BIU 1 on top and BIU 2 on bottom.
- BIU wires connection to the PCB shall be two (2) 34 pin connectors. These connectors shall have locking latches.
- All BIU wiring shall be soldered to backside of a screw terminal. The screw terminals provide access to all functions of BIUs.
- Wiring for one Type-16 MMU. All MMU wiring shall be soldered to backside of a screw terminal. The screw terminals provide access to all functions of the MMU.
- All 24 VDC relays shall have the same base socket, but it shall be different from the 115VAC relays.
- All 115VAC relays shall have the same base socket, but it shall be different from the 24VDC relays. (not applicable to flash transfer relays)
- Shall have a relay that drops +24VDC to load switches when the cabinet is in flash.
- The load bay shall have terminals to access the flash circuits 1 and 2.
- There shall be a wire between the pedestrian yellow field terminals and another terminal on the load bay. The MMU channel 9-12 yellows shall terminate next to said pedestrian yellows terminal.
- The load-bay shall be silkscreened on both sides. Silkscreen shall be numbers and functions on the front side, and numbers only on the back side. The back side shall have labels upside down, so when load bay is rolled down labels will be right side up.
- Field wiring terminations shall be per channel across the bottom of the load-bay. Each channel shall have 3 terminations corresponding to the appropriate vehicle phase Green, Yellow and Red. Default wiring shall be left to right vehicle phases 1-8, pedestrian phases 2, 4, 6, 8 and overlap channels A, B, C, and D following the order of the load switches. Field terminals shall be #10 screw terminal and be rated for 600V.
- All cable wires shall be terminated. No tie-off of unused terminals will be allowed.
- Shall be 100% manufactured in the United States of America.

All wiring shall conform to NEMA TS2 Section 5.2.5 and table 5-1. Conductors shall conform to military specification MIL-W-16878D, Electrical insulated high heat wire, type B. Conductors #14 or

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larger shall be permitted to be UL type THHN. Main panel wiring shall conform to the following colors and minimum wire sizes:

Vehicle green load switch output	14 gauge brown
Vehicle yellow load switch output	14 gauge yellow
Vehicle red load switch output	14 gauge red
Pedestrian Don't Walk switch	14 gauge orange
Pedestrian Walk switch	14 gauge blue
Pedestrian Clearance load switch	14 gauge yellow
Vehicle green load switch input	22 gauge brown
Vehicle yellow load switch input	22 gauge yellow
Vehicle red load switch input	22 gauge red
Pedestrian Don't Walk input	22 gauge orange
Pedestrian Walk input	22 gauge blue
Pedestrian Clearance input	22 gauge yellow
Logic Ground	18 gauge white with red tracer
+24V DC	18 gauge red with white tracer
+12V DC	18 gauge pink
AC+ Line	14 gauge black
AC- Line	14 gauge white
Earth Ground	16 gauge green
AC line (load bay)	12/14 gauge black
AC neutral (load bay)	12/14 gauge white
Controller A cables	22 gauge blue with the exception of power wires

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	(AC+ Black, AC- White & Earth Ground Green) these wires shall be 18AWG
MMU A & B cables	22 gauge orange with the exception of power wires (AC+ Black, AC- White & Earth Ground Green Start Delay Relay Common Black, Normally open Black & Normally Closed Black) These wires shall be 18AWG

Four conductors will supply alternating current (AC) power to the load switch sockets. The load switch sockets shall be supplied 1-4, 5-8, 9-12 & 13-16 by each conductor.

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.

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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

The cabinet shall have two (2) LED lighting fixture with 15 high power LEDs using a cool white color emitting 300lm min @ 12VDC/750mA.The LED shall be a Rodeo Electronics TS-LED-05M02. The LED fixture shall be powered by a Mean Well class 2 power supply LPV-20-12 that shall be mounted on the inside top of the cabinet near the front edge. The cabinet light circuit shall be designed for a second LED fixture to be installed in the cabinet without the need a of a second power supply. It shall be attached under the cabinet drawer so that it remains stationary when drawer is extended. An on/off switch that is turned on when the cabinet door is opened and off when it is closed shall activate the lighting fixture(s) power supply.

Convenience Outlet

The cabinet shall be wired with one convenience outlet with a ground fault interrupter and two quad convenience outlets without ground fault interrupters. The ground fault outlet shall be mounted on the right side of the cabinet on or near the power panel. The two quad convenience outlets shall be near the top shelf on both the right and left walls. No outlets shall be mounted on the door. The GFI power shall be fed through the auxiliary breaker (CB2). The two quad convenience outlets shall be fed through an EDCO SHP300-10 transient voltage suppressor located on the cabinet power panel.

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Auxiliary Panel

The cabinet shall include an auxiliary switch panel mounted to the interior side of the police panel compartment on the cabinet door. The panel shall be secured to the police panel compartment by (2) screws and shall be hinged at the bottom to allow access to the soldered side of the switches with the use of only a Phillips screwdriver. Both sides of the panel shall be silkscreened. Silk-screening on the backside of the switch panel shall be upside down so that when the panel is opened for maintenance the silk-screening will be right side up. All of the switches shall be protected by a hinged see-through Plexiglas cover.

