

APPENDIX A

TRAFFIC CONTROL CENTER SPECIFICATIONS

City of Federal Way
Traffic Control Center
33325 8th Ave S,
Federal Way, WA 98063

100% CD
July 11, 2019

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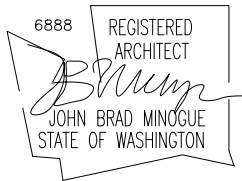
DIVISION 9 FINISHES

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122413 Roller Window Shades
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*Note: See Division 1-06 of the Special Provisions for Buy America Requirements



DIVISION 9

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum board (GWB).
 - 2. Related accessories.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. 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.
- B. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. Georgia-Pacific Gypsum LLC:
 - 1) Tough Rock Gypsum Wallboard Panels
- b. American Gypsum Co.
- c. BPB America Inc.
- d. G-P Gypsum.
- e. Lafarge North America Inc.
- f. National Gypsum Company.
- g. PABCO Gypsum.
- h. USG Corporation
- i. Approved Equal.

B. Type X (GWB)

- 1. Thickness: 5/8 inch.
- 2. Long Edges: Tapered.

2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

- 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
- 2. Shapes:
 - a. Cornerbead.
 - 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.

- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - d. Approved Equal.
 - 3. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
 - 4. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.3 JOINT TREATMENT MATERIALS

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

2.4 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 thick.
 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. 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.
- D. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.2 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 1. Type X: Vertical surfaces, unless otherwise indicated

3.3 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 according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.4 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, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for acoustical tile; panels that are substrate for acoustical tile; where indicated on drawings.
 - 3. Level 3: Where indicated on Drawings.

3.5 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Wood.
 - 2. Gypsum board.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each finish and for each color and texture required.
- C. Product List: Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.3 QUALITY ASSURANCE

- A. 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 Specification Manual" for products and paint systems indicated.
- B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Apply benchmark samples after permanent lighting and other environmental services have been activated.

3. Final approval of color selections will be based on benchmark samples.
 - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & CO.
 2. Sherwin Williams Company
 3. Dunn-Edwards Corporation
 4. Approved Equal.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
 4. Floor Coatings: VOC not more than 100 g/L.

5. Shellacs, Clear: VOC not more than 730 g/L.
 6. Shellacs, Pigmented: VOC not more than 550 g/L.
 7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
 8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
 9. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
 10. Dry-Fog Coatings: VOC content of not more than 400 g/L.
 11. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
 12. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. 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).
 2. Restricted Components: Paints and coatings shall not contain any of the following:
 - a. Acrolein.
 - b. Acrylonitrile.
 - c. Antimony.
 - d. Benzene.
 - e. Butyl benzyl phthalate.
 - f. Cadmium.
 - g. Di (2-ethylhexyl) phthalate.
 - h. Di-n-butyl phthalate.
 - i. Di-n-octyl phthalate.
 - j. 1,2-dichlorobenzene.
 - k. Diethyl phthalate.
 - l. Dimethyl phthalate.
 - m. Ethylbenzene.
 - n. Formaldehyde.
 - o. Hexavalent chromium.
 - p. Isophorone.
 - q. Lead.
 - r. Mercury.
 - s. Methyl ethyl ketone.
 - t. Methyl isobutyl ketone.
 - u. Methylene chloride.
 - v. Naphthalene.
 - w. Toluene (methylbenzene).
 - x. 1,1,1-trichloroethane.
 - y. Vinyl chloride.
- D. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.
 - 1. VOC Content: Max. VOC 50g/L.

2.4 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.
 - 1. VOC Content: Max. VOC 50g/L.
- B. Interior Alkyd Primer/Sealer: MPI #45.
 - 1. VOC Content: Max. VOC 100g/L.
- C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.5 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.
 - 1. VOC Content: Max. VOC 100g/L..

2.6 LATEX PAINTS

- A. Interior Latex (Flat): MPI #53 (Gloss Level 1).
 - 1. VOC Content: Max. VOC 50g/L.
- B. Interior Latex (Satin): MPI #43 (Gloss Level 4).
 - 1. VOC Content: Max. VOC 150g/L.
- C. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).
 - 1. VOC Content: Max. VOC 150g/L.
- D. Interior Latex (Gloss): MPI #114 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).
 - 1. VOC Content: Max. VOC 150g/L.

- E. Institutional Low-Odor/VOC Latex (Low Sheen): MPI #144 (Gloss Level 2).
 - 1. VOC Content: Max. VOC 150g/L.
- F. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
 - 1. VOC Content: Max. VOC 150g/L.
- G. High-Performance Architectural Latex (Satin): MPI #140 (Gloss Level 4).
 - 1. VOC Content: Max. VOC 150g/L.
- H. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).
 - 1. VOC Content: Max. VOC 150g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Masonry (Clay and CMU): 12 percent.
 - 3. Wood: 15 percent.
 - 4. Gypsum Board: 12 percent.
 - 5. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION AND APPLICATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.3 INTERIOR PAINTING SCHEDULE

- A. Gypsum Board Substrates:
 - 1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.
 - a. Prime Coat: Interior latex primer/sealer.
 - b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
 - c. Topcoat: Institutional low-odor/VOC interior latex (low sheen) (eggshell) (semigloss)

END OF SECTION 099123

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes roller shades.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, details of installation, operational clearances, and relationship to adjoining Work.
 - 1. Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.
- C. Coordination Drawings: Drawn to scale and coordinating penetrations and ceiling-mounted items.
- D. Samples: For each exposed finish and for each color and texture required.
- E. Window Treatment Schedule: Use same designations indicated on Drawings.
- F. Maintenance data.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Fire-Test-Response Characteristics: Provide products passing flame-resistance testing according to NFPA 701 by a testing agency acceptable to authorities having jurisdiction.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with WCMA A 100.1.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

A. Basis-of-Design Product: Subject to compliance with requirements, provide:; Draper Inc.; "Access Dual Roller Flex Shade, and Snugfold Shades"; or a comparable product by one of the following:

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

- 1) Am-Source International.
- 2) BTX Window Automation, Inc.
- 3) Custom Laminations, Inc.
- 4) Hunter Douglas, Inc.
- 5) Levolor; Levolor-Kirsch Window Fashions; a Newell Rubbermaid Company.
- 6) Lutron Shading Solutions by VIMCO.
- 7) MechoShade Systems, Inc.
- 8) Nysan Shading Systems Ltd.
- 9) Shade Techniques, Inc.
- 10) Silent Gliss USA, Inc.
- 11) SMAutomatic, Inc.
- 12) Sol-R-Veil.
- 13) Verosol USA, Inc.
- 14) OEM Shades Inc.

B. Shade Band Material: Fabric.

1. Colors: As selected by Architect from manufacturer's full range.
2. Material Energy Efficient
3. Material Sound Absorption.
4. Material UV Blockage: 95 percent.

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets. Provide capacity for one roller shade band(s) per roller.

D. Direction of Roll: Regular, from back of roller.

E. Mounting Brackets: Fascia end caps, fabricated from steel finished to match fascia or headbox.

F. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; removable design for access.

G. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.

- H. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.
- I. Pocket with Ceiling Slot Opening: Six-sided box units for recessed installation; fabricated from formed-steel sheet, extruded aluminum, or wood; with a bottom consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing rollers, brackets, and operating hardware and operators within.
 - 1. Corner Section: Factory formed and welded.
- J. Mounting: Inside and Ceiling.
- K. Shade Operation: Manual.

2.2 ROLLER SHADE FABRICATION

- A. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 - 2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- B. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting roller, and operating hardware and for hardware position and shade mounting method indicated.
- C. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

PART 3 - EXECUTION

3.1 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

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- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

END OF SECTION 122413

SECTION 123210 - MANUFACTURED CONSOLE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Command Center Console.

1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For cabinet finishes and for each type of top material indicated.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."
- C. Product Designations: Drawings indicate sizes, configurations, and finish material of manufactured wood casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered. Refer to Division 01 Section "Product Requirements."

1.5 WARRANTY

- A. Standard actual Manufacturer's warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Manufactured Console:
 - a. Winsted; Control Room Consoles.
 - b. TBC Consoles,
 - c. Americon, or
 - d. Approved equal.

2.2 MATERIALS, GENERAL

- A. Low-Emitting Materials: Provide manufactured console, including countertops, made with adhesives and composite wood products containing no urea formaldehyde.
- B. Softwood Plywood: DOC PS 1.
- C. Particleboard: ANSI A208.1, Grade M-2.
- D. MDF: ANSI A208.2, Grade 130.
- E. Hardboard: AHA A135.4, Class 1 Tempered.
- F. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

2.3 COMAND CENTER CONSOLE

- A. Static countertop space. Refer to Architect's drawings for dimensions.

2.4 CONSOLE COMPONENTS

- A. Framework: the self-supporting skeleton framework shall be fully capable of supporting all specified electronics.
- B. Countertop: shall be constructed from 1" thick, high density composite core with a high-pressure plastic laminate (color to be selected by Architect)
- C. Access doors and panels shall be constructed from high pressure plastic laminate with 3/4" thick composite core. Enclosure panels are high-pressure plastic laminate with minimum 40-pound.

- D. (medium) density particle board with backer sheet of high-pressure standard plastic laminate (color to be selected by Architect)
- E. Access doors shall be vented and will swing-out for convenient access to the PCUs.
- F. Bottom Shelf: to storage (5) CPUs towers
- G. Edging: ergonomically designed, applied to all console desktops in the work space area (front, sides).
- H. Data / Power rail: shall include cable grommets and openings for a universal data mounting plate and/or duplex power box.
- I. Internal UL listed power strips.
- J. Hardware: manufacturer's standard finish, commercial quality, heavy-duty hardware

2.5 DESIGN, COLOR, AND FINISH

- A. Design: Provide manufactured wood casework of the following design:
 - 1. Reveal overlay with wire pulls.
- B. Wood Colors and Finishes: As indicated by manufacturer's designations.
- C. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from plastic-laminate manufacturer's full range of wood-grain patterns.
- D. Edgebanding Color: As selected from casework manufacturer's full range.

PART 3 - EXECUTION

3.1 CONSOLE INSTALLATION

- A. As recommended by manufacturer.

3.2 CLEANING AND PROTECTING

- A. Clean finished surfaces.
- B. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123210

DIVISION 23 SEALS PAGE

THE PROFESSIONAL SEALS AND SIGNATURES AFFIXED HERON INDICATE THE PROFESSIONALS' REVIEW AND PARTICIPATION IN THE PREPARATION OF THE CONTRACT SPECIFICATIONS LISTED.



230010 – GENERAL HVAC REQUIREMENTS

230020 – BASIC MATERIALS AND METHODS FOR HVAC

230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

230593 – TESTING, ADJUSTING, AND BALANCING

230713 – DUCT INSULATION

230993 – SEQUENCES OF OPERATION FOR HVAC CONTROLS

233100 – HVAC DUCTS AND CASINGS

233300 – AIR DUCT ACCESSORIES

233600 – AIR TERMINAL UNITS

233700 – AIR OUTLETS AND INLETS

DIVISION 23

SECTION 23 00 10 - GENERAL HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC) REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL

- A. Conform to General Conditions, Supplementary Conditions, and Division 01.
- B. This section of the specification applies to the entire mechanical work, both interior and exterior, as specified herein after and shown on the plans.

1.2 SCOPE

- A. Provide heating, ventilating, and air conditioning equipment, piping, ductwork, etc. as shown on Plans and as described in contract documents.

1.3 DEFINITIONS

- A. The term "approved equal" means final approval by the Owner's representative of a material or piece of equipment substituted for that which is shown in the specifications or plans.
- B. The term "provide" means the furnishing and installing of equipment (including connections and appurtenances) complete and ready for use.
- C. The term "Mechanical Contractor (MC)" and "Electrical Contractor (EC)" as used in these Specifications or on the Contract Drawings, refers to those subcontractors working under the direction of the "General Contractor (GC)."

1.4 INTENT OF DRAWINGS

- A. The drawings are diagrammatic and do not show the exact details and locations, nor all offsets in ductwork and piping. Contractor shall provide additional fittings, offsets and extensions in piping, ductwork and related mechanical insulation as required to meet the intent of the documents. Contractor shall include in his bid provisions to relocate or shift piping and ductwork where conflicts exist with Structural, Architectural, or Electrical.
- B. Refer to the complete set of Architectural, Structural, Electrical, and Civil Plans and Specifications for additional details of the work. Review Plans and Specifications of other trades to identify other requirements. Discrepancies shall be reported to the Owner's representative immediately before ordering material or beginning work.

1.5 COORDINATION

- A. Examine the Architectural, Civil, Structural and Electrical drawings before work is started. Consult with each of the other Contractors regarding locations and spaces required for work and lay out work to avoid interference. Maximum clearance shall be maintained for service access and maintenance of all equipment. Failure to coordinate shall be justification to require

Contractor, at his own expense, to move his work to provide the necessary space for the other contractors.

- B. Contractor shall be responsible for his own coordination between all other trades. Development of Shop Drawings shall be a collaborative effort between the General Contractor, Mechanical Contractor, Electrical Contractor and all other subcontractors working on the project. Shifting of piping, ductwork and other mechanical items shall be the responsibility of the Team to maintain the intent of the documents. Submit shop drawings to the Owner's representative.

1.6 WORK IN OTHER SECTIONS

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

1.7 CODES AND REFERENCES

- A. Codes and Standards listed shall be the most current issue as adopted by the Local Jurisdiction. In the event of a conflict of codes, the most stringent code will apply.
 - 1. International Building Code (IBC)
 - 2. Uniform Plumbing Code (UPC)
 - 3. International Mechanical Code (IMC)
 - 4. Washington State Energy Code
 - 5. SMACNA Duct Construction Standards, Metal and Flexible
 - 6. National Electrical Code (NEC)

1.8 PERMITS AND FEES

- A. Obtain and pay for all permits, licenses and construction or utility fees. Furnish final certificate to Owner showing compliance with code requirements.

1.9 SCHEDULING

- A. Comply with requirements of General Specifications.

1.10 PRIOR APPROVALS

- A. Specifications have been written around equipment and material selected for this project based on quality, size, capacity, and performance required to meet building design criteria. Any equipment and/or material used in this project, that is not as specified, must have prior approval from the Owner's representative.
- B. Request for Approval must be submitted with substitution request form included in Division 0 to Owner's representative, a minimum of 10 calendar days prior to bid date. This letter shall be accompanied with complete information regarding items to be substituted. If supplier requires a reply to the request for approval, he is to send self-addressed, stamped envelope with request.

- C. Those items that receive prior approval, will be listed in the Mechanical Addenda.
- D. Supplier, and/or Mechanical Contractor, shall be responsible for ensuring that substituted material or equipment is of the same size, quality, capacity, weight, and electrical characteristics as that specified. Any changes and costs required during construction, due to contractor's/supplier's neglect to properly select substituted equipment, shall be paid by the contractor/supplier.
- E. Prior approval to bid does not mean automatic final approval of material or equipment by the Owner's representative. Final approval will be given after final submittal data has been presented to Owner's representative, with complete information regarding weights, capacities, size, electrical requirements and quality.