At a minimum the following switches shall be included;

Controller ON/OFF Switch: There shall be a switch that renders the controller and load-switching devices electrically dead while maintaining flashing operations for purpose of changing the controller or load-switching devices. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

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

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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 immediately cause all signal displays to flash as programmed for emergency flash and apply stop time to the controller. When the police flash switch is returned to “Auto”, the controller shall restart except when the MMU has commanded flash operation. The effect shall be to disable the police panel switch when the MMU has detected a malfunction and all controller and MMU indications shall be available to the technician regardless of the position of the police flash switch. The switch shall be a general-purpose bat style toggle switch with .688-inch long bat.

Cables

All wire cable bundles shall be encased in flex or expandable braided sleeving along their entire free length.

All SDLC cables shall be terminated on both ends, securely terminated to the SDLC interface panel with screw type connection and professionally routed in the cabinet interior to easily reach the load bay, controller, malfunction management unit and detector racks. All SDLC connectors shall be fully populated with 15 pins each.

Flashing Operation

All cabinets shall be wired to flash for all vehicle channels. Flashing operation shall alternate between the used vehicle phases 1, 4, 5, 8, OLA, OLD and 2, 4, 6, 8, OLB, OLD. Flash

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programming shall be either red, yellow or no flash simply by changing wires on the front of the load-bay.

Detector Racks

At a minimum, the cabinet shall be wired to accommodate (64) channels of detection. One detector rack shall be half width size and support (16) channels of loop detection, one (1) Buss Interface Unit (BIU) and (4) channel of Opticom™. Three detector racks shall be half width size and support (16) channels of loop detection and one (1) Buss Interface Unit (BIU). These racks shall be capable of using half width four channel detection devices. The loop cabling shall be connected via a 37 pin DB connector using spring clips. The Opticom cable shall be connected via a 24 pin connector using locking latches. The power cable shall be a 6 pin connector. All power wires shall be 18AWG. The addressing of detector racks shall be accomplished via dipswitches mounted to 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 mounted to the PCB. There shall be a 34 pin connector using locking latches that breaks the output from the detector to the input of the BIU, there shall also be +24VDC and logic ground on this connector. All racks shall have space at the bottom front for labeling. All racks shall be designed for horizontal stacking. Separate racks for detection and preemption are not allowed.

768 Panel

There shall be an Opticom™ GTT 768 interface panel installed in the cabinet. At a minimum it shall be soldered to the load switch green outputs and to the advanced vehicle preemption terminal block on the detector panel. This panel shall have a protective plastic cover. It shall be mounted on the lower right wall of the cabinet, under the bottom shelf.

Detection Panel

The detection panel shall support (64) channels of vehicle detection, (4) channels of emergency vehicle preemption, (8) channels of pedestrian detection and (8) pedestrian returns on a single panel. The loop wires shall be a 22AWG twisted pair, color coded as follows. Channel one brown, channel two red, channel three orange and channel four yellow. One of the twisted pair wires of all colors shall have a white tracer and land on the second position terminal of each loop. The emergency preempt wires shall be color coded as follows. +24VDC orange, preempt inputs yellow and ground blue. This panel will be mounted on the left side of the cabinet below the bottom shelf. The panel shall also include a (19)

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position solid aluminum, tin plated neutral and ground buss bars with raised slotted & torque style screws heads. They shall be mounted vertically at the bottom of the panel.

Video Detection Panel

The video detection interface panel shall be the single point interface for video power and coax cabling. The panel shall have (6) individual coax surge arrestor EDCO CX06-M, (6) 1 amp circuit breaker so that individual cameras can be replaced in the field without disrupting the entire video detection system, a (1) 10 position terminal block with a protective plastic cover, (1) neutral and (1) ground buss bars with raised slotted & torque style screws heads.

Power Supply Interface Panel

The power supply interface panel shall include terminations for all the cabinet power supply inputs and outputs. It shall have a protective plastic cover. This panel shall be mounted on the left wall of the cabinet.

Generator Bypass Compartment and Cable

The cabinet front door shall have a locking generator bypass compartment that shall be used to connect a generator to operate the cabinet during extended loss of service line power. The generator compartment shall be capable of being closed and locked while a generator is connected. The mechanism for allowing generator cable access, while the compartment is closed, shall be an integral part of the generator bypass door, via a sliding panel that will normally be in the closed position. Inside the compartment there shall be a silkscreened panel housing a Hubbell HBL2615 30A / 125V flanged inlet receptacle capable of accepting a standard 30 amp generator plug, a BACO HC52DQG cam switch with split 120VAC line and neutral feeds.The switch shall be a break before make type. (2) LED lamps with sockets. One LED shall be illuminated when the cabinet has service line power available and the other when the cabinet has generator power available. All LED's shall be field replaceable without putting the intersection in flash and shall carry a 5-year manufacturer warranty.

All wiring to and from the generator bypass compartment shall be contained in a single cable bundle. The cable shall connect to the backside of the electrical components and shall only be accessible from the inside of the cabinet front door. All electrical components on the inside of the front door that carry AC voltage shall be

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covered by a see-through plexi-glass cover. The generator bypass cable shall terminate at the same power panel location as service line voltage.

Additional Panels

Sheet metal panels shall be installed in the available space on the lower left and upper right & left sides of the cabinet. The lower left side panel shall be 10" x 12". The upper right side panel shall be 36" x 12". The upper left side shall be as determined by City of Kirkland.

Supplemental Loads

Vehicle phase 1, 3, 5, 7, 13, 14, 15 and 16 yellows and greens shall be loaded with a 2K-ohm, 10-watt resistor. Pedestrian phases 2, 4, 6 and 8 don't walks and walks shall be loaded with a 2K-ohm, 10-watt resistor. Each load resistor shall be soldered to the backside of the load switch socket and easily accessed from the back of the main panel (load-bay).

Service Surge Suppression

The cabinet shall be equipped with an EDCO model SHP300-10 or approved equivalent surge arrestor mounted on the power panel. Power to all cabinet electronic equipment and convenience outlets shall come through this surge suppression circuit.

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)

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- 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 10/100 ethernet port. It shall come with software to run flashing yellow arrow operation. The MMU shall be an Eberle Design, Inc. model MMU-16LEip.

Load Switch

The cabinet shall come with (16) load switches. All load switches shall be cube type and have LED indications for both the input and output side of the load. The load switches shall be PDC model SSS87 I/O.

Flasher

The cabinet shall come with (1) flasher. The flasher shall be cube type and have LED indications. The flasher shall be PDC model SSF87.

Flasher Transfer Relay

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The cabinet shall come with (6) heavy duty flash transfer relays. The relays shall be Detrol Controls model 295.

Bus Interface Unit (BIU)

The cabinet shall come with (6) bus interface units (BIU). These shall meet all the requirements of NEMA TS-2 1998 standards. In addition, all BIUs shall provide separate front panel indicator LED's for DC power status and SDLC Port 1 transmit and receive status. The BIU's shall utilize only 1 rack position. The (BIU)'s shall be Eberle Design, Inc. model BIU700H.

Power Supply (PS)

The cabinet shall come with a shelf mounted cabinet power supply meeting at minimum TS 2-2003 standards. It shall be a heavy duty device that provides +12VDC at 5 Amps / +24VDC at 2 Amps / 12VAC at .25 Amp, and line frequency reference at 50 mA. The power supply shall provide a separate front panel indicator LED for each of the four outputs. Front panel banana jack test points for 24VDC and logic ground shall also be provided. The power supply shall provide 5A of power and be able to cover the load of four (4) complete detector racks. The (PS) shall be Eberle Design, Inc. model PS250.

Loop Detector

The cabinet shall come with (16) 4-channel rack mounted loop detectors. These devices shall have LCD displays and be capable of monitoring the call strength from (2) of the channels simultaneously. These devices must have the capability to perform directional logic and 3rd car queuing for protected/permissive operation. Each 4 channel loop amplifier card shall utilize only (1) card rack position. The loop detectors shall be Reno A&E model E/2-1200-SS.

Opticom

The cabinet shall come with (2) 4-channel rack mounted Opticom™ phase selectors. These devices shall be capable of receiving encoded signals from Opticom series 700 emitters and detectors. The Opticom™ phase selectors shall be Global Traffic Technologies model 764 or approved equivalent. (1) Opticom™ 768 auxiliary interface panels shall be supplied for each Opticom™ phase selector supplied.

BBS System

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The cabinet shall come with a complete uninterruptable power system (BBS) which shall include at a minimum a UPS module with SNMP, ATS assembly, batteries, battery heater mats, battery cables and a battery management system. All other ancillary equipment for a complete functioning UPS system shall be included.

The key BBS system components include:

UPS Module

The cabinet shall come with (1) FXM 1100W uninterruptible power supply that supplies clean reliable power control and management. It shall have Automatic Voltage Regulation (AVR), an Ethernet SNMP interface and a control and power connection panel that is rotatable for viewing in any vertical or horizontal orientation. It shall have nominal dimensions of 5.22” x 15.5” x 8.75” and come with mounting brackets. The UPS module shall be an Alpha model 017-201-23.

UATS/UGTS Assembly

The cabinet shall come with (1) universal automatic transfer switch and universal generator transfer switch connected between the UPS module and the batteries. It shall have surge protection, have dimensions of 3.25” x 15.5” x 6.00” and come 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

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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

General

This specification sets forth the minimum requirements for a system that detects vehicles on a roadway using only video images of vehicle and bicycle traffic.

System Hardware

The video detection system (VDS) shall consist of up to four video cameras, up to four video detection processors (VDP) capable of processing two video sources each, one Central Control Unit (CCU), input/output extension modules, video surge suppressors and a pointing device, or any combination thereof.

The VDS will be deployed at locations where site conditions and roadway geometry vary. The VDS system may also be deployed at locations where existing cabinets or equipment exist. Existing site configurations will dictate the availability of cabinet space and VDS usage.