1.11 MATERIAL AND MATERIAL SUBMITTALS

- A. All material used on the project shall be new material and free from defects. This Contractor shall submit catalog data and engineering data on all equipment as specified or having received prior approval.
- B. Material and equipment specified is designated by various manufacturer's catalog numbers. Acceptable alternate manufacturers are also listed. Such manufacturers are exempt from the 10-day prior approval clause of these specifications, but must submit standard submittal data for final approval as otherwise noted.
- C. Submittal shall be arranged in numerical order, according to specification section number and item number. Submittal shall be bound in hard cover, loose-leaf binder(s).
- D. Submittal shall be as follows: Before ordering or installing any of the materials, this Contractor shall submit copies of complete information on the materials to be used on the project. Submittal may be electronic or in hard copy. If contractor chooses to submit printed copies, he shall provide five copies to the Owner's representative. Submittal shall include, but not be limited to, the following.
 - 1. Contractor's Cost Breakdown
 - 2. Complete List of Subcontractors and Suppliers
 - 3. HVAC Insulation
 - 4. All Air-Handling Equipment
 - 5. HVAC Ductwork
 - 6. Tests and Adjustments - Balancing
 - 7. Integrated Automation - Energy management and control system
- E. Owner's representative's review of submittals is for general conformance with the design concept and Contract Documents. Marking or comments shall not be construed as relieving the Contractor from compliance with the project Plans and Specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy for confirming and correlating all quantities and assembly and for safe performance of his work.
- F. The Owner's representative will return one set, electronic or printed copy, of this submittal to

the contractor showing any corrections, additions, and/or deletions. If the Contractor needs additional printed copies, he shall photocopy his approved copy of the required items. This Contractor shall resubmit those items that need to be corrected or added.

1.12 CONTRACTOR'S COST BREAKDOWN

- A. Mechanical Contractor shall submit, with the bound submittals, a cost breakdown of the major portions of his work, pursuant to the following outline.
 - 1. Job organization and submittals.
 - 2. Outside site utilities.
 - 3. HVAC Equipment.
 - 4. HVAC ductwork and air terminals.
 - 5. HVAC piping and insulation.
 - 6. Tests and adjustments
 - 7. Integrated Automation - Energy management and control system.

1.13 RECORD (AS-BUILT) DRAWINGS

- A. This Contractor shall maintain a set of Contract Drawings at the site on which the actual installed location of piping, equipment, etc., shall be shown in a legible, neat manner. This set of plans shall show actual dimensions (including depth of bury) of underground piping from construction lines, so they can be readily found after covering. Upon completion of the project, the as-built information shall be transformed into AutoCAD version 2007 or greater. Record drawings shall be the same size as contract drawings. This set of plans shall be submitted for final approval. Drawings shall be one full size set, one half size set and on CD in PDF and .dwg format. The contractor shall be ready for review of the on-site as-builts monthly prior to submitting his billing. Failure to have drawings available for review may delay monthly billings.

1.14 OPERATING INSTRUCTIONS

- A. Operate all systems through complete cycles in the presence of designated Owner's representative. Give instructions for operation, care and maintenance. All systems shall be operated through complete operating cycles for a minimum period of 7 days in conjunction with the designated Owner's representative before acceptance.

1.15 TRAINING

- A. The Mechanical Contractor shall digitally record all Owner Mechanical training sessions and shall provide copies on DVDs. Training sessions shall be provided for all mechanical systems. Three copies of these DVDs shall be turned over to the Owner at the completion of the project.

1.16 OPERATION AND MAINTENANCE MANUALS (O&Ms)

- A. General: Provide a manual complete with parts list furnished by the manufacturer with the equipment, together with supplementary drawings where necessary, to itemize serving and maintenance points. Include filter maintenance, methods of operation, seasonal requirements, manufacturer's data and warranty forms. Warranty forms are to be located in the front of the

manuals as well as in each applicable specific section. Provide address and 24-hour phone number of the firms responsible under warranty. Items requiring service or correction during the warranty period shall be serviced within 24 hours of notification by Owner. Data in manuals shall be neat, clean copies, with operation and maintenance instructions for each item of equipment installed. An index shall be provided with all contents listed in an orderly presentation according to specification section.

1.17 CERTIFICATIONS

- A. Provide written certification that work has been fully completed in strict accordance with Plans and Specifications and request final inspection.
- B. Provide written certification that Contractor will replace materials and workmanship that prove defective for one (1) year after date of acceptance or extended warranty as listed in individual sections.
- C. Provide written certification of inspection from the Authority Having Jurisdiction, stating that all work has been inspected, accepted, and approved as complying with existing governing ordinances and codes.
- D. Provide written certification that Owner's representative has been fully instructed in the operation and function of all mechanical systems.
- E. Provide copies of certification in the O & M Manuals.
- F. See Division 1-06 of the Special Provisions for Buy America requirements.

1.18 DOCUMENTS

- A. Present the following documents to the Owner's representative prior to final acceptance of buildings. Final payment of the Contract will be contingent upon receiving these documents:
 - 1. Record (as-built) drawings.
 - 2. Operation and Maintenance Manuals
 - 3. Final material submittal.
 - 4. Warranties and Extended Warranties.
 - 5. Approved Final Balancing logs.
 - 6. Final certificates of inspection and code compliance.
 - 7. All applicable forms required by these specifications.
 - 8. Provide copies of the above documents in O & M Manuals.

1.19 WARRANTY

- A. All mechanical equipment and systems including Heating, Ventilating, and Air Conditioning systems, including controls and all parts thereof, shall be warranted (parts and labor), for a period of one (1) year after the date of substantial completion as determined by the documentation.
- B. Contractor shall repair or replace to the satisfaction of the Owner's representatives any

defective material, equipment, or poor workmanship, which may show itself during this warranty period.

- C. Controls shall be warranted for two (2) years total parts and labor, from date of final acceptance.
- D. Test and Balance shall be warranted for two (2) years total, from date of final acceptance.

1.20 MECHANICAL ACOUSTICAL REQUIREMENTS

- A. The noise criteria (NC) end resultant for each space shall be per Code as adopted by Local Jurisdiction.

1.21 DEMOLITION

- A. Complete all Demolition Work as shown on the drawings and where required to install the new work shown on the drawing and as specified herein. Demolition work shall not be started until the occupants have moved out. The move will be scheduled in stages and the contractor must phase out his work in stages (with advance coordination with the Owner's Representative) to cause as little disruption to the Owner's work flow as possible.
- B. Work To Be Removed By Owner Before Starting Work: The Owner will remove from the construction areas all equipment that is to remain the property of the Owner, but not reused or installed later as part of the work. Contractor to notify Owner prior to the need for area or building, and allow the Owner a reasonable time to accomplish removal or move as determined by the Owner's representative.

PART 2 PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 SUBMITTAL

- A. Owner's representative's review of submittals is for general conformance with the design concept and Contract Documents. Marking or comments shall not be construed as relieving the Contractor from compliance with the project Plans and Specifications, nor departures therefrom. The Contractor remains responsible for details and accuracy for confirming and correlating all quantities and assembly and for safe performance of his work.

3.02 DEMOLITION

- A. Complete all demolition, wrecking, and removal of work necessary for the completion of the work shown on the drawings and/or as specified. All mechanical materials designated for removal shall be removed from site and disposed of legally. The Owner shall be offered the right of first refusal for demolished mechanical equipment and components. Loading and disposal as described here shall be at no expense to the Owner. Care shall be taken in making openings in walls and roofs as not to damage any of the existing walls, floors and roofs. Where holes are left from removal of mechanical equipment this Contractor shall be responsible for patching same to match the surrounding finishes unless otherwise shown or specified.
- B. Debris: Allow no debris to accumulate at, or in buildings, on grounds, streets, and/or walks. Haul away from site as soon as removed. Allow no debris to remain in the building and/or outside the building overnight. Legally dispose of at Contractor's expense.

- C. Interior Dust Control: Provide dust tight partition around area to be cut and as required to prevent dust from entering the ventilation system. Equip partition with adequate access doors that can be closed dust tight while cutting work is in progress. Remove dust tight partitions when no longer required.
- D. Building Protection: Protect the inside of the building from foul weather by covering wall and roof openings.
- E. Asbestos Materials: Notify the Owner's representative if the presence of asbestos is suspected. Immediately stop work in that area.
- F. Structural Members: Check with, and gain approval from, the Owner's representative prior to cutting or altering structural members.

END OF SECTION 230010

DIVISION 23

SECTION 23 00 20 - BASIC MATERIALS AND METHODS FOR HEATING, VENTILATING, AND AIR-CONDITIONING

PART 1 GENERAL

1.1 WORK INCLUDES

- A. General requirements for basic materials and methods.

1.2 REFERENCES

- A. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
- B. "Seismic Restraint Manual Guidelines for Mechanical Systems" by Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

PART 2 PRODUCTS

2.1 GENERAL

- A. See specific sections for this requirement.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.

2.2 PRODUCT TESTING

- A. Any piece of equipment used in this project and hereinafter specified which, by its nature, requires electrical connection, such as fans, pumps, air handling equipment, etc., must be provided with an approval label from one of the agencies hereinafter listed.
- B. Approval of agency must be for the total package; approval of individual components not acceptable. All labels must be located outside of equipment and shall be visible to inspector. Comply with all requirements of RCW 19.28.010 and NEC Sections 90-7 and 110-3 (1993).
- C. It shall be the responsibility of the Mechanical Contractor or the equipment supplier to meet the requirements of this section. Any agency costs to provide an appropriate label for a piece of equipment must be included in this bid. Failure by Mechanical Contractor or supplier to obtain approval labels prior to bid shall be sufficient cause for the Mechanical Contractor/supplier to obtain all such labels at no additional cost to Owner. The following is a list of approval testing laboratories:
 - 1. Underwriters Laboratories, Inc., www.ul.com
 - 2. Canadian Standards Association, www.csagroup.org
 - 3. American Gas Association, www.aga.org.
 - 4. Factory Mutual Systems, www.fmglobal.com
 - 5. MET Electrical Testing, www.metlabs.com
 - 6. Intertek Testing, www.intertek.com

2.3 DAMAGED OR REJECTED MATERIALS

- A. Remove from the site immediately.

2.4 STARTERS, DISCONNECTS AND VFDS

- A. All starters shall be provided and installed by Electrical Contractor unless otherwise noted.
- B. All disconnects shall be provided and installed by Electrical Contractor unless otherwise noted.
- C. VFDs shall be provided by the Control Contractor, installed by the Electrical Contractor, and controlled by the Control Contractor unless otherwise noted.
- D. Mechanical Contractor shall coordinate VFDs, based on direction provided in the Contract Specifications. All VFDs are to be of a single manufacture and/or provided by a specific contractor. The MC shall be responsible for compliance with the specification or shall correct problems at his expense.
- E. The Mechanical Contractor shall coordinate with the Electrical Contractor and provide voltage, phase, horsepower, and amperage for all of the mechanical equipment being provided, based on approved submittals and the actual equipment being provided.
- F. Starters, disconnects, and VFDs shall be provided in a timely manner, so as to not delay the Electrical Contractor's work.

2.5 FIRE INTEGRITY

A. Manufacturers

- 1. 3M Fire Products
- 2. Holdrite
- 3. STI
- 4. Approved equal

B. The penetration sealing systems shall be provided with F-Rating and/or T-Rating as required by IBC Section 714.3 and 714.4 Penetrations include the following:

- 1. Through-penetration firestopping in fire-rated construction.
- 2. Construction-gap firestopping at connections of the same or different materials in fire-rated construction.
- 3. Construction-gap firestopping occurring within fire-walls, floor or floor-ceiling assemblies.
- 4. Construction-gap firestopping in smoke partitions.
- 5. Through-penetration smoke stopping in smoke partitions.
- 6. Construction-gap smoke stopping in smoke partitions.
- 7. All ductwork and piping penetrating mechanical spaces, mechanical mezzanines, mechanical lofts, mechanical boiler rooms, or other mechanical spaces, shall be fire caulked, even if the walls are not rated. Visible piping penetrations shall be covered by

split chrome-plated floor and ceiling plates. Visible ductwork penetrations shall be covered by painted angle-iron frames.

- C. All products shall be listed in Underwriters Laboratory Fire Resistance Directory. Firestopping for penetrations and voids shall be UL-tested systems.
 - 1. Through-penetration firestop devices (XHCR).
 - 2. Fire resistance ratings (BXUV).
 - 3. Through-penetration firestop systems (XHEZ).
 - 4. Fill, void or cavity material (XHHW).
- D. All material shall be tested per American Society for Testing and Material Standards, ASTM E814: Standard test method for fire tests of through-penetration firestops.
- E. Firestopping for penetrations and voids shall be UL-tested systems.

2.6 HANGERS

- A. Manufacturers:
 - 1. Grinnell
 - 2. Michigan Hanger
 - 3. Tolco
 - 4. PHD
 - 5. Anvil
 - 6. Holdrite
 - 7. Approved equal
- B. Provide all anchors, hangers and all supports for piping and equipment included in contract.
- C. It is the responsibility of the Contractor to provide an adequate pipe suspension system in accordance with recognized engineering practices, using standard, commercially-accepted pipe hangers and accessories.
- D. All pipe hangers and supports shall conform to the latest requirements of ASME B31.1 Code for Pressure Piping, and Manufacturers Standardization Society Documents MSS SP-58 and MSS SP-69.

2.7 ACCESS DOORS AND PANELS

- A. Manufacturers:
 - 1. Jay R. Smith
 - 2. Milcor
 - 3. Mifab

4. Approved equal.
- B. 16 gauge steel door and frame with concealed hinge and cylinder lock. Provide matching latches/locks keyed the same for multiple panels in a project. When "B" dimension is 24" or more, provide additional latches at the top and bottom of door. Provide finish and material as noted in Part 3 – Execution.

2.8 VIBRATION ISOLATION

A. Manufacturers:

1. Kinetics Noise Control, Inc.
2. Mason Industries
3. Amber-Booth
4. I.S.A.T.
5. Flexicraft
6. Twin City Hose
7. Approved equal.

B. General

1. If equipment is internally isolated by the manufacturer, internal isolation (base and isolator) shall be equivalent to the scheduled base and isolator and the isolator shall meet the scheduled spring static deflection.
2. Size anchoring bolts to withstand lateral seismic shear and isolate bolts from direct contact with structure using bolt isolation washer and bushing.
3. Bases specified in the schedule can be supplied by the manufacturer of the equipment if they meet the specification given herein.
4. Electrical connections shall be made with floppy length of flexible cable.
5. Piping in connected to vibrating equipment shall be supported from resilient ceiling hangers or from floor mounted resilient supports.

C. VAV box - Up to 5000 CFM

1. Hung Type Isolator: 1" Deflection - 30 degree Swing Spring and Double Deflection Neoprene Hanger.
2. Flex Connector: Flexible duct connection manufactured from UL listed fire-retardant neoprene-coated woven glass fiber fabric to NFPA 90A, with minimum density of 30 ounces per square yard.
3. Motion Restraint Snubber: Seismic Restraint - Cable.