System Software

The system shall include software that discriminately detects the presence of individual vehicles and bicycles in a single or multiple lanes using only the video image. Detection zones shall be defined using only an embedded software application. A monitor and a pointing device are used to place the zones on a video image. A minimum of 32 detection zones per camera view shall be available. A separate computer shall not be required to program the detection zones. In addition to creating vehicle and bicycle zones, the system shall automatically define a pedestrian crossing area in front of the stop bar zones. The system shall provide a tracking mechanism that counts pedestrian volume moving within this crossing area, and also determine the average, maximum, and minimum speed of pedestrians moving within this crossing zone.

The VDS shall be made in the U.S.A. in compliance with FTA “Buy America” regulations.

VDS Hardware

Video Detection Processor (VDP) System Interfaces

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The VDP shall be a single-rack detector card width, and provide provision for up to two sensors per VDP. The following interfaces shall be provided on each video detection processor

Video Input

Each VDP will be supplied with video from the VDS Camera Sensor via Ethernet cables plugged into the front of the Central Control Unit. The interface connectors shall be RJ-45 type.

Video Lock LED

A LED indicator shall be provided to indicate the presence of the video signal. The LED shall illuminate upon valid video synchronization and turn off when the presence of a valid video signal is removed.

Contact Closure Output

Open collector (contact closure) outputs shall be provided. Four (4) open collector outputs shall be provided for the Video Detection Processor rack-mount configuration. Additionally, the VDS shall allow the use of extension modules to provide up to 32 open collector contact closures per camera input. Each open collector output shall be capable of sinking 30mA at 24VDC. Open collector outputs will be used for vehicle detection indicators as well as discrete outputs for alarm conditions. The VDP outputs shall be compatible with industry standard detector racks assignments.

Logic Inputs

Logic inputs such as delay/extend or delay inhibit shall be supported through the appropriate detector rack connector pin or front panel connector in the case of the I/O module. For VDPs and extension modules, 4 inputs shall be supported via detector rack interface. The I/O module shall accommodate eight (8) inputs through a 15-pin “D” connector.

Detection LEDs

Detection status LEDs shall be provided on the front panel. The LEDs shall illuminate when a contact closure output occurs. Rack-mounted video processors shall have a minimum of four (4) LEDs. Rack-mounted extension modules shall have two (2), four (4) or eight (8) LEDs (depending upon extension module type) to indicate detection.

Test Switches

The front panel of the VDP shall have detector test switches to allow the user to manually place vehicle and bicycle calls on each VDP

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output channel. The test switch shall be able to place a momentary call.

Both the VDP and EM shall be specifically designed to mount in a standard detector rack, using the edge connector to obtain power, provide contact closure outputs and accept logic inputs (e.g. delay/extend). No adapters shall be required to mount the VDP or EM in a standard detector rack and no rack rewiring shall not be required.

VDP printed circuit boards (PCBs) shall be conformally coated in accordance with Caltrans and NEMA specifications.

On-board Memory

The VDP shall utilize non-volatile memory technology to store on-board firmware and operational data.

Firmware Upgrade

The CCU shall enable the loading of modified or enhanced software through either the Ethernet or front-panel USB port (using a USB thumb drive) and without removing or modifying the CCU hardware. The upgrade will affect both the CCU and VDP hardware when connected into a single system.

VDP and EM Power

The VDP and EM shall be powered by 12 or 24 volts DC. VDP and EM modules shall automatically compensate for either 12 or 24 VDC operation. VDP power consumption shall not exceed 7.5 watts. The EM power consumption shall not exceed 3 watts.

Operating Temperature

The VDS shall operate satisfactorily in a temperature range from -30° F to +165° F (-34° C to +74° C) and a humidity range from 0%RH to 95%RH, non-condensing as set forth in NEMA specifications.

VDS CCU

The VDS Central Control Unit (CCU) shall be supplied by the VDS manufacturer.

Hardware

The CCU shall be supplied in a shelf mount format.

CCU Power

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The CCU shall be powered from an 110V or 230V, 50Hz or 60Hz supply. CCU power consumption shall not exceed 20 Watts.

Operating Temperature

The VDS shall operate satisfactorily in a temperature range from -30° F to +165° F (-34° C to +74° C) and a humidity range from 0%RH to 95%RH, non-condensing as set forth in NEMA specifications.

On-board Memory

The CCU shall utilize non-volatile memory technology to store on-board firmware and operational data.

Video Surge Suppression

The CCU shall incorporate video surge suppression for each video input. The CCU shall be appropriately grounded to the cabinet ground rod using 14 AWG ($2.5mm^2$) minimum.

Power Surge Suppression

The CCU shall incorporate power surge suppression both on the input power and on the power supplied to the cameras. The CCU shall be appropriately grounded to the cabinet ground rod using 14 AWG ($2.5mm^2$) minimum.

Power Management

The CCU shall incorporate power management for the various parts of the VDS such that if fault conditions are detected the power supply will safely shut down the power to that peripheral.

Interfaces

Extension Modules

Extension modules (EM) shall be available to eliminate the need of rewiring the detector rack, by enabling the user to plug an extension module into the appropriate slot in the detector rack to provide additional open collector outputs. The EM shall be available in both 2- and 4-channel configurations. EM configurations shall be programmable from the CCU. A separate I/O module shall also be available having 32 outputs through a 37-pin “D” connector on the front panel and 8 inputs through a 15-pin “D” connector using an external wire harness for expanded flexibility.

The CCU shall provide four ports for connection to VDS camera sensors. The connector shall be an RJ-45 type.

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The CCU shall provide four ports for connection to VDPs. The connector shall be an RJ-45 type.

The CCU shall provide 2 USB 'A' ports on the front panel of the rack mount CCU unit. These ports can be utilized for various functions. For example, keyboard and mouse functions during system configuration, USB storage devices can be utilized for bin data and video collection. The USB ports shall not require special mouse software drivers. The USB ports shall be used as part of system setup and configuration

The CCU shall provide an output to a monitor. The port shall be HDMI. The native resolution of the monitor port shall be 1024 x 768.

Communications

An Ethernet communications port shall be provided on the front panel. The Ethernet port shall be compliant with IEEE 802.3 and shall use a RJ-45 type connector mounted on the front panel of the CCU. The Ethernet communications interface shall allow the user to remotely configure the system and/or to extract calculated vehicle/roadway information. The interface protocol shall be documented or interface software shall be provided. Each VDS shall have the capability to be IP addressable. The VDP shall support data rates of up to 100Mbps.

The CCU shall provide an SDLC connection to the Traffic Controller. The connector shall be a 'D-15' type, in compliance with NEMA TS-2 specifications.

The CCU shall provide an indicator when the SDLC port is active.

The CCU shall provide an indicator when the unit has power.

The CCU shall provide an indicator when the unit is on line.

The CCU shall provide a Wi-Fi connection. The connection shall be over a standard 2.4GHz connection. The Wi-Fi connection shall be enabled and disabled by a switch on the CCU. The CCU shall provide an indicator when the Wi-Fi connection is active.

The CCU shall provide a connection for a removable antenna. The antenna connection shall be a SMA Male type.

The CCU shall provide system status via an on-board Organic Light Emitting Diode display. The display shall indicate various system parameters, such as camera health and VDP health, firmware version and camera air temperature. The display will be enabled with a switch

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on the CCU. The display will automatically disable 15 minutes after the button is pressed.

VDS Camera Sensor

The VDS camera sensor shall be supplied by the VDS manufacturer.

The VDS camera sensor shall utilize a single shielded CAT5E or CAT6 cable for power and video. The cable termination at the camera shall be a weatherproof RJ-45 connection that shall not require opening of the camera housing to make the field connection.

The camera sensor shall allow the user to set the focus and field of view via the VDS software. Camera sensor control from the controller cabinet shall communicate over a single Cat-5e or CAT6 cable. No additional wires shall be required.

The camera shall produce a useable video image of the features of vehicles under all roadway lighting conditions, regardless of time of day. The minimum range of scene luminance over which the camera shall produce a useable video image shall be the minimum range from nighttime to daytime, but not less than the range 0.003 lux to 10,000 lux.

The camera electronics shall include automatic gain control (AGC) to produce a satisfactory image at night for the VDS algorithms.

The imager luminance signal to noise ratio (S/N) shall be more than 50 dB with the automatic gain control (AGC) disabled.

The imager shall employ three dimensional dynamic noise reduction (3D-DNR) to remove unwanted image noise.

The camera imager shall employ wide dynamic range (WDR) technology to compensate for wide dynamic outdoor lighting conditions. The dynamic range shall be greater than 100 dB.

The camera shall be digital signal processor (DSP) based and shall use a CCD sensing element and shall output color video with resolution of not less than 540 TV lines. The color CCD imager shall have a minimum effective area of 811(h) x 508(v) pixels.

The camera shall include an electronic shutter control based upon average scene luminance and shall be equipped with an auto-iris lens that operates in tandem with the electronic shutter. The electronic shutter shall operate between the range of 1/60th to 1/90,000th second.

The camera shall utilize automatic white balance.

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The camera shall include a variable focal length lens with variable focus that can be adjusted, without opening up the camera housing, to suit the site geometry by means of a portable interface device designed for that purpose and manufactured by the detection system supplier.

The horizontal field of view shall be adjustable from 4.5 to 48 degrees. This camera configuration may be used for the majority of detection approaches in order to minimize the setup time and spares required by the user. The lens shall be a 12x zoom lens with a focal length of 3.5mm to 35mm.

The lens shall also have an auto-focus feature with a manual override to facilitate ease of setup.

The camera shall incorporate the use of preset positioning that store zoom and focus positioning information. The camera shall have the capability to recall the previously stored preset upon application of power.

The camera shall be housed in a weather-tight sealed enclosure. The housing shall allow the camera to be rotated to allow proper alignment between the camera and the traveled road surface.