2.9 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

- A. Where non-metallic piping is buried, provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of

buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3" minimum width, color-coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall read "Caution: Buried Water Piping Below" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

PART 3 EXECUTION

3.1 LAYING OUT WORK

- A. Locate all general reference points as established by the General Contractor and take such action as is necessary to prevent their destruction; lay out work and be responsible for all lines, elevations, grading for utilities and other work executed under the Contract. Exercise proper precautions to verify figures shown on drawings, before laying out work and be responsible for any errors resulting from failure to exercise such precaution. The coordination of the utility installation with the final site grading and elevation by the General Contractor shall be the responsibility of this contractor. Locate existing utility lines which will be affected by the building location before any footing work begins. Report conflicts with the Plans to the Owner's representative for adjustment before proceeding with the work. Failure to follow this instruction will result in the contractor being required to alter his work at his own expense.

3.2 ELECTRICAL WORK

- A. All electrical work performed under this Section of the Specifications shall conform to all applicable portions of the Electrical Section of the Specifications, and shall conform to all applicable codes.

3.3 WORKMANSHIP

- A. Furnish and install all equipment for a neat and finished appearance. If, in the judgment of the Owner's representative, any portion of the work has not been installed in a workmanlike manner, or has been left in a rough, unfinished manner, Contractor will be required to remove and reinstall the equipment, and patch and paint surrounding surfaces in a manner satisfactory to the Owner's representative, without any increase in cost to the Owner.

3.4 OPENINGS IN DUCTWORK

- A. Keep all openings covered tightly with plastic during the work.

3.5 WALL/FLOOR PLATES AND ESCUTCHEONS

- A. Where piping or ductwork passes through any wall, floor or ceiling, it shall be fitted with chromium-plated escutcheons or stainless steel angle/trim rings for ductwork, with suitable set screws or other approved holding device. Where extended sleeves are necessary, the plates shall be of sufficient depth to cover the sleeves.

3.6 HANGERS AND SUPPORTS

- A. General
 - 1. Submittals: The Contractor shall submit, prior to installation, the following information and data for approval.
 - a. Data Sheets on all cataloged items to be used.

- b. Sketches covering all specially designed hanger assemblies and fabrications.
 2. Where piping or ductwork is to be supported from building steel, beam clamps shall be used. Beam clamp selection shall be for the required load and the configuration of the steel at the point of attachment. Drilling holes in the steel for hanger rod will not be permitted unless approved by the Structural Engineer. Use only adjustable side beam clamps (Type 25); standard beam clamps are not acceptable.
 3. Angle Clips: Where piping or ductwork is to be supported from building wood structure, angle clips shall be used with lag bolts sized to support the load in shear. Any attachment to wooden structural members shall be subject to the approval of the Structural Engineer.
 4. Hanger Rods: Hanger rod size shall be selected on the basis of loading from the following table:

3/8"	610#
1/2"	1130#
5/8"	1810#
3/4"	2710#
7/8"	3770#

Hangers shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing. **DO NOT BEND RODS.**
 5. All rods shall be electro-plated to prevent corrosion.
 6. All rods shall be double-nutted with lock washer and cut washer, on both ends if applicable, and excess rod on the bottom shall be cut flush and ground for safety.
 7. Brackets and Racks: Where piping or ductwork is run adjacent walls or steel columns, welded steel brackets shall be used as base supports. Multiple pipe racks or trapeze hangers shall be designed and fabricated to suit conditions.
 8. Auxiliary Steel: All auxiliary steel necessary for the installation of the hangers and supports shall be designed in accordance with the AISC Steel Handbook, furnished by the Mechanical Contractor, and shall receive one shop coat of primer paint.
- B. Hangers for Ductwork:
1. Reference and comply with SMACNA HVAC Duct Construction Standards - Metal and Flexible Table 4-1 - Rectangular Duct Hangers Minimum Size, and Table 4-2 - Minimum Hanger Sizes for Round Duct for the following:
 - a. Strap and Rod Sizes
 - b. Hanger Spacing
 2. Steel Cables
 - a. Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 602
 - b. Stainless-Steel ducts: Stainless steel complying with ASTM A 492.
 - c. End Connections: Cadmium-plate steel assemblies with brackets, swivel, and bolts designed for duct hanger service, with an automatic locking and clamping device.
 3. Duct Attachments: Sheet-metal screws, blind rivets, or self-tapping metal screws, compatible with duct materials.

4. Support materials shall match ductwork materials (i.e. provide stainless steel support materials for stainless steel duct, galvanized steel support materials for galvanized steel ducts, and aluminum support materials for aluminum ducts).
5. Hanger and Support Installation:
 - a. Reference Table 4-1 - Rectangular Duct Hangers Minimum Size, and Table 4-2 - Minimum Hanger Sizes for Round Duct.
 - b. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheetmetal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
 - c. Install upper attachments to structure. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CUTTING AND PATCHING (NEW WORK)

- A. Furnish dimensions and locations of openings to other Contractors doing the work. Provide ample time to avoid delays and unnecessary labor. Cutting and patching made necessary to admit work, repair defective material or workmanship, or by neglect to anticipate proper requirements, shall be done by the General Contractor at the expense of the Mechanical Contractor.

3.8 CUTTING AND PATCHING (EXISTING STRUCTURE)

- A. All necessary cutting and patching of existing structures necessary for installation of mechanical work shall be done by the Mechanical Contractor as directed by the Owner's representative.
- B. All surfaces must be patched upon completion of the work to the satisfaction of the Owner's representative. Final finish of all patched surfaces shall be done per Architectural finish schedule, by the General Contractor. All excavation necessary for the Mechanical Contractor shall be performed by the MC. Surfaces shall be patched as hereinbefore specified and all backfilling shall be done in accordance with requirements of this section and other related notes in the Contract Documents. If none specified, restore to original condition.

3.9 ACCESSIBILITY

- A. Locate valves, damper operators, etc., so as to be easily accessible in mechanical spaces or through access panels, specified hereinafter. Otherwise, obtain Owner's representative's approval of location.
- B. Any equipment requiring maintenance clearances for servicing of filters, motors, compressors, etc., shall be carefully installed to avoid servicing problems. Failure of contractor to comply with this requirement shall be sufficient cause for contractor to make all necessary changes at no cost to the Owner. To avoid problems with interpretation of the NEC, allow 42" for all electrical clearances.

3.10 ACCESS DOORS AND PANELS

- A. Locations of panels shall be carefully selected during construction, so as not to be located behind cabinets, etc. Coordinate closely with the Architectural and Electrical Plans before installing panels.
- B. In areas such as janitor's room or on painted walls, etc., access panels shall be prime-coated and painted by the General Contractor; install before surrounding surfaces have been painted. In areas such as toilet rooms, the access panels shall be stainless steel or chrome-plated. In

other finished areas such as on ceilings, all access panels shall have the same type of finished surface as that of the surrounding area.

- C. Verify with the Owner's representative location and finish prior to ordering; failure to get the Owner's representative's approval may result in replacement of access panels at the Mechanical Contractor's expense. Minimum size of access doors is 12" x 12"; actual size depends on the specific circumstance, and panel shall be large enough to accomplish replacement or repair of the item requiring access. The Owner's representative shall have the final say on whether or not the access is of sufficient size.
- D. Provide access panels for all concealed valves for all piping.
- E. Doors shall have cylinder lock latches, all keyed alike.
- F. Provide fire-rated access doors for one-hour or two-hour rated walls and ceilings; units shall be UL labeled.

3.11 MECHANICAL ACCESSES

- A. Provide suitable access to all mechanical equipment requiring servicing, maintenance, replacement, or repair. In concealed spaces where access has not been provided by the Architect by means of doors, hatchways, walkways or other means, provide wall or ceiling access doors of a type suitable to the Owner's representative, sized to provide easy access to all equipment. Location of such doors shall be coordinated with the work of the other trades, to avoid conflict therewith, and such locations shall be approved by the Owner's representative prior to installation of access panels.
- B. In addition to building access openings, provide access panels on ducts where required to service fire dampers, damper operators, and other associated equipment. All access doors providing access to mechanically furnished panels, control boxes and filter compartments shall be provided with fully-hinged, easily-opened access doors. Minimum size is 12" x 12", unless access area prevents that size. Consult Owner's representative prior to installing smaller sizes.

3.12 PAINTING, TAGS, ETC.

- A. Field painting of all mechanical equipment, piping etc., located in and exposed in occupied spaces, shall be by the General Contractor. See Architectural painting specification.
- B. Each major item of Mechanical Equipment shall be provided with the name of the item, i.e., Exhaust Fan No. 2, etc., in labels of black phenolic plastic with white engraved inscription. Minimum size of lettering is 1" with a maximum of 2". Select appropriate sizes for the size of the equipment being labeled. Align labels with edges of equipment and locate labels so as to be visible. For ceiling exhaust fans, provide additional tag on grille.
- C. Ceiling Tile Access Labels: Where it is necessary to remove ceiling tile(s) to access mechanical equipment, backdraft dampers, motorized dampers, remote control sensors, valves/controllers, combination fire/smoke dampers, filters, valves, volume dampers, etc., provide and install round 1/2" diameter, yellow, self-adhesive labels on the metal ceiling grid, visible near all four corners of each tile requiring removal.

3.13 FIRE INTEGRITY

- A. All penetrations of fire-rated walls, ceilings, roofs or floors via ductwork, piping and air terminals must be protected by fire dampers, fire/smoke dampers, appropriately-rated assemblies, and caulking to maintain integrity of structure.

3.14 CLEANING UP

- A. Comply with requirements of the General Specifications.
- B. Ducts shall be maintained as clean as possible during erection, and shall be blown clean before the building painting operations are started. Ducts and apparatus casings shall be thoroughly cleaned before fans and filters are operated. Installed ductwork and equipment openings shall be sealed to prevent contamination of construction dust, debris and moisture. Uninstalled ductwork and equipment shall be securely covered to prevent contamination or the insulation getting wet. Uninstalled ductwork and equipment shall be stored on pallets or dunnage that prevents water reaching the ductwork. If ductwork or equipment is found to be dirty or wet, this contractor shall be responsible for replacing such items. Contaminated or wet duct shall be spray painted with high visibility paint and removed from the site immediately. After equipment has been used for any purpose, such as adjusting, testing, or temporary ventilation, filters shall be replaced and exhaust/return ducts shall be cleaned. Use temporary filters with 80% to 85% filter efficiency during construction. Cover all openings with temporary filters if startup, test and balance, or commissioning starts prior to all work being completed in the building.
- C. Remove tags, shipping labels, etc., from all ductwork in exposed areas, whether ductwork is painted or not.

3.15 CAULKING

- A. Caulk all openings and flash around all piping, equipment, and ductwork passing through roof, floor, and walls. All caulking shall be water resistant. See also paragraph "Fire Integrity" for rated walls, ceilings, roofs, or floor penetrations.
- B. All piping and ductwork penetrations of walls, ceilings, and floors shall be caulked. A chrome-plated escutcheon plate shall be installed at each visible piping penetration of walls, ceilings, or floors. All duct penetrations of walls, ceilings or floors shall be flashed with 3" x 3" 18 gauge galvanized sheet metal angle for concealed ducts, and stainless steel angle for exposed ducts.

3.16 OPERATION OF EQUIPMENT AND SYSTEMS

- A. Contractor is responsible during all periods of balancing and testing. Provide temporary utilities as required.

3.17 TESTS, ADJUSTMENTS AND INSPECTION

- A. Test all work thoroughly and systematically, both during construction and after completion. Notify Owner's representative 48 hours in advance of all tests. Tests shall be maintained until approved. Tests shall be as hereinafter specified.
- B. The Contractor shall test the completed installation as in regular service. Any defects or imperfections that may show up are to be promptly corrected. The Contractor shall guarantee the entire system and all parts thereof for a period of one year from date of final acceptance. The Contractor shall repair or replace any part which may show signs of failure during that time, if such failure, in the opinion of the Owner's representative, is due to imperfections in material or to improper workmanship.
- C. No system, whether prescribed for testing or not, shall be covered or concealed below ground, in walls, in ceiling spaces, or generally from ease of viewing, without first notifying the Owner's representative. Failure to notify the Owner's representative for inspection of concealed systems shall be cause to require this contractor to uncover and recover such systems at no additional cost to Owner.

- D. A log of all tests shall be kept. The log shall note, dates, time of day test started, system or portion of system tested, length of test, test results, and who witnessed the test (AHJ, Owner's representative, or GC). Contractor shall insert legible name of witnesses. Contractor to submit a copy of the contractor's test log monthly to the Owner's representative.
- E. Review the project to determine when final inspection is appropriate and advise Owner's representative. Mechanical Contractor is required to complete his work before requesting final inspection.
- F. See specification section of piping used for test methods or procedures used.
- G. Conduct refrigeration leak test on all DX equipment prior to installation on or in buildings.
- H. Prior to repair, modification or tying into existing hydronic systems, take test samples from the system to be analyzed for glycol type, concentration, and/or other ingredients. Test report shall be forwarded to the Owner's representative.

3.18 FINAL INSPECTION

- A. This contractor shall thoroughly review and inspect the project to determine when final inspection is required, and shall so advise the Owner's representative. It shall be understood that the work is to be essentially complete. If such is not the case and more than one final inspection and one backcheck are necessary, this Contractor may be billed for the additional backchecks at the then governing rate for the personnel involved. The final inspection punchlist shall be legibly signed on a copy of the punch list by a person responsible for the trade involved, and transmitted to the Owner's representative, before a backcheck will be scheduled.

3.19 PROTECTION AND CLEANING

- A. All equipment and material installed by this contractor shall be properly protected from damage during the course of construction.
- B. In attic or other spaces where piping such as condensate drains, heating lines, refrigeration lines, etc. have been installed at floor level and interfere with foot traffic, the Mechanical Contractor shall provide covers to protect this piping. Wood or other such material will be acceptable. Where duct plenums or duct runs interfere with normal traffic patterns of maintenance personnel, the sheet metal contractor shall provide a wooden "bridge" over the ducts to prevent damage.
- C. Protect walking paths in mechanical spaces. Maintain 6'-8" headroom minimum, for all piping and ductwork. If required clearance is not possible, obtain permission from the Owner's representative to violate the above requirement, and comply with protective measures required.

3.20 SPECIAL PROTECTION

- A. Exercise maximum precaution to protect the building and equipment from damage of any kind, and in particular, prevent water and dust seepage into new equipment.

3.21 BALANCING WORK

- A. Provide Testing, Adjusting and Balancing as required in this section of the specification.

3.22 INSTRUCTION PERIODS FOR OWNER'S PERSONNEL

- A. Scope: Following installation of mechanical work, have representatives of installation tradesmen conduct demonstrations and instruction periods to point out locations of servicing points and required points of maintenance to Owner's representatives.
- B. General Description of Instruction Periods: Each period shall include preliminary discussion and presentation of information from maintenance manuals with appropriate references to drawings, followed by tours of building areas explaining maintenance requirements, access methods, servicing and maintenance procedures, equipment cleaning procedures, temperature control settings, and available adjustments.
- C. Scheduling of Instruction Periods: Notice of Contractor's readiness to conduct such instruction and demonstration shall be given to the Owner's representative at least two weeks prior to the instruction periods, and agreement reached as to the date at which the instruction periods are to be performed. Advise Owner's representative two weeks prior to date when ready to conduct instruction and demonstrations; receive approvals of proposed date prior to making final arrangements.
- D. Schedule an additional instruction period for the off-season. That is, if initial instruction period takes place during the heating season, schedule another during the cooling season, or vice versa.

3.23 ON-SITE OBSERVATIONS AND SAFETY MEASURES

- A. During its progress, all work shall be subject to observation by the Owner's representative, and of the National Board of Fire Underwriters, State and Local Inspectors. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be totally responsible for conditions of the jobsite, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Owner's representative to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site. It shall be the Contractor's responsibility to comply with "Safety and Health Regulations for Construction" in the Federal Register by the U.S. Department of Labor. Contractor shall be responsible for providing all such safety measures and shall consult with the State and/or Federal Safety Inspector for interpretation whenever in doubt as to whether he is or is not in compliance with State and/or Federal regulations. Furthermore, the Contractor distinctly assumes all risk or damage or injury to any persons or property wherever located resulting from any action or operation under this contract or in connection with the work.

3.24 CONTINUITY OF BUILDING UTILITIES AND SHUTDOWNS

- A. General: Continuity of utilities services in the building shall be maintained at all times as required to provide heat, water, lighting, and power to all portions of the building. Utility systems shutdowns required for extensions, alterations or connections of new services shall be accomplished in accordance with the following requirements.
- B. Shutdowns: While building is in operation, utilities shutdowns shall be scheduled for weekends, holidays, or at night, if the shutdown affects the use of the building or surrounding buildings. The actual time and date is to be coordinated with and approved by the Owner's representative at least 72 hours in advance.
- C. Costs: The Contractor shall include in his bid proposal, all costs associated with utilities shutdowns. No extra payment will be made for overtime work, schedule changes, or failure to

complete utilities connections within authorized shutdown periods.

3.25 DRAFT STOPS

- A. It shall be the responsibility of each contractor performing his trade to verify with Architectural Plans and to maintain the integrity of draft stops, whenever his work requires penetration of these areas. Patch as required to maintain integrity of draft stops.

3.26 SYSTEM STARTUP

- A. Provide the services of manufacturer's field representative for starting and testing equipment.
- B. Prepare a manufacturer's startup report, and turn over to the Owner's representative.

END OF SECTION 230020

DIVISION 23

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Ductwork Identification Nameplates.
- C. Ceiling Tile Access Markers.

1.2 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers.
- B. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.3 SUBMITTALS

- A. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification, including matching size and colored arrows.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Project Record Documents: Record actual locations of tagged valves, on As-Builts.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Brady Corporation
- B. Seton Identification Products
- C. Marking Services, Inc.
- D. Approved equal

2.2 NAMEPLATES

- A. Description: Laminated three-layer plastic with engraved letters.
 - 1. Letter Color: White.
 - 2. Letter Height, Equipment: 1 -1/2".
 - 3. Background Color: Black.

2.3 DUCTWORK IDENTIFICATION NAMEPLATES

- A. Description:
 - 1. Plastic Laminate 1-1/4" letters and arrows.
 - 2. Vinyl Markers 1-1/4" letters and arrows.
 - 3. Color per ASME standards.

2.4 CEILING TILE ACCESS MARKERS

- A. Description: Vinyl or plastic markers, 1/2" diameter minimum with color coded head.
- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.

PART 3 EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION

- A. Install plastic nameplates and markers with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion.
- B. Identify all mechanical equipment; air handling units, VAV boxes with plastic nameplates.
- C. Identify control panels and major control components outside panels with plastic nameplates.
- D. Tag automatic controls, instruments and relays. Key to control schematic, show on control As-Builts. Provide tags identical to valve tags. First line = abbreviation [EMCS]. Number consecutively starting at 01. Provide Valve Chart Frames and Control Device Lists on walls in an accessible location, well lighted space, in each Mechanical Space. (Does not include Janitor Rooms).
- E. Identify all ductwork with plastic or vinyl nameplates. Identify with air handling unit identification number, system (Primary Air, Outside Air, Return Air, Exhaust Air, Supply Air, etc.) and area served. Locate identification as ducts leave or return to Air Handling Unit, on duct runs not to exceed 20' on center, adjacent each branch, at each side of penetration of structure or enclosure, and at each obstruction. air handling unit, at each side of penetration of structure or enclosure, and at each obstruction. Do not install labels on exposed ductwork.
- F. Provide ceiling tile access markers to locate Mechanical Equipment, Filters, Valves, Dampers, etc., above T-bar type panel ceilings. Locate on the metal ceiling grid near all four corners of

City of Federal Way
Traffic Control Center
33325 8th Ave S
Federal Way, WA 98063

100% CD
July 11, 2019

the tile requiring removal.

END OF SECTION 230553

DIVISION 23

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

- A. AABC MN-1 - AABC National Standards for Total System Balance; Associated Air Balance Council.
- B. ASHRAE Standard 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting Balancing of Environmental Systems; National Environmental Balancing Bureau.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting, and Balancing; Sheet Metal and Air Conditioning Contractors' National Association.
- E. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.3 SUBMITTALS

- A. Qualifications: Submit name of Testing, Adjusting and Balancing agency and TAB supervisor within 30 days after award of the Mechanical Contract by the General Contractor. Include a list of the last 12 projects completed with a list of the respective Owner's representatives and a contact phone number for each.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Submit for Review.
 - 2. Submit for forwarding to Owner's Commissioning Authority.
 - 3. Submit plan twelve weeks prior to starting the testing, adjusting, and balancing work, or sooner.
 - 4. Include at least the following in the plan:
 - a. List of all air flow, water flow, system capacity, and efficiency measurements to be performed and a description of specific test procedures, parameters, and formulas to be used.

- a. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - b. Identification and types of measurement instruments to be used and their most recent calibration date.
 - c. Discussion of what notations and markings will be made on the ductwork and piping drawings during the process.
 - d. Final test report forms to be used.
 - e. Detailed step-by-step procedures for TAB work for each system and issue, including:
 - 1) Terminal flow calibration (for each terminal type).
 - 2) Diffuser proportioning.
 - 3) Total flow calculations.
 - 4) Rechecking.
 - 5) Diversity issues.
 - f. Expected problems and solutions, etc.
 - g. Details of how TOTAL flow will be determined; for example:
 - 1) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
 - h. Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
 - i. Procedures for formal progress reports, including scope and frequency.
 - j. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Field Logs: Submit at least twice a week to General Contractor, Owner's representative, and Commissioning Authority. Label accordingly. If no field logs are submitted, it will be assumed that no work was being done during this period.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Progress Reports. Provide preliminary/hand-written balance report no later than one (1) week after completion of work. No progress payments will be authorized if a preliminary balance report has not been submitted.
- F. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- 1. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Owner's representative and for inclusion in Operating and Maintenance manuals.
 - 2. Include actual instrument list with manufacturer name, serial number, and date of calibration.
 - 3. Form of Test Reports: Use report format recommended by TAB standard. If none of

these apply, follow ASHRAE Standard 111.

4. Units of Measure: Report data in I-P (inch-pound) units only.
 5. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name of project.
 - e. Project location of project.
 - f. Project Architect.
 - g. Project Mechanical Engineer.
 - h. Project General Contractor.
 - i. Project Mechanical Contractor.
 - j. Project Controls Contractor.
 - k. Owner's Commissioning Agent.
 - l. Report date.
 - G. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.
- 1.4 DALT DUCT AIR LEAKAGE TESTING - ASSISTANCE
- A. M.C. to provide HVAC equipment mechanics to operate and assist with HVAC equipment and HVAC ductwork mechanics to provide the field required test ports and other modifications needed to perform the DALT. M.C. to ensure that these support personnel are present at the agreed upon times.
- 1.5 INSULATION PRIOR TO TAB OR DALT AIR LEAKAGE TESTING
- A. Do not allow insulating of ductwork or piping prior to TAB and or DALT testing. If project is behind schedule, the Owner's representative may agree to partial insulation prior to completion of testing, if the TAB contractor agrees.
- 1.6 QUALITY ASSURANCE
- A. Perform work in accordance with applicable codes.
 - B. See Division 1-06 of the Special Provisions for Buy America requirements.
 - C. M.C. to provide conformed construction drawings and specifications to the TAB firm, if available. If not available, issue the same drawings that are being provided to the other Subcontractors, along with any RFIs or Change Orders that may affect their work. The M.C. is responsible to keep the TAB firm up to date with pertinent contract documents and correspondence.
 - D. M.C. to provide approved equipment submittals and project schedule for the use by the TAB subcontractor.
- 1.7 WARRANTY
- A. Include a warranty for 24 months after final acceptance by the Owner, during which time the Owner may request a recheck, or resetting of any outlet, coil or device listed in the project test report. TAB contractor to contact other project subcontractors if their technical assistance is

required to make any test or adjustments required. Maximum number of rechecks shall not exceed a yearly total of 5% of the entire project. However, if the balance reports are proved to be inaccurate, the Owner may request the entire project be re-balanced during the warranty period. See paragraph Commissioning in this Section for recheck and failure criteria. The above warranty shall be included in the original contract bid proposal.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.2 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC MN-1, AABC National Standards for Total System Balance.
 - 2. ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 - 4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:
 - 1. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabchq.com; upon completion submit AABC National Performance Guaranty.
 - b. NEBB, National Environmental Balancing Bureau: www.nebb.org.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org.
- D. TAB Supervisor Qualifications: Professional Engineer licensed in the State in which the Project is located.
- E. TAB Team Members: Submit their qualifications along with the Companies qualifications and the TAB Supervisor qualifications. TAB team approved to accomplish work on this contract, must be full-time employees of the TAB agency. No other personnel are allowed to do TAB work on this contract.
- F. Pre-Qualified TAB Agencies:
 - 1. Neudorfer Engineering (206) 621-1810.
 - 2. Hardin & Sons (253) 862-6645.
 - 3. Air Balance Associates (206) 528-4788.

3.3 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, have HVAC contractor replace or install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Access doors are closed and duct end caps are in place.
 8. Air outlets are installed and connected.
 9. Confirm duct system leakage is minimized. Have HVAC contractor coat or recoat joints that may not be up to SMACNA standards prior to testing.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. The testing and balancing work is a part of the overall project, and shall be shown on the project schedule with a reasonable time allotted to accomplish the work. If the Owner, General Contractor and or other Subcontractors have delayed the project and there is no time left for the testing and balancing to be performed, the following remedies shall be considered by the Owner;
1. The time of completion shall be extended.
 2. The Owner's representative and General Contractor shall negotiate overtime for the Test and Balancing Contractor to accelerate the time required to complete his work.
 3. The Owner's representative may allow some systems and requirements to be waived or extended to a later time period.
 4. Or other remedies as suggested by the Test and Balance Contractor that will allow him to complete his work and is agreeable to the Owner's representative and General Contractor.
 5. Any changes in the contract terms or specification requirements shall be in writing prior to the testing and balancing work commencing.
- D. Beginning of work means acceptance of existing conditions, or that a letter allowing revised conditions has been received by the TAB contractor.
- E. The TAB contractor shall exercise care while performing his work so as to avoid damaging the work of other trades, particularly paint and ceiling tile. If damage is incurred by the Test and Balance Contractor, repairs shall be made at their expense.

3.4 PREPARATION

- A. Hold Pre-balancing meeting two weeks prior to starting TAB work.
 - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced, plus General Contractor, Owner's representative, and Owners Commissioning Agent.
 - 2. Complete Project Examination noted above prior to Pre-balancing meeting, so that any problems found that would prevent balancing can be dealt with at the meeting.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Owner's representative and Owner's Commissioning Agent to facilitate spot checks during testing.
- C. Request HVAC contractor provide additional balancing devices as required.

3.5 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10% of design for supply, return, and exhaust systems.
- B. Air Outlets and Inlets: Adjust total airflow to within plus or minus 10% of design to space. Adjust outlets and inlets in space to within plus or minus 10% of design.

3.6 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark locations where traverse and other critical measurements were taken on the Plans and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order; replace belt guards, close access doors, close doors to electrical switch boxes, and restore thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner's representative and Owner's Commissioning Agent.

3.7 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required design supply, return, and exhaust air quantities at site altitude.
 - B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
 - C. Measure air quantities at air inlets and outlets.
 - D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
 - E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
 - F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
 - G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
 - H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50% loading of filters.
 - I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
 - J. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
 - K. For variable air volume system powered units, set volume controller to air flow setting indicated. Confirm connections are properly made and confirm proper operation for automatic variable air volume temperature control.
 - L. On fan-powered VAV boxes, adjust air flow switches for proper operation.
 - M. At completion, be sure all test holes in low pressure duct have pressure sealing plugs installed; duct tape is not allowed. Test holes in high pressure duct shall employ threaded and capped duct air fittings.
 - N. The Test and Balance contractor shall include in his bid the cost of one sheave change for each belt driven air moving piece of equipment. If a sheave change is not required, the test and balance contractor shall submit to the Owner a credit for the work that was not required. The total cost of sheave changes shall be listed as a separate line item on the Schedule of Values and submitted to the Owner's representative for approval prior to the first pay application.
- 3.8 MINIMUM DATA TO BE REPORTED
- A. Electric Heaters:
 - 1. Identification/number
 - 2. Location

3. Design kW
 4. Number of stages
 5. Phase, voltage, amperage
 6. Test voltage (each phase)
 7. Test amperage (each phase)
 8. Air flow, specified and actual
 9. Temperature rise, specified and actual
- B. Duct Leak Tests:
1. Description of ductwork under test
 2. Duct design operating pressure
 3. Duct design test static pressure
 4. Duct capacity, air flow
 5. Maximum allowable leakage duct capacity times leak factor
 6. Test apparatus
 - a. Blower
 - b. Orifice, tube size
 - c. Orifice size
 - d. Calibrated
 7. Test static pressure
 8. Test orifice differential pressure
 9. Leakage
- C. Terminal Unit Data:
1. Manufacturer
 2. Type, constant, variable, single, dual duct
 3. Identification/number
 4. Location
 5. Model number
 6. Amp draw
 7. Size
 8. Minimum static pressure

9. Minimum design air flow
 10. Maximum design air flow
 11. Maximum actual air flow
 12. Inlet static pressure
- D. Air Distribution Tests:
1. Air terminal number
 2. Room number/location
 3. Terminal type
 4. Terminal size
 5. Area factor
 6. Design velocity
 7. Design air flow
 8. Test (final) velocity
 9. Test (final) air flow
 10. Percent of design air flow

END OF SECTION 230593

DIVISION 23

SECTION 230713 - DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass Fiber Flexible Duct Wrap Insulation
- B. Duct Liner

1.2 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ductwork and Casings:

1.3 REFERENCE STANDARDS

- A. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation.
- B. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- F. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association.
- G. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.
- H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.
- I. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.4 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.

- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of experience.
- C. See Division 1-06 of the Special Provisions for Buy America requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on-site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- B. Do not store excess material in the building. Provide secure dry storage on-site, to store material.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION INSTALLED INSIDE BUILDINGS

- A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.