The camera enclosure shall be equipped with a sunshield. The sunshield shall include a provision for water diversion to prevent water from flowing in the camera's field of view. The camera enclosure with sunshield shall be less than 3.5" (89mm) diameter, less than 5.25" (133mm) long, and shall weigh less than 2.5 pounds (1.14kg) when the camera and lens are mounted inside the enclosure.

The enclosure shall be designed so that the pan, tilt and rotation of the camera assembly can be accomplished independently without affecting the other settings.

Camera Lens

The camera enclosure shall include a proportionally controlled Indium Tin Oxide (ITO) lens coating for the heating element of the front glass that maximizes heat transfer to the lens. The output power of the heater shall vary with temperature, to assure proper operation of the lens functions at low temperatures and prevent moisture condensation on the optical faceplate of the enclosure. The transparent coating shall not impact the visual acuity and shall be optically clear.

The glass face on the front of the enclosure shall have an anti-reflective coating to minimize light and image reflections.
The glass face on the front of the enclosure will include a Titanium Dioxide shelf cleaning coating.

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When mounted outdoors in the enclosure, the camera shall operate satisfactorily in a temperature range from -30° F to +140° F (-34 °C to +60 °C) and a humidity range from 0% RH to 100% RH. Measurement of satisfactory video shall be based upon VDP system operation.

The camera shall be powered by 48VDC. Power consumption shall be 5 watts typical and 16 watts or less under worst conditions.

Recommended camera placement height shall be 33 feet (or 10 meters) above the roadway, and over the traveled way on which vehicles are to be detected. For optimum detection the camera should be centered above the traveled roadway. The camera shall view approaching vehicles at a distance not to exceed 350 feet (107 meters) for reliable detection (height to distance ratio of 10:100). Camera placement and field of view (FOV) shall be unobstructed and as noted in the installation documentation provided by the supplier.

The video signal shall be fully isolated from the camera enclosure.

Cable terminations at the camera for video and power shall not require crimping tools.

A weather-proof protective cover shall be provided shall be provided to protect all terminations at the camera. No special tooling shall be required to remove or install the protective cap.

The camera assembly shall include a temperature sensor. The sensor will be polled by the VDS every minute and will supply the current air temperature. The VDS software will display this information on the On-Screen Display for each camera.

VDS Software

General System Functions

Detection zones shall be programmed via an embedded application displayed on a video monitor and a keyboard and a pointing device connected to the CCU. The menu shall facilitate placement of detection zones and setting of zone parameters or to configure system parameters. A separate computer shall not be required for programming detection zones or to view system operation. All programming function shall occur on live video images, no snapshots or still images are allowed.

The VDS software shall store up to five completely independent detection zone patterns in non-volatile memory. The VDS can switch to any one of the three different detection patterns within 1 second of user request via menu selection with the pointing device. Each configuration shall be uniquely

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labeled and able to be edited by the user for identification. The currently active configuration indicator shall be displayed on the monitor.

The VDS shall detect vehicles and bicycles in real time as they travel across each detection zone.

The VDP shall automatically define a pedestrian crossing area, and track pedestrians in real-time as they travel across this pedestrian crossing area in both directions. The VDP shall count pedestrians moving left-to-right, and right-to-left. The VDP shall measure the speed of pedestrians moving left-to-right, and right-to-left, and provide the minimum, maximum, and average speed of the pedestrians per the bin interval. These values shall be displayed on-screen for both directions, and an option shall be provided to the user to turn this on-screen display on or off. This data will be stored in local memory for later retrieval via a remote device. The data will be stored at the Bin Interval set in the system.

The VDS shall accept new detection patterns from an external computer through the Ethernet port when the external computer uses the correct communications protocol for downloading detection patterns. A Windows™-based software designed for local or remote connection and providing video capture, real-time detection indication and detection zone modification capability shall be provided with the system.

The VDS shall have the capability to automatically switch to any one of the stored configurations based on the time of day which shall be programmable by the user.

The VDS shall send its detection patterns to an external computer through the Ethernet port when requested when the external computer uses the appropriate communications protocol for uploading detection patterns.

The VDS shall default to a safe condition, such as a constant call on each active detection channel, in the event of unacceptable interference or loss of the video signal.

The VDS shall be capable of automatically detecting a low-visibility condition such as fog and respond by placing all affected detection zones in a constant call mode. A user-selected alarm output shall be active during the low-visibility condition that can be used to modify the controller operation if connected to the appropriate controller input modifier(s). The system shall automatically revert to normal detection mode when the low-visibility condition no longer exists. An On-Screen Icon will be displayed while the system is in this mode.

Up to 32 detection zones per camera input shall be supported and each detection zone must be user-sizeable to suit the site and the desired vehicle detection region.

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The VDS shall provide up to 32 open collector output channels per camera input using one or more extension modules.

A single detection zone shall be able to replace multiple inductive loops and the detection zones shall be OR'ed as the default or may instead be AND'ed together to indicate vehicle presence on a single approach of traffic movement.
When a vehicle is detected within a detection zone, a visual indication of the detection shall activate on the video overlay display to confirm the detection of the vehicle for the zone.