2.2 MANUFACTURERS

- A. Knauf Fiber Glass
- B. Johns Manville Corporation
- C. Owens Corning Corp
- D. CertainTeed Corporation
- E. Pittsburgh Corning Corporation
- F. Armacell International
- G. Approved equal.

2.3 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
 - 2. Maximum Service Temperature: 450 degrees F.
 - 3. Maximum Water Vapor Sorption: 5.0% by weight.

4. Usage: HVAC Air Distribution Systems Ductwork - Interior - Medium to Low Temperatures.
 - B. Vapor Barrier Jacket:
 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
 3. Secure with pressure sensitive tape.
 - C. Vapor Barrier Tape:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
 - D. Tie Wire: Annealed steel, 16 gage.
- 2.4 DUCT LINER
- A. Insulation: Incombustible glass fiber complying with ASTM C 1071; flexible blanket, rigid board, and preformed round liner board with impregnated surface and edges coated with polyvinyl acetate polymer or acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21.
 1. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
 2. Service Temperature: Up to 250 degrees F.
 3. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.
 4. Minimum Noise Reduction Coefficients:
 - a. 1" Thickness: 0.45.
 - B. Usage: Low pressure ductwork interior
 - C. Adhesive: Waterproof, fire-retardant type, ASTM C916.
 - D. Liner Fasteners: Galvanized steel, welded with press-on head, per SMACNA standards.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Verify that ductwork pressurization has been tested before applying insulation materials.
 - B. Verify that surfaces are clean and dry, with foreign material removed.
- 3.2 INSTALLATION
 - A. Install in accordance with manufacturer's instructions.
 - B. Install in accordance with NAIMA National Insulation Standards; have a copy on site for

reference. Employ only skilled tradesmen specializing in this kind of work.

- C. Insulated ductwork conveying air, below ambient temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Duct Liner Application:
 - 1. Adhere insulation with adhesive for 90% coverage.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

- A. Provide thickness of insulation to meet or exceed Washington State Energy Code and or local codes whichever are more stringent.
- B. Special Requirements - DUCT LINER.
 - 1. Duct liner for this project will be 1" unless noted otherwise in Contract documents.
 - 2. Line ALL of the following ductwork
 - a. First 5' of ductwork downstream of the VAV box
- C. Special Requirements - DUCT WRAP.
 - 1. Wrap all of the following ductwork:
 - a. Primary air ductwork (upstream of the VAV box).
 - b. Concealed supply ductwork
 - 2. Duct wrap shall not be used in the following applications:

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- a. In conditioned spaces, do not wrap ductwork exposed to view within a zone that serves that zone.
- D. Provide insulation thicknesses per Washington State Energy Code as a minimum.

END OF SECTION 230713

DIVISION 23

SECTION 230993 - SEQUENCES OF OPERATION FOR HVAC CONTROLS

PART 1 GENERAL

1.1 SCOPE

- A. Provide all DDC controls and points required for proper operation of the system in the manner as described in these sequences. The DDC system shall be an extension of the existing system. All parts and pieces shall be compatible and integrated into the existing building DDC system. Thermostats shall have temperature adjustment, digital display, and occupancy override pushbutton.
- B. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections. These sequences are for use with an Energy Management Control System (EMCS), incorporating Direct Digital Control (DDC) for energy management, equipment monitoring, and control.
- C. Sequence of operation for:
 - 1. Alarm Reporting
 - 2. Night Setback
 - 3. Occupied Mode
 - 4. Optimum Start/Stop
 - 5. Start-Up of Mechanical Equipment
 - 6. Terminal Air Units
 - 7. Warm-Up Mode - Mechanical Equipment

1.2 RELATED SECTIONS

- A. Section 23 09 23 - Direct-Digital Control System for HVAC.
- B. Section 23 09 13 - Instrumentation and Control Devices for HVAC.

1.3 SUBMITTALS

- A. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
 - 1. Preface: One or two paragraph overview narrative of the system describing its purpose, components, and function.
 - 2. State each sequence in small segments, and give each segment a unique number for referencing in Functional Test procedures. Provide a complete description regardless of the completeness and clarity of the sequences specified in the contract documents.
 - 3. Include at least the following sequences:

- a. Start-up.
 - b. Warm-up mode.
 - c. Occupied mode.
 - d. Unoccupied mode.
 - e. Shutdown.
 - f. Capacity control sequences and equipment staging.
 - g. Temperature and pressure control, such as setbacks, setups, resets, etc.
 - h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
 - i. Effects of power or equipment failure with all standby component functions.
 - j. Sequences for all alarms and emergency shut downs.
 - k. Seasonal operational differences and recommendations.
 - l. Interactions and interlocks with other systems.
4. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
 5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
 6. Include schedules, if known.
- B. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
1. Label with settings, adjustable range of control and limits.
 2. Include flow diagrams for each control system, graphically depicting control logic.
 3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
 4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
 5. Include all monitoring, control and virtual points specified elsewhere.
 6. Include a key to all abbreviations.
- C. Points List: Submit list of all control points indicating at least the following for each point.
1. Name of controlled system.
 2. Point abbreviation.
 3. Point description; such as dry bulb temperature, airflow, etc.
 4. Display unit.
 5. Control point or setpoint (Yes/No); i.e. a point that controls equipment and can have its setpoint changed.

6. Monitoring point (Yes/No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
 7. Intermediate point (Yes/No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
 8. Calculated point (Yes/No); i.e. a "virtual" point generated from calculations of other point values.
- D. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.
- C. Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the State in which the Project is located.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL

- A. Provide 5-degree adjustable deadband to meet requirements of Washington State Energy Code.

3.2 ALARM REPORTING

- A. Report alarm conditions indicated on the Input/Output Summary to the Operator Station.

3.3 NIGHT SETBACK

- A. Apply to each heating and ventilation zone.
- B. Night Setback shall be configured and interlocked with the building schedule.
- C. Night Setback temperature shall be adjustable.
- D. Building schedule shall be fully configurable allowing for each day and hour per year.

3.4 OPTIMUM START/STOP

- A. Apply the Optimized Start/Stop program to each heating and ventilation zone.
- B. Optimized Start/Stop shall be fully configurable; provide all required hardware, sensors and programming to enable Optimum Start/Stop.
- C. Optimized Start/Stop shall automatically adjust start time for each individual unit to achieve setpoint temperature 30 minutes prior to occupancy.

- D. Building schedule shall be fully configurable allowing for each day and hour per year.

3.5 START-UP OF MECHANICAL EQUIPMENT

- A. All mechanical equipment shall energize in a staged fashion. In case of loss of electricity due to power failure, holiday/weekend scheduling and morning warm-up shall require mechanical equipment to be staged "on" in a staggered fashion to prevent a large initial electrical load.

3.6 TERMINAL BOXES - FAN-POWERED

- A. Each unit shall be controlled by the EMCS. It shall also have its own standalone microprocessor based controller with resident control logic, and damper drive that shall be capable of operating the unit in a standalone mode in the DDC trunk communication is lost.
- B. Flow sensor on primary air supply shall continuously measure primary airflow. The terminal units shall maintain constant flow as the inlet pressure varies.
- C. Occupied Mode: Fan shall operate continuously during occupied mode.
 - 1. Cooling Mode: Primary air damper shall modulate as required to maintain leaving air temperature setpoint. Leaving air temperature setpoint shall be reset to maintain space temperature setpoint.
 - 2. Heating Mode: Primary air damper shall modulate down to minimum position. Electric heating coil shall modulate (SSR control) to maintain leaving air temperature setpoint. Leaving air temperature setpoint shall be reset to maintain space temperature setpoint.
- D. Unoccupied mode: Fan shall be off, primary air damper shall be closed. Unit shall cycle as needed to maintain space temperature setpoint. Heating and cooling modes shall be as for occupied mode, except minimum primary air damper position shall be closed.
- E. Revert to temporary Occupied Mode when space temperature sensor night override button is pushed; override initially set at 2 hours (adjustable).
- F. Shut down fans on receipt of fire alarm condition.

3.7 WARM-UP MODE - MECHANICAL EQUIPMENT

- A. Control system optimum-start controls shall provide warm-up switching for all items indicated as having a warm-up cycle. The primary air dampers shall remain fully closed during the warm-up cycle until the space temperature heating setpoint is reached or occupied period begins, whichever occurs first. After warm-up and 30 minutes prior to room occupancy, the outside air damper shall be opened to minimum outside air volume damper position as listed on Plans and as set by the Test and Balance subcontractor.

END OF SECTION 230993

DIVISION 23

SECTION 233100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct Materials
- B. Ductwork Fabrication
- C. Manufactured Metal Ductwork and Fittings
- D. Duct Cleaning

1.2 RELATED REQUIREMENTS

- A. Section 23 00 20 - Basic Materials And Methods for HVAC
- B. Section 23 07 13 - Duct Insulation: External insulation and duct liner.
- C. Section 23 33 00 - Air Duct Accessories.
- D. Section 23 37 00 - Air Outlets and Inlets.
- E. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- F. Division 31 - Excavation, Fill, Trenching.

1.3 REFERENCE STANDARDS

- A. ASTM A 36 - Standard Specification for Carbon Structural Steel.
- B. ASTM A 653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.
- G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.
- H. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association.
- I. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and

Air Conditioning Contractors' National Association.

- J. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.
- K. All codes and reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.4 PERFORMANCE REQUIREMENTS

- A. No variation of duct configuration or sizes permitted except by written permission of the Architect and Engineer. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. Meet or exceed SMACNA requirements for all sheet metal systems.
- B. Leakage Testing (High Velocity): Test the system for leaks in accordance with the SMACNA HVAC Air Duct Leakage Test Manual. Maximum permissible leakage shall be 1% of the total system flow. All audible leaks shall be eliminated.
- C. Leakage Testing General Requirements: Maximum permissible leakage shall be as noted in the Washington State Energy Code, or as noted in these specifications, whichever is more stringent.

1.5 SUBMITTALS

- A. Product Data: Provide data for all materials.
- B. Shop Drawings: Indicate ducts, fittings, and particulars such as gage, sizes, welds, and configuration prior to starting work on systems. Duct design pressure rating is posted on contract drawings, shop drawings shall reflect pressure class as shown. Shop drawings are to clarify duct routing taking into consideration structural members, electrical equipment, and other mechanical equipment. Contractor to submit shop drawings for review.
- C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual.
- D. Manufacturer's Installation Instructions.
- E. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.

1.7 REGULATORY REQUIREMENTS

- A. Construct ductwork to NFPA 90A, 90B, 96 and SMACNA standards.

1.8 FIELD CONDITIONS

- A. Do not install lined duct in wet locations. Contractor to keep ends of lined duct covered at all times. If lined duct becomes wet or dirty, remove from jobsite and replace with new duct. The General Contractor to provide weather protection if his schedule requires the sheet metal

subcontractor to working ahead of the building being dried in.

- B. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 DUCT ASSEMBLIES

- A. Provide duct assemblies as shown on Plans.

2.2 MATERIALS

- A. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, ASTM A 653 FS Type B, with G60/Z180 coating.
- B. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E84.
- C. Insulated Flexible Ducts:
 - 1. Manufacturers:
 - a. Thermaflex Model G-KM
 - b. Johns Manville
 - c. Atco
 - d. Approved equal
 - 2. Chlorinated polyethylene core supported by helically wound coated spring steel wire; fiberglass insulation; black polyethylene vapor barrier film.
 - a. Pressure Rating: 6" wg positive and 1" wg negative.
 - b. Maximum Velocity: 5000 fpm
 - c. Temperature Range: -20 degrees F to 200 degrees F continuous.
 - d. R-4.2, meeting UL 181, & NFPA 90A - 90B fire codes, self-extinguishing.
 - e. GREENGUARD certified for Children and Schools.
 - f. Acoustically rated.
 - g. Warranted for 10 years
 - h. Maximum length 6'.
 - i. Install per manufacturer's recommendations.
 - j. Run insulated flexible duct as straight as possible.
- D. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- E. Primary air duct (upstream of VAV box): 8" w.g. pressure class, galvanized steel.

- F. Supply air duct (downstream of VAV box): 2" w.g. pressure class, galvanized steel.
- G. Hanger Rod: ASTM A 36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.3 DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and SMACNA High Velocity Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- D. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- E. T's, bends, and elbows: Construct according to SMACNA (DCS).
- F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- G. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- H. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- I. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide minimum 12" long plenum same size as the louver, sloped to drain to the exterior. Line plenum with self-adhering rubberized asphalt flashing as shown on Plans; seal plenum to louver frame and duct. Connect duct to plenum with 45 degree divergence fittings.
- J. Contractor may use the Ductmate connection system at his option. System consists of flanges with integral sealants, corner pieces, clips, bolts, cleats and gaskets.

2.4 MANUFACTURED METAL DUCTWORK AND FITTINGS

- A. Manufacturers
 - 1. Metal-Fab, Inc.
 - 2. SEMCO Incorporated
 - 3. United McGill Corporation
 - 4. Local shop fabrication by installing contractor.
 - 5. Approved equal
- B. Manufacture in accordance with SMACNA HVAC Duct Construction Standards as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated on drawings.

- C. Single Wall Round Duct And Fittings: Materials shall be per SMACNA HVAC Duct Construction Standards, Metal and Flexible, Galvanized Sheet Metal. Provide spiral duct.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. General:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
 - 3. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
 - 4. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - 5. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
 - 6. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
 - 7. Use crimp joints with or without bead for joining round duct sizes 8" and smaller with crimp in direction of air flow.
 - 8. Use double nuts and lock washers on threaded rod supports. Cut rods flush with second nut.
 - 9. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
 - 10. Connect diffusers to low pressure ducts directly or with 6' maximum length of flexible duct held in place with strap or clamp.
 - 11. The sheet metal contractor shall protect the fabric duct to assure that the system is clean on completion of installation and at project acceptance.

3.2 CLEANING

- A. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. Repair any damage caused to duct lining caused by cleaning operation.
 - 1. Duct cleaning required, when contractor fails to protect duct prior to installation and or

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keep ends covered once duct is installed.

- B. Remove all labels from exposed ductwork, including ductwork in mechanical spaces. Labels may remain on ducts in concealed locations only.

END OF SECTION 233100

DIVISION 23

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air Turning Devices
- B. Duct Access Doors
- C. Duct Test Holes
- D. Flexible Duct Connections
- E. Sleeves For Ducts Through Non-Fire-Rated Walls
- F. Volume Control Dampers

1.2 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings

1.3 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.
- B. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association.
- C. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.4 SUBMITTALS

- A. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers.
- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.
- C. Products specified in this section shall be manufactured in the United States of America. Products shall be labeled with the manufacturer's logo and country of origin. This paragraph will be strictly enforced; contractors to bid this project accordingly.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

- A. Manufacturers:
 - 1. Krueger
 - 2. Price Industries
 - 3. Ruskin Company
 - 4. Titus
 - 5. Approved equal
- B. Multi-blade device with blades aligned in short dimension, steel construction, with individually adjustable blades and mounting straps.
- C. Multi-blade device with radius blades attached to pivoting frame and bracket, steel construction, with push-pull operator strap.