Detection shall be at least 98% accurate in good weather conditions, with slight degradation possible under adverse weather conditions (e.g. rain, snow, or fog) which reduce visibility. Detection accuracy is dependent upon site geometry, camera placement, camera quality and detection zone location, and these accuracy levels do not include allowances for occlusion or poor video due to camera location or quality.

The VDS shall provide dynamic zone reconfiguration (DZR). DZR sustains normal operation of existing detection zones when one zone is being added or modified during the setup process. The new zone configuration shall not go into effect until the configuration is saved by the operator.

Detection zone setup shall not require site specific information such as latitude and longitude to be entered into the system.

The VDS shall process the video input from each camera at 30 frames per second. Multiple camera processors shall process all video inputs simultaneously.

The VDS shall output a constant call during the background learning period of no longer than 3 minutes.

Detection zone outputs shall be individually configurable to allow the selection of presence, pulse, extend, and delay outputs. Timing parameters of pulse, extend, and delay outputs shall be user definable between 0.1 to 25.0 seconds.
Up to six detection zones per camera view shall have the capability to count the number of vehicles detected. The count value shall be internally stored for later retrieval through the Ethernet port. The zone shall also have the capability to calculate and store average speed and lane occupancy at user-selectable bin intervals of 10 seconds, 20 seconds, 1 minute, 5 minutes, 15 minutes, 30 minutes and 60 minutes.

In addition to the count type zone, the VDS shall be able to calculate average speed and lane occupancy for all of the zones independently. These values shall be stored in non-volatile memory for later retrieval.

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The VDS shall have an “advance” zone type where raw detection output duration to the traffic controller is compensated for angular occlusion and distance.

The VDS shall employ color overlays on the video output.

The VDS shall have the ability to show controller phase status (green, yellow, or red) for up to 8 phases. These indications shall also be color coded.

The user shall have the ability to enable or disable the display of the phase information on the video output.

The VDS shall have the capability to change the characteristics of a detection zone based on external inputs such as signal phase. Each detection zone shall be able to switch from one zone type (i.e. presence, extension, pulse, etc.) to another zone type based on the signal state. For example, a zone may be a “count” zone when the phase is green but change to a “presence” zone type when the phase is not green. Another application would be zone type of “extension” when the signal phase is green and then “delay” when red.

The VDS software shall aid the user in drawing additional detection zones by automatically drawing and placing zones at appropriate locations with only a single click of the mouse. The additional zone shall utilize geometric extrapolation of the parent zone when creating the child zone. The process shall also automatically accommodate lane marking angles and zone overlaps.

When the user wishes to modify the location of a zone, the VDS software shall allow the user move a single zone, multiple zones or all zones simultaneously.

When the user wishes to modify the geometric shape of the zone, the VDS software shall allow the user to change the shape by moving the zone corner or zone sides.

On screen zone identifiers shall be modifiable by the user. The user shall be allowed to select channel output assignments, zone type, input status, zone labels or zone numbers to be the identifier.

The VDS software shall support bicycle type zones where the zone can differentiate between motorized vehicles and bicycles, producing a call for one but not the other.

Bicycle zone types shall only output when a bicycle is detected. Larger motorized vehicles such as cars and trucks that traverse a bicycle zone shall not provide an output.

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The VDS software shall provide the ability to assign a separate output channel for bicycle zones to allow traffic controllers to implement special bicycle timing.
Placement of bicycle type zones in vehicle lanes shall be allowed.

Upon detection of a bicycle, the video output overlay shall indicate active detection as well as providing a unique bicycle detection identifier to visually distinguish bicycle detection versus vehicle detection.

Up to six bicycle detection zones per camera view shall have the capability to count the number of bicycles detected in addition to their normal detection function. The count value shall be internally stored for later retrieval through the Ethernet port.

Automatic Traffic Volume Graph

The On-Screen Display shall include an Automatic Traffic Volume graph. This graph will display estimated Vehicles Per Hour (VPH) per movement for each camera view. The graph will display a rolling 24 hour period of VPH.

Occupancy Graph

The On-Screen Display shall include an Occupancy Graph. This graph will display estimated approach occupancy for each camera view. The graph will display a rolling 24 hour period of Occupancy.

User Interfaces

This section sets forth the minimum requirements for the VDS to provide a single point interface to remote and local users. The VDS shall also have the capability to stream up to four simultaneous video streams over an Ethernet interface.

The user interface shall provide capabilities to enable multiple rack-mounted video detection processors to be locally and remotely accessed from a single point via an Ethernet connection.

The device shall allow the operator to view four videos simultaneously or any one video by controls embedded in the VDS.

Local user access to video detection programming shall be limited to the detection processor unit that is currently being displayed on the monitor.

All local programming and setup parameters for the video detection processor shall be user accessible through the interface unit without requiring the user to swap user interface cables between video detection processors.

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Remote access to the device shall be through the built-in Ethernet port via access software running on a Microsoft Windows based personal computer. A Windows OS remote access firmware shall also be available for remote setup and diagnostics of the interface unit.

The VDS shall support streaming video technology using H.264 standards to allow the user to monitor video detection imagery over the Ethernet interface. Motion JPEG streaming video shall not be allowed.