2.2 DUCT ACCESS DOORS

- A. Manufacturers:
 - 1. Acudor Products Inc.
 - 2. Greenheck Fan Corporation
 - 3. Nailor Industries Inc.
 - 4. Ruskin Company
 - 5. Approved equal
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- C. Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1" thick insulation with sheet metal cover.
 - 1. Less Than 12" Square: Secure with sash locks.
 - 2. Up to 18" Square: Provide two hinges and two sash locks.
 - 3. Up to 24" x 48": Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Provide an additional hinge.

2.3 DUCT TEST HOLES

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.4 FLEXIBLE DUCT CONNECTIONS

- A. Wherever ducts make connection with any air-handling device such as supply fans, exhaust fans, etc., flexible connections shall be provided.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- C. Flexible Duct Connections: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 ounces per square yard.
 - 2. Net Fabric Width: Approximately 2" wide.

2.5 SLEEVES FOR DUCTS THROUGH NON-FIRE-RATED WALL

- A. Provide sheet metal sleeves around ducts, penetrating through walls or floors. Pack opening around duct with fiberglass and caulk with resilient acoustical caulk and then install 3" x 3" - 18 gage sheet metal closure angle all around duct, overlapping corners, secure to duct and wall. Caulk and install closure angle on both sides of wall. When insulated on the exterior, butt to closure angles. See Section 07 84 00 for Fire Caulking requirements, Fire Caulking installation by Section 07 84 00 Subcontractor or General Contractor.

2.6 VOLUME CONTROL DAMPERS

- A. Manufacturers:
 - 1. Louvers & Dampers, Inc.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company
 - 4. Greenheck Fan Corporation
 - 5. Approved equal
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.
- C. Volume Control Dampers, shall be installed on all branch duct take-offs to diffusers, grilles and registers. Do not provide or use dampers at the face of the diffuser, grilles or registers for balancing.
- D. Single Blade Dampers: Fabricated for duct sizes up to 6" x 30"
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8" x 72". Assemble center and edge crimped blades in galvanized channel frame with suitable hardware.
- F. End Bearings: Except in round ducts 12" and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.

- G. Quadrants:
1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
 3. Where rod lengths exceed 30", provide regulator at both ends.

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide additional backdraft dampers on exhaust fans or exhaust ducts nearest to the outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, and elsewhere as indicated. Provide minimum 8" x 8" size for hand access, 18" x 18" size for shoulder access, and as indicated. Provide 4" x4" for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent the equipment.
- F. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- G. Provide balancing dampers on high velocity systems where required.
- H. Provide balancing/volume dampers on all branch duct take-offs to diffusers, grilles, and registers. These will be used in addition to dampers at the face of the devices.

3.3 COMMISSIONING

- A. A factory-authorized commissioning agent shall fully demonstrate all functions of the fire life safety monitoring and testing system in conjunction with Owner's Commissioning Agent.

END OF SECTION 233300

DIVISION 23

SECTION 233600 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fan-Powered Variable Volume Units

1.2 RELATED REQUIREMENTS

- A. Section 23 31 00 - HVAC Ducts and Casings
- B. Section 23 33 00 - Air Duct Accessories

1.3 REFERENCE STANDARDS

- A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilation Systems; National Fire Protection Association.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc.
- C. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.4 SUBMITTALS

- A. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- B. Manufacturer's Installation Instructions: Indicate support and hanging details, and service clearances required.
- C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.
- D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 WARRANTY

- A. Provide a five (5) year manufacturer's warranty on units, covering parts and labor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Nailor
- B. Enviro-tec
- C. Trane
- D. Carnes
- E. Price
- F. Krueger
- G. Titus
- H. Approved equal.

2.2 FAN-POWERED VARIABLE VOLUME UNITS

A. Basic Assembly:

- 1. Casings: Minimum 22 gage galvanized steel.
- 2. Lining: Minimum 1/2" thick neoprene or vinyl coated fibrous glass insulation, 1.5 lb/cu ft density, meeting NFPA 90A requirements and UL181 erosion requirement. Face lining with mylar.
- 3. Plenum Air Inlets: Round stub connections and s-slip and drive connections for duct attachment.

B. Basic Unit:

- 1. Configuration: Air volume damper assembly and fan in series arrangement inside unit casing. Locate control components inside protective metal shroud.
- 2. Volume Damper: Construction of galvanized steel with peripheral gasket and self-lubricating bearings: maximum damper leakage: 2% of design air flow at 1" rated inlet static pressure
- 3. Mount damper operator to position damper normally open.

C. Automatic Damper Operator:

- 1. Electric Actuator: 24 volt with high limit.

D. Fan Assembly:

- 1. Fan: Forward curved centrifugal type with direct drive thermally-protected, electronically commutated motor (ECM).
- 2. Speed Control: Infinitely adjustable with electronic controls.
- 3. Isolation: Fan/motor assembly on rubber isolators.

4. Electrical Characteristics: See schedule on Plans.
- E. Attenuator Section: Line attenuator sections with 2" thick insulation.
- F. Electric Heating Coil:
 1. Construction: UL listed, slip-in type, open coil design, integral control box factory wired and installed, with:
 - a. Primary and secondary over-temperature protection.
 - b. Minimum airflow switch.
 - c. SSR control
 2. Electrical Characteristics: See schedule on Plans.
- G. Wiring:
 1. Factory mount and wire controls. Mount electrical components in control box with removable cover. Incorporate single-point electrical connection to power source.
 2. Factory mount transformer for control voltage on electric and electronic control units. Provide terminal strip in control box for field wiring of thermostat and power source.
 3. Wiring Terminations: Wire fan and controls to terminal strip. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
 4. Disconnect Switch: Factory mount fused disconnect switch in control panel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide ceiling access doors or locate units above easily removable ceiling components.
- C. Support units individually from structure. Do not support from adjacent ductwork. Make sure unit is level.
- D. Connect to ductwork in accordance with Section 23 31 00 - HVAC Ducts and Casings.
- E. Provide a straight section of duct before and after unit, for proper control functioning.
- F. Verify that electric power is available and of the correct characteristics.
- G. Units to have a minimum of top and bottom access.
- H. Units to be provided with factory-installed hanger brackets.
- I. Do not block access with hangers.
- J. See Section 23 05 53 - Identification for HVAC Piping and Equipment. Label equipment and identify location above ceiling, by color coded ceiling tacks.

3.2 SYSTEM STARTUP

City of Federal Way
Traffic Control Center
33325 8th Ave S
Federal Way, WA 98063

100% CD
July 11, 2019

- A. Provide the services of manufacturer's field representative for starting and testing unit.
- B. Prepare a manufacturer's startup report and turn over to the Owner and commissioning agent.

END OF SECTION 233600

DIVISION 23

SECTION 233700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rectangular Ceiling Diffusers.
- B. Ceiling Grid Core Exhaust and Return Registers/Grilles.

1.2 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.
- B. ARI 890 - Standard for Air Diffusers and Air Diffuser Assemblies; Air-Conditioning and Refrigeration Institute.
- C. ASHRAE Standard 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.
- D. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association.
- E. Reference standards shall be the latest revision as accepted by the local Authority Having Jurisdiction.

1.3 SUBMITTALS

- A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, throw, drop, terminal velocity and noise level.

1.4 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.
- C. Test and rate air outlet and inlet performance in accordance with ASHRAE Standard 70.
- D. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Grilles/Registers/Diffusers

1. Titus
2. Price Industries
3. Kees
4. Krueger
5. Carnes Company
6. Tuttle & Bailey
7. Approved equal

2.2 RECTANGULAR CEILING DIFFUSERS

- A. Type: Square, stamped, multi-core diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated.
- B. Frame: Surface mount type.
- C. Accessories: Provide radial opposed-blade, butterfly, and combination splitter volume control damper; removable core, sectorizing baffle, equalizing grid, operating rod extension, anti-smudging device, and gaskets for surface mounted diffusers with damper adjustable from diffuser face.
- D. Fabrication: Steel with baked enamel off-white finish.

2.3 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES

- A. Type: Fixed grilles of 1/2" x 1/2" x 1/2" louvers.
- B. Fabrication: Aluminum with factory off-white enamel finish.
- C. Frame: 1-1/4" margin with countersunk screw mounting.
- D. Frame: Channel lay-in frame for suspended grid ceilings. Where required provide 24" x 24" pan.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Air Terminals
 1. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
 2. When installed in T-bar ceilings, provide pans as necessary.
 3. Terminals installed in suspended ceiling systems shall be attached or supported as required by the latest appropriate Building Code for "Suspended Acoustical Ceilings."
 4. Install diffusers to ductwork with air tight connections.

5. Install insulated diffuser boxes as detailed on the contract drawings.
 6. Install grilles and registers to ductwork with air tight connections. Use screws and foil tape only; do not use duct tape.
 7. Provide balancing/volume dampers on all branch duct take-offs to diffusers, grilles and registers.
 8. Paint ductwork visible behind air outlets and inlets matte black.
- C. Duct Openings: Where no grille, register, or diffuser is called out at duct openings, provide 1/2" hardware cloth over openings.

END OF SECTION 233700

DIVISION 26 SEALS PAGE

THE PROFESSIONAL SEALS AND SIGNATURES AFFIXED HERON INDICATE THE PROFESSIONALS' REVIEW AND PARTICIPATION IN THE PREPARATION OF THE CONTRACT SPECIFICATIONS LISTED.



260000 – GENERAL ELECTRICAL PROVISIONS

260519 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

260533.13 – CONDUIT FOR ELECTRICAL SYSTEMS

260533.16 – BOXES FOR ELECTRICAL SYSTEMS

260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

262726 – WIRING DEVICES

262816.16 – ENCLOSED SWITCHES

265100 – INTERIOR LIGHTING

DIVISION 26

SECTION 260000 - GENERAL ELECTRICAL PROVISIONS

PART 1 GENERAL

1.1 GENERAL

- A. Conform to General Conditions, Supplementary Conditions and Division 1.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.

1.2 WORK INCLUDES

- A. Description Of Work: Provide all supervision, labor, materials, tools, equipment/machinery, temporary power and lighting and all other services necessary to complete the work for complete operations described herein and shown on the Drawings.
- B. Related Work Specified Elsewhere: The provisions and intent of the General Conditions, Special Conditions, and General Requirements apply to the work as if specified in this section and other sections of the Specifications. Provide the electrical work as indicated or specified in other sections of the Specifications and Drawings of the Contract Documents.
- C. Mounting details of equipment, devices, light fixtures, raceways, junction boxes, etc., are not usually shown or specified. Provide per industry standard practice and code requirements as necessary for proper installation and operation. Shall be included in the Contractor's estimate, the same as if herein specified or shown.
- D. Where items of the General Conditions or of the Special Conditions are repeated in this section or other sections of the Specifications, it is intended to call particular attention to or qualify them; it is not intended that any other parts of the General Conditions or Special Conditions shall be assumed to be omitted if not repeated herein.

1.3 PERMITS

- A. Purchase the necessary permits, licenses, and approvals required for execution of work and include purchase price in the bid.

1.4 CODES AND STANDARDS

- A. All work shall comply with NFPA, NEC, NEMA, and NECA standards for applicable industry standards.
- B. Execute electrical work in strict accordance with the latest edition of the National Electric Code and governing City of Federal Way ordinances, codes, and regulations. Assure the strict conformity of all Electrical equipment, materials, construction methods, tests, and definitions with the established standards of the following in their latest adopted revision: Underwriter's Laboratories, Inc., and the National Electrical Manufacturers Association.

1.5 REFERENCE DOCUMENTS

- A. These Specifications and Drawings are intended to cover a completed installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the Contractor

from providing such labor and materials. Refer to the Drawings and Shop Drawings or other trades for additional details, which affect the proper installation of this work.

1.6 WORKMANSHIP

- A. This Contractor, in harmony with other trades, shall furnish and install all equipment included in the Contract to provide completed systems with neat, finished appearance, using approved methods of the trade. Only good workmanship will be accepted. If, in the judgment of the Project Engineer, any portion of work has not been installed in a workmanlike manner or left in a rough, unfinished condition, this Contractor shall be required to remove the equipment, reinstall same, patch and paint surrounding surfaces satisfactory to the Project Engineer, with no increase in cost to the Owner.

1.7 PRIOR APPROVALS

- A. Specifications have been written around equipment and materials selected for this project based on quality, size capacity and performance required to meet building design criteria. All equipment and materials used in this project, which have not been specified, must have prior approval from Engineer.

1.8 SUBMITTALS

- A. Conform to Division 1 requirements.
- B. All submittals shall be transmitted in both printed form and electronically.
- C. All shop drawings shall be transmitted in printed form, PDF, and AutoCAD (release 2010).
- D. Only hard copy submittals and drawings shall be stamped and returned to Contractor.

1.9 WARRANTY

- A. Warranty workmanship and all components of the work for a period of one (1) year from the date of acceptance of the installation. Remedy any defects in workmanship and repair or replace any faulty equipment, which fails within the warranty period without additional cost to the Owner. Assure cleanliness of lamps and fluorescent tubes and replacement of defective unit at the time of final acceptance.

1.10 FINAL DOCUMENTS

- A. As-Built Drawings: This Contractor shall maintain a set of Contract Plans at the site on which current changes and the actual location of conduits, devices, equipment, etc., as installed, shall be marked in red pencil in a legible, neat manner. This set of Plans shall show actual dimensions, including depth of underground conduits and feeders from construction lines so they can be readily found after covering. This set of Plans will be reviewed monthly by Project Engineer prior to approvals of pay request. Submit a set of Electrical Drawings marked in red to indicate the routing of conduit runs to the Engineer for review at the completion of conduit rough-in and prior to cover. Upon completion of the project, the Contractor shall submit the as-built information on a set of reproducible sepias made from the original Contract Document tracings and presented to the Project Engineer for approvals.
- B. Documents: The following documents shall be presented to the Project Engineer prior to final acceptance of the project. Bind three (3) complete sets of the following in a hard-backed three-ring binder:
 - 1. Guarantee letter.

2. Electrical Inspection Certificate.
 3. Copies of all permits.
 4. Operating and Maintenance Manuals, operating instructions.
- C. Letter from the Electrical Sub-Contractor stating that the Electrical portion of the project is complete and that all punch list items have been completed.

1.11 SCHEDULING, DELIVERY AND STORING

- A. Schedule all materials, equipment and light fixture deliveries and make all arrangements as necessary to complete all work in accordance with the project construction schedules. Provide schedules of work to Project Engineer as directed during construction.
- B. Schedule deliveries and unloading to prevent traffic congestion, blocking of access, and interference with work. Arrange deliveries to avoid larger accumulations than can be suitably stored at site. Provide for continuity of supply to avoid change of supplier or change in brand of materials during any phase of work.
- C. Deliver packaged materials to site in manufacturer's original, unopened, labeled containers. Do not open containers until approximate time for use. Store materials at locations that will not interfere with progress of work. Arrange locations of storage areas in approximately order of intended use.
- D. Store materials in a manner that will prevent damage to materials or structure, and that will prevent injury to persons. Store cementitious materials in dry, weathertight, ventilated spaces. Store ferrous materials to prevent contact with ground and to avoid rusting and damage from weather.
- E. Provide documents to Project Engineer for any claim of material, equipment and light fixture deliveries not able to meet construction schedules.

1.12 SITE EXAMINATION

- A. Before submitting bid, Contractor shall visit the site and examine all adjoining existing buildings, temporary power and communication service, equipment and space conditions on which his work is in any way dependent for the best workmanship and operation according to the intent of Specifications and Drawings. He shall report to the Project Engineer any condition which might prevent him from installing his equipment in the manner intended.

PART 2 GENERAL

2.1 GENERAL

- A. All materials and equipment shall be new, undamaged, and shall be UL listed for its use.

PART 3 GENERAL

3.1 GENERAL

- A. All device or equipment mounting height given herein the Specifications, Contract Drawing, and/or documents are intended to provide general guidelines pursuant to industry standards. Such guidelines may not be exact or accurate and may or may not conflict with other trade's installation without verification. The contractor will require in his bid, to provide field

coordination and verification with other contractors, trades, or any shop drawings, and to ensure that such mounting heights if indeed are practical and feasible as not to conflict with other installation and construction. If conflicts are discovered at any time during the construction, report to Project Engineer immediately for resolution. Before any installation, all devices or equipment can be directed or located by Project Engineer within 20' of the designed contract location without any extra cost.

- B. If the contractor fails to provide such coordination and field verification and results of erroneous installation, the contractor shall remedy such installation per Project Engineer's direction, at contractor's cost.

3.2 MANUFACTURER'S DIRECTIONS

- A. Apply, install, connect, and erect manufactured items or materials according to the recommendations, wiring diagrams, instructions of the manufacturer when such recommendations are not illustrated or in conflict with the Contract Documents.
- B. Furnish to the Project Engineer, on request, copies of manufacturer's recommendations. Secure approval of recommendations before proceeding with work.
- C. Keep at the site not less than one copy, in good condition, of manufacturer's recommendations, wiring diagrams, instructions, or directions, pertaining to work at the site. Inform involved personnel of requirements and availability of manufacturer's recommendations.

3.3 PREPARATORY WORK

- A. Inspection: Prior to all work of this Section, carefully inspect the work of all other trades and verify the completeness of all such work to the point where this work may properly commence.
- B. Discrepancies: Do not proceed with the work in the event of a discrepancy until resolved by the Project Engineer.
- C. Change Orders: Where changes of work require additional cost, prepare complete cost/credit breakdown herein specified and comply with change order requirements as specified in Division 1, Contract Documents. No cost will be allowed for as-built drawings on any change order unless otherwise instructed.

3.4 COORDINATION

- A. Electrical Contractor to coordinate and verify exact locations of all wiring devices, light fixtures, fire alarm and communication devices and equipment with Project Engineers in field prior to beginning of rough-in.
- B. If directed by the Project Engineer, the Contractor shall, without extra charge, verify with local inspectors or authorities having jurisdiction and make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

3.5 RACEWAYS

- A. All one-lines, risers, and conduit routing are schematic and are not showing exact physical arrangement of equipment.
- B. Where indicated on Drawings, all junction boxes and pull boxes are minimum requirements.
- C. Electrical Contractor to provide all other fittings and pull boxes of adequate size in the raceway system wherever necessary or required by National Electrical Code.

- D. Coordinate all conduit routing, pull box and equipment locations with other trades to avoid conflicts of equipment installations.
- E. All empty conduits shall have pull wires.
- F. Provide unistrut mounting channels, hanger rods, anchor bolts and all fittings to support conduits and pull boxes.
- G. Electrical Contractor shall anchor and brace all conduits (2" in diameter and larger) per UBC, Table 23-P, Part II.

3.6 MISCELLANEOUS

- A. Cutting And Patching: The Contractor shall perform all cutting and patching as may be necessary for the proper installation of the electrical work. Grout around all raceway penetrations and fill all anchor bolt holes or spalled areas. Core drill new penetrations through existing structural walls, ceilings and floor slabs.
- B. Cleanup: The premises must be kept free of accumulated materials, rubbish, and debris at all times. Surplus material, tools, and equipment must not be stored at the building. At the completion of the job, all equipment fixtures shall be left clean and in proper condition for their intended use.
- C. Remove all temporary markings, etc., from devices when installing nameplates. Nameplates shall be engraved phenolic, white letters on black background, letter height 1/4" unless a lack of space requires smaller nameplate. Minimum overall height 1/2", length as required. Install with screws or pop rivets; glue is NOT approved.
- D. Tests: Test all wiring and all electrical equipment to verify absence of grounds and short circuits and verify proper operation, rotation, and phase relationship. Demonstrate operation of all equipment in accordance with the requirements of this specification and the manufacturer's recommendations. Perform tests in the presence of the Project Engineer. Provide all instruments and personnel required to conduct these tests.

3.7 ON-SITE OBSERVATIONS AND SAFETY MEASURES

- A. During its progress, all work shall be subject to observation by the Project Engineer, and/or their representatives, and of the National Board of Fire Underwriters, State and Local Electrical Inspectors. The Engineer has not been retained or compensated to provide design and construction review services relating to the Contractor's safety precautions or to means, methods, techniques, sequences or procedures required for the Contractor to perform his work. The Contractor will be totally responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. The duty of the Project Engineer to conduct construction observations of the Contractor's performance is not intended to include review of the adequacy of the Contractors' safety measures -- in, on, or near the construction site. It shall be the Contractor's responsibility to comply with "Safety and Health Regulations for Construction" in the Federal Register by the U.S. Department of Labor. Contractor shall be responsible for providing all such safety measures and shall consult with the State or Federal Safety Inspector for interpretation whenever in doubt as to whether safe conditions do or do not exist or whether he is or is not in compliance with state or federal regulations. Furthermore, the Contractor distinctly assumes all risk of damages or injury to any persons or property wherever located, resulting from any action or operation under this contract or in connection with the work.

3.8 DRAFT STOPS

- A. It shall be the responsibility of each Contractor performing his trade to verify with Architectural Plans and to maintain the integrity of the draft stops whenever his work requires penetration of these areas. Patch as required to maintain integrity of stops.

3.9 FIRE STOPS AND ENCLOSURES

- A. It shall be the responsibility of the Electrical Contractor to verify with Project Engineers and other trades to maintain the fire-resistance rating of the walls, partitions, floors or ceiling tops whenever his work requires penetration and opening for equipment installation of these areas. Provide and use approved methods and fire seal material and fitting to maintain the fire resistance rating. All flush-mounted panels where installed on fire rated walls, the Electrical Contractor to provide approved fire rated enclosures of double gypsum wall board for the electrical panels to maintain the wall fire resistance rating. Where panels are semi-flush mounted, provide painted oak wood trim.
- B. The Electrical Contractor shall locate all devices horizontally a minimum of 2' apart on opposing sides of a fire separation wall to maintain fire rating of wall.

3.10 CONTINUITY OF BUILDING AND UTILITY SERVICES AND SHUTDOWNS

- A. Continuity of utilities services in the building shall be maintained at all times as required to provide heat, water, lighting, and power to all portions of the building. Utility systems shutdowns required for extensions, alterations or connections of new services shall be accomplished in accordance with the following requirements:
- B. Shutdowns: Utilities shutdowns shall be scheduled for week-ends, holidays, or at night if the shutdown affects the use of the building or surrounding buildings. The actual time and date will be coordinated with and approved by the Owner at least 72 hours in advance.
- C. Costs: The Contractor shall include in his bid proposal all costs associated with utilities shutdowns. No extra payment will be made for overtime work, schedule changes, or failure to complete utilities connections within authorized shutdown periods.

END OF SECTION 260000

DIVISION 26

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Underground feeder and branch-circuit cable.
- C. Wire and cable for 600 volts and less.
- D. Wiring connectors.
- E. Electrical tape.
- F. Heat shrink tubing.
- G. Oxide inhibiting compound.
- H. Wire pulling lubricant.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 53 – Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. ASTM B -13 - Standard Specification for Soft or Annealed Copper Wire
- B. ASTM B 8-11 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- C. ASTM B 787/B 787M -04 (2009) - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation.
- D. ASTM D 3005 - 10 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.
- E. NEIS – National Electrical Installation Standards
- F. NECA 1-2010 Standard Practice of Good Workmanship in Electrical Construction (ANSI)
- G. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; National Electrical Manufacturers Association; 2009 (ANSI/NEMA WC 70/ICEA S-95-658).
- H. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2013.
- I. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- J. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- N. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.4 WIRING METHODS

- A. Wiring systems 50V and greater shall be installed in a complete raceway system.
- B. Wiring systems less than 50V: Unless noted otherwise in other sections of these documents, may be installed as open wiring concealed above accessible suspended ceilings and other accessible spaces, subject to the following conditions.
 - 1. Install wiring in conduit where routed in walls, exposed, above non-accessible ceilings, in non-accessible spaces, and outdoors.
 - 2. Open wiring shall be plenum rated.
 - 3. Provide conduit sleeves where wire penetrates walls.
 - 4. Provide outlet boxes for low voltage wiring devices and splices.

1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Product Data: Provide for each cable assembly type.
- D. Project Record Documents: Record actual locations of components and circuits.
- E. See Division 1-06 of the Special Provisions for Buy America requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.7 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Owner's Representative and

obtain direction before proceeding with work.

PART 2 - PRODUCTS

2.1 WIRING REQUIREMENTS

- A. Branch Circuits.
 - 1. Provide separate grounded circuit conductor (neutral) for each ungrounded circuit conductor. Shared neutral not permitted for multiwire branch circuits.
- B. Interior Locations: Use only building wire with Type THHN-THWN insulation in raceway.

2.2 MANUFACTURERS

- A. Wire
 - 1. Cerro Wire
 - 2. Southwire
 - 3. General Cable
- B. Splice Connectors:
 - 1. Burndy
 - 2. Ideal Industries
 - 3. 3-M
 - 4. Thomas & Betts.
- C. Terminal Lugs:
 - 1. IlSCO
 - 2. Burndy
 - 3. Anderson
 - 4. Thomas & Betts

2.3 ALL CONDUCTORS AND CABLES

- A. Provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- B. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- C. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- D. Conductor Material:
 - 1. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper

conductors complying with ASTM B 3, ASTM B 8, or ASTM B 787/B 787M unless otherwise indicated.

- E. Minimum Conductor Size:
 - 1. Branch Circuits: 12 AWG.
 - 2. Control Circuits: 14 AWG.

2.4 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.
- E. Insulation Voltage Rating: 600 volts.
 - 1. Insulation: NFPA 70, Type THHN/THWN, 90 degree C.
 - 2. #10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
 - 3. #10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (60 m).

2.5 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

2.6 WIRING ACCESSORIES

- A. Electrical Tape:
 - 1. Vinyl Insulating Electrical Tape: Complying with ASTM D 3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.

- D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- E. Split Bolt Connectors.
- F. Solderless Pressure Connectors.
- G. Spring Wire Connectors.
- H. Compression Connectors.
- I. Vinyl Mastic Pads and Rolls.
 - 1. Self-fusing, rubber based insulating compounds laminated to a flexible, all weather vinyl (PVC) backing.
 - 2. 600-volt rated.
 - 3. Suitable for continuous submersion in water.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that raceway installation is complete and supported.
- E. Verify that field measurements are as shown on the drawings.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- C. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.

3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- D. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- E. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- F. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- G. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- H. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.
- I. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- J. Insulate ends of spare conductors using vinyl insulating electrical tape.
- K. Color Code Legend: Provide identification label identifying color code for ungrounded conductors at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
- L. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 84 00.
- M. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- N. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA
- 1.
- O. Open wire shall be installed in a neat and workmanship like manner, parallel or perpendicular to building lines and supported at intervals not greater than 5'.
- P. Route wire and cable as required to meet project conditions.
- Q. Use wiring methods indicated.

- R. Pull all conductors into raceway at same time.
- S. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- T. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- U. Clean conductor surfaces before installing lugs and connectors.
- V. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- W. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- X. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- Y. Use Vinyl Mastic Pads and Rolls for splices in wet locations.
- Z. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- AA. Branch Circuit Installation:
 - 1. Continuous color code insulation throughout.
 - 2. Make no splices in wiring from distribution equipment to first outlet.
 - 3. Do not intermix wiring from separate electrical systems unless specifically indicated.
- BB. Feeder Installation:
 - 1. Size feeders as shown on drawings.
 - 2. Identify according to color code standards.
 - 3. Make no splices unless shown on the Plans or specifically approved by the Owner's representative.
 - 4. Splices shall be compression sleeve type.

END OF SECTION 260519

DIVISION 26

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding components.
- B. Provide all components necessary to complete the grounding system(s) consisting of:
 - 1. Metal underground water pipe.
 - 2. Metal frame of the building.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.

1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience with service facilities within 100 miles of Project.
- C. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- D. See Division 1-06 of the Special Provisions for Buy America requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Cooper Power Systems: www.cooperpower.com.
- B. Storm Copper Components Co.
- C. Harger

2.2 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.

1. Product: Mechanical Clamp manufactured by T&B, Burndy or Harger.
- B. Exothermic Connections:
 1. Product: manufactured by Cadweld, Burndy, or Erico.
- C. Wire: Stranded copper.
- D. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

- A. Provide system and equipment grounding in accordance with the applicable codes and ordinances and as indicated on the Plans.
- B. Grounding Conductor: Provide green insulated equipment grounding conductor in conduits containing wiring systems above 50V. Insulation and conductor type shall be the same for circuit or feeder conductors. Size conductors in accordance with NEC Article 250.
- C. Inspection: Place no backfill around made electrode earth grounding systems until the installation is inspected and approved by the Owner's Representative.
- D. Bonding: Conduit systems shall be effectively grounded and bonded together by approved bonding means in accordance with the NEC. Verify ground continuity between conduits, boxes, receptacles and equipment.
- E. Provide bonding to meet requirements described in Quality Assurance.

END OF SECTION 260526

DIVISION 26

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.

1.2 REFERENCE STANDARDS

- A. NEIS – National Electrical Installation Standards
- B. NECA 1-2010 Standard Practice of Good Workmanship in Electrical Construction (ANSI)
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for fastening systems.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. See Division 1-06 of the Special Provisions for Buy America requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Thomas & Betts Corporation: www.tnb.com.
- B. Threaded Rod Company: www.threadedrod.com.
- C. Cooper B-Line.
- D. Kindorf.

2.2 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.