The interface unit shall allow eight independent streams, one from each video processor, to be transported via Ethernet to four independent streaming video players simultaneously in D1 resolution.

The interface shall allow the user to select the resolution of the displayed streamed video.

The interface unit shall support the streaming and display of eight concurrent streams in D1 resolution.

The VDS shall allow the user to manage the unit's Ethernet bandwidth usage by allowing the user to select high, medium or low resolution.

The interface shall allow the user to change the unit's Ethernet network settings of IP address, subnet mask and default gateway.

The VDS shall allow the user to upload new application firmware through the use of the interface, remotely or on-site.

A Windows OS based application will be provided to remotely view video streams from the VDS.

An iOS and Android based application shall be available to remotely access each configured VDS on the agency's network. This application shall allow the user to choose between any number of pre-configured intersection locations. Using the iOS or Android device, the application will allow the user to view live video from any camera at that intersection, including vehicle and bicycle detections in real-time. The application will also allow the user to view individual intersection data, including turning movement counts and occupancy. The application will show each data set in time periods of day, week, or month, and have the capability of turning on or off right, left, and thru movement data for turning movement count data. The application will also allow the user to view current system diagnostic data, including the following, but not limited to; individual camera glare and low contrast information, system low contrast, constant call, alarm, reboots, logins, and menu access information.

SDLC Functionality

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This section sets forth the minimum requirements for a full-function BIU and integrated video detection communication. The VDS shall provide outputs to the controller of vehicle calls from video processors that reside within the detector rack.

Functional Capabilities

The VDS shall have the capability of monitoring phase information and passing that information and other system data such as "time" from the controller to video detection processor modules. The VDP shall also accept data from video processor modules and relay the information to the controller. The unit shall provide a maximum of 64 detector outputs to the controller via the SDLC interface.

Requirements

The module shall be in compliance with the following industry specifications:

Transportation Electrical Equipment Specifications (TEES), August 16, 2002 (or latest edition), California Department of Transportation

NEMA Standard Publication TS 1-1989 (or latest edition), *Traffic Control Systems,* National Electrical Manufacturers Association

NEMA Standard Publication TS 2-2003, Traffic Controller Assemblies With NTCIP Requirements, Version 02.06 (or latest edition), National Electrical Manufacturers Association

Data Interfaces

The VDS shall have two data interfaces:

The interface to the controller shall be accomplished by the use of the TS-2 SDLC port and protocol in accordance with the TS-2 specifications. The module shall be able to be configured to respond to BIU addresses 8, 9, 10 and 11 or a combination thereof.

The interface to communicate with card rack video detection processors shall be manufacturer specific.

SDLC Communication Indicators

One LED indicator shall be provided for the TS-2 SDLC interface. The indicator shall be used to inform the user of any communication activity on the SDLC port.

Installation

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The cable to be used between the camera and the CCU in the traffic cabinet shall be Cat-5e, shielded, direct burial. This cable shall be suitable for installation in conduit or overhead with appropriate span wire. Shielded RJ-45 connectors shall be used where applicable. The Cat-5e cable, RJ-45 connector, stripping and crimping tool shall be approved by the supplier of the video detection system, and the manufacturer's instructions must be followed to ensure proper connection.

The video detection camera shall be installed by factory-certified installers as recommended by the supplier and documented in installation materials provided by the supplier. Proof of factory certification shall be provided.

Warranty

The supplier shall provide a limited three-year warranty on the video 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.

During the warranty period, updates to VDP 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 video 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 video 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

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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: EZ Communicator Navigator 2-Wire (EN2); Part Number: EN29VN1-G

Each pushbutton station shall include the following:

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: EZ Communicator Central Control Unit with Ethernet (CCU2EN)

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.

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Provide one EConfigurator 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
A1	Fire Station Driveway	NE 132nd St	1	Right
A2	Fire Station Driveway	NE 132nd St	1	Left
C1	Juanita Elementary Driveway	NE 132nd St	1	Left
C2	Juanita Elementary Driveway	NE 132nd St	1	Right
D1	NE 132nd St	Fire Station Driveway	1	Left
D2	NE 132nd St	Juanita Elementary Driveway	1	Right

Order forms shall be completed by the Contractor using the information presented above.

(******)

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.

(******)

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Add the following new section:

9-29.26 CCTV Camera Equipment

Television Camera Assembly
The CCTV camera shall consist of Cohu RISE 4260HD Series system equipment, software and mounting components.

The following CCTV Camera components shall be manufactured by Cohu and installed in accordance with the plans.

1. Equipment Model Numbers:

   CCTV Camera
   Cohu RISE 4261-1100

   CCTV Mount
   SMR 1_1NOT0 Model

2. Manufacturer:

   CohuHD Costar
   12367 Crosthwaite Circle
   Poway, CA 92064
   Tel: (800) 391-1800
   www.cohuhd.com

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 Cohu RISE 4260HD 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

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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:

Cisco Systems Inc.
170 West Tasman Dr.
San Jose, CA 95134
Telephone: 1 (800) 553-6387

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