- B. Supports: Fabricated of structural steel or formed steel members; galvanized.
- C. Anchors and Fasteners:
 - 1. Do not use powder-actuated anchors.
 - 2. Concrete Structural Elements: Use precast inserts, expansion anchors, or preset inserts.
 - 3. Steel Structural Elements: Use beam clamps, steel spring clips, or welded fasteners.
 - 4. Concrete Surfaces: Use expansion anchors.
 - 5. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
 - 6. Solid Masonry Walls: Use expansion anchors or preset inserts.
 - 7. Sheet Metal: Use sheet metal screws.
 - 8. Wood Elements: Use wood screws.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
 - 1. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 - 2. Obtain permission from Owner's Representative before drilling or cutting structural members.
- B. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

END OF SECTION 260529

DIVISION 26

SECTION 260533.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit, fittings and conduit bodies.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems.
- D. Section 26 05 33.16 - Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. ANSI C80.5 - American National Standard for Electrical Rigid Aluminum Conduit (ERAC); 2005.
- D. NEIS – National Electrical Installation Standards
- E. NECA 1-2010 Standard Practice of Good Workmanship in Electrical Construction (ANSI)
- F. NECA 101 - Standard for Installing Steel Conduit (Rigid, IMC, EMT); National Electrical Contractors Association; 2013.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012.
- H. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; National Electrical Manufacturers Association; 2013.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit; National Electrical Manufacturers Association; 2013.
- J. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2013.
- K. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing,

fittings, and conduit bodies.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.
- C. See Division 1-06 of the Special Provisions for Buy America requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept conduit on site. Inspect for damage.
- B. Protect conduit from corrosion and entrance of debris by storing above grade.
- C. Provide appropriate covering.
- D. Protect PVC conduit from sunlight.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Conduit Size: Comply with NFPA 70.
 - 1. Minimum Size: 3/4 inch (19 mm) unless otherwise specified.
 - 2. Minimum Size from panelboard to outlet or equipment: 3/4 inch unless otherwise specified
- B. Wet and Damp Locations: Use liquid tight flexible conduit, rigid steel conduit, rigid aluminum conduit, or intermediate metal conduit.
- C. Dry Locations:
 - 1. Concealed: Use flexible metal conduit, rigid steel conduit, rigid aluminum conduit, intermediate metal conduit, or electrical metallic tubing.
 - 2. Exposed: Use flexible metal conduit, rigid steel conduit, rigid aluminum conduit, intermediate metal conduit, or electrical metallic tubing.
- D. Flexible metal conduit shall be the type approved for continuous grounding. No flexible conduit allowed for any concealed installation or in wall, or over 6' in length.

2.2 METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedtube.com.
 - 2. Beck Manufacturing, Inc: www.beckmfg.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
- B. Rigid Steel Conduit: ANSI C80.1.

- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Intermediate Metal Conduit (IMC): Rigid steel.
- E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.3 PVC COATED METAL CONDUIT

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedtube.com.
 - 2. Thomas & Betts Corporation: www.tnb.com.
 - 3. Robroy Industries: www.robroy.com.
- B. Description: NEMA RN 1; rigid steel conduit with external PVC coating.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.4 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. International Metal Hose: www.metalhose.com.
- B. Description: Interlocked steel construction.
- C. Fittings: NEMA FB 1.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. International Metal Hose: www.metalhose.com.
- B. Description: Interlocked steel construction with PVC jacket.
- C. Fittings: NEMA FB 1.

2.6 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedtube.com.
 - 2. Beck Manufacturing, Inc: www.beckmfg.com.
 - 3. Wheatland Tube Company: www.wheatland.com.

- B. Description: ANSI C80.3; galvanized tubing.
- C. Conduit Bodies: NEMA FB 1; steel or malleable iron compression type.
- D. Fittings:
 - 1. Steel.
 - 2. 1/2" to 1" Compression type, 1-1/4" and larger set-screw type.
 - 3. Connectors with insulated throat.

2.7 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. Carlon.
- B. Description: NEMA TC 2; Schedule 40 or 80 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.8 CONDUIT PULL LINE

- A. 130 LB average breaking strength Polyester.
- B. Printed footage marking from 0 - 3000'.
- C. Manufacturer: Greenlee, Klein or Ideal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify routing and termination locations of conduit prior to rough-in.
- B. Coordinate installation with other trades. Route conduit to avoid conflicts.
- C. Conduit routing indicated on drawings is approximate unless dimensioned. Route as required to avoid conflicts and provide a complete wiring system.

3.2 INSTALLATION

- A. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install steel conduit as specified in NECA 101.
- C. Install nonmetallic conduit in accordance with manufacturer's instructions.
- D. Arrange supports to prevent misalignment during wiring installation.
- E. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

- F. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- G. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.
- H. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- I. Do not install conduit in concrete structure or other structural components unless specifically indicated in drawings.
- J. Do not attach conduit to ceiling support wires.
- K. Arrange conduit to maintain headroom and present neat appearance.
- L. Route exposed conduit parallel and perpendicular to walls and building gridlines.
- M. Install exposed adjacent conduits in parallel runs with matching bends offsets fittings and supports.
- N. Use galvanized intermediate conduit for transitions or bends in PVC conduit.
- O. Provided offset bends in surface mounted conduits entering boxes and enclosures.
- P. Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- Q. Route conduit in and under slab from point-to-point.
- R. Maintain adequate clearance between conduit and piping.
- S. Cut conduit square using saw or pipecutter; de-burr cut ends.
- T. Bring conduit to shoulder of fittings; fasten securely.
- U. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- V. Use conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations.
- W. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch (50 mm) size.
- X. Provide large radius sweep conduit bends where required by electrical power or telecommunication utility standards or other industry requirements.
- Y. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- Z. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.
- AA. Provide pull line in each empty conduit except sleeves and nipples.
- BB. Terminate empty conduit emerging from floor/surface 12" AFF, unless otherwise noted.
- CC. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

DD. Ground and bond conduit under provisions of Section 26 05 26.

EE. Identify conduit under provisions of Section 26 05 53.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Route conduit through roof openings for piping and ductwork wherever possible. Where separate roofing penetration is required, coordinate location and installation method with roofing installation.

END OF SECTION 260533.13

DIVISION 26

SECTION 260533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall and ceiling outlet boxes.
- B. Pull and junction boxes.

1.2 RELATED REQUIREMENTS

- A. Section 26 27 16 - Electrical Cabinets and Enclosures.
- B. Section 26 27 26 - Wiring Devices.

1.3 REFERENCE STANDARDS

- A. NEIS – National Electrical Installation Standards
- B. NECA 1-2010 Standard Practice of Good Workmanship in Electrical Construction (ANSI)
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012.
- D. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. See Division 1-06 of the Special Provisions for Buy America requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Appleton Electric.

- B. Raco.
- C. Steel City.
- D. Bowers.
- E. Utility Vault Company.
- F. Jensen Precast.
- G. Hubbell Quazite.

2.2 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
- B. Cast Boxes: NEMA FB 1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

2.3 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Size boxes in accordance with NFPA 70 - National Electrical Code; National Fire Protection Association.
- B. Verify locations of outlets prior to rough-in.
- C. Where indicated on Drawings, junction boxes and pull boxes are minimum requirement. Provide additional pull boxes of adequate size in the raceway system wherever necessary to comply with the National Electrical Code.
 - 1. Provide additional boxes to limit conduit bends to not exceed 360-degrees bends in any conduit run.
 - 2. Provide additional boxes to limit conductor pulling tension within conductor manufacturer's ratings.
 - 3. Coordinate locations with other trades to avoid conflicts of equipment installations.

3.2 INSTALLATION

- A. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- B. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.
- C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned.
- D. Adjust box locations up to 10 feet (3 m) if required to accommodate intended purpose.
- E. Maintain headroom and present neat mechanical appearance.
- F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- G. Install boxes to preserve fire resistance rating of partitions and other elements.
- H. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- I. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- J. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- K. Use flush mounting outlet box in finished areas.
- L. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- M. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic rated walls.
- N. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- O. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- P. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- Q. Use adjustable steel channel fasteners for hung ceiling outlet box.
- R. Do not fasten boxes to ceiling support wires.
- S. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches (305 mm) of box.
- T. Use gang box where more than one device is mounted together. Do not use sectional box.
- U. Use cast outlet box in exterior locations exposed to the weather and wet locations.

3.3 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

3.4 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 260533.16

DIVISION 26

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.
- D. Field-painted identification of conduit.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.4 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.
- C. See Division 1-06 of the Special Provisions for Buy America requirements.

PART 2 - PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Conduit: Conduit markers.
- B. Control Device Station: Labels.
- C. Electrical Distribution and Control Equipment Enclosures: Nameplates.
- D. Transformers: Nameplates.
- E. Junction Box Load Connections: Wire markers.
- F. Outlet Box Load Connections: Wire markers.

- G. Panel Gutter Load Connections: Wire markers.
- H. Pull Box Load Connections: Wire markers.

2.2 NAMEPLATES AND LABELS

- A. Manufacturers:
 - 1. Double O Laser Services, Inc. <http://www.doubleolaser.com/>
 - 2. Marking Services, Inc. (MSI): <http://www.markserv.com>
 - 3. Seton: <http://www.Seton.com>
- B. Nameplates: Laser engraved stainless steel with brushed satin finish & permanent black impression.
 - 1. 430 Alloy, .029 thick.
 - 2. 1/8" Holes for attachment to equipment with stainless steel self-tapping screws.
 - 3. Letter Size:
 - a. Use 1/4 inch (6 mm) letters.
- C. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) white letters on black background. Use only for identification of individual wall switches, receptacles, and control device stations.

2.3 DEVICE AND JUNCTION BOXES

- A. Paint Inside and outside
 - 1. Emergency system: Orange
 - 2. Fire alarm system: Red

2.4 WIRE MARKERS

- A. Description: Vinyl cloth type self-adhesive wire markers.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
- C. WIRE COLOR CODING.
 - 1. Three Phase, 4-Wire System: 120/208-Volt.
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - d. Neutral: White.
 - 2. Three Phase, 4 Wire System 277/480-Volt.
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - d. Neutral: Gray.

3. Equipment ground wire - green.
4. Control wiring shall be black with identifying wire numbers at each termination.
5. Color-coded tape may be used in lieu of color-coded insulation for conductors #8 AWG and larger. However, when color coded tape is used, the conductor insulation shall be black only and shall be tape identified with color scheme shown above at splices, terminations and junction boxes.

2.5 CONDUIT MARKERS

- A. Location: Furnish markers for each conduit longer than 6 feet (2 m).
- B. Spacing: 20 feet (6 m) on center.
- C. Color:
 1. 480 Volt System: Yellow.
 2. 208 Volt System: Blue.
 3. Fire Alarm System: Red.
 4. Telecommunication System: Gray.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

- A. Install nameplates and labels parallel to equipment lines.
- B. Secure nameplates to equipment front using screws.
- C. Locate nameplates on exterior of panelboards and equipment.
- D. Identify empty conduit at each end with permanent ink marker. Indicate function and termination location of other end.

END OF SECTION 260553

DIVISION 26

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 33.16 – Boxes for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2005).
- E. NEMA WD 6 - Wiring Device -- Dimensional Requirements; National Electrical Manufacturers Association; 2002 (R2008).
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.
- K. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- L. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Notify Owner's Representative of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Project Record Documents: Record actual installed locations of wiring devices.
- D. Maintenance Materials: Furnish the following for Pierce Transit's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Screwdrivers for Tamper-Resistant Screws: Two for each type of screw.
 3. Extra Keys for Locking Switches: Two of each type.
 4. Extra Wall Plates: One of each style, size, and finish.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. See Division 1-06 of the Special Provisions for Buy America requirements.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hubbell Incorporated: www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc: www.leviton.com.
- C. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us.
- D. Cooper Wiring Devices: <http://www.cooperwiringdevices.com>.

2.2 APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.

2.3 ALL WIRING DEVICES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.4 WALL SWITCHES

- A. All Wall Switches: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

2.5 RECEPTACLES

- A. All Receptacles: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- B. Single Receptacles; Heavy Duty, Grounding Type, complying with NEMA WD 6 and WD 1.
 - 1. Ratings: Match branch circuit and load characteristics.
- C. Duplex Receptacles: Heavy Duty Specification Grade, 20-Ampere Grounding Type.
 - 1. One piece integral all brass mounting strap with back wired ground terminal.
 - 2. Back and side wired conductor terminals.
 - 3. External wiring clamps with #10 large head brass screws.
 - 4. NEMA Configuration: 5 - 20.

2.6 APPROVED PRODUCTS

DEVICE	LEVITON	HUBBELL	COOPER
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1-POLE SWITCH	CSB1-20	1221	2221
3-WAY SWITCH	CSB3-20	1223	2223
4-WAY SWITCH	CSB4-20	1224	2224
DUPLEX RECEPT.	5362	5362	CR5362
DUPLEX RECEPT GFCI	8899	GF5362	VGf20
DUPLEX RECEPTACLE TAMPER RESISTANT	8200SG	GFR5362TR	TR8300

2.7 WALL PLATES

- A. All Wall Plates: Comply with UL 514D.
 - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 - 2. Size: Standard.
 - 3. Screws: Metal with slotted heads finished to match wall plate finish.
- B. Interior Device Cover Plates:
 - 1. 302 Stainless Steel
 - 2. Receptacle cover plates for special use shall be Pre-Marked by the manufacturer.
 - a. EMERGENCY
 - b. COMPUTER
 - c. ISOLATED GROUND
 - d. GFCI PROTECTED
- C. Exterior Device Cover Plates: Wiring devices installed outdoors or wet areas shall be provided with hinged, gasketed weatherproof covers.
- D. Exterior Receptacle Covers: Exterior receptacles accessible to the general public (building exterior at grade, etc.) shall be installed in flush cast aluminum outlet covers with hinged cover and key-lock. Approved manufacturer: Pass & Seymour Catalog No. 4600.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Device or equipment mounting height given herein the Specifications, Contract Drawing, and/or documents are intended to provide general guidelines pursuant to industry standards. Such guidelines may not be exact or accurate and may or may not conflict with other trades installation without verification. Provide field coordination and verification with other divisions.
 - 1. Examine other trades shop drawings to ensure that such mounting heights are appropriate for the intended device use, and the device location do not conflict with other components. Immediately report impaired device use and conflict/location to the Owner's representative for resolution.

2. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- B. Verify that final surface finishes are complete, including painting.
 1. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
 - C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.
- C. The drawings are diagrammatic and indicate generally the locations of materials and equipment. These drawings shall be followed as closely as possible.
 1. Coordinate the work under this section with the architectural, structure, plumbing, heating and air conditioning, and the drawings of other trades for exact dimensions, clearances, and roughing-in locations.
 2. Cooperate with other trades in order to make minor field adjustments to accommodate the work of others.
 3. Devices, outlets, can be field located by Owner's representative within 20' of the designed locations prior to rough-in work without extra compensation.

3.3 INSTALLATION

- A. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- B. Install wall switches with OFF position down.
- C. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- D. Install two or more wiring devices shown in one location under a common plate. Install plates with edges in continuous contact with finished wall surfaces. Do not install more than one device in single gang position.
- E. Before installation rough in, devices locations may be revised by the Owner's representative within 20' of the designed contract location, at no cost.

3.4 FIELD QUALITY CONTROL

- A. Perform field inspection, testing, and adjusting in accordance with Section 01 45 00.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

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Traffic Control Center
33325 8th Ave S
Federal Way, WA 98063

100% CD
July 11, 2019

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

END OF SECTION 262726

DIVISION 26

SECTION 262816.16 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Electrical Identification for Electrical Systems.
- D. Section 26 28 13 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.
- C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2001 (R2006).
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Project Record Documents: Record actual locations of enclosed switches.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

- B. See Division 1-06 of the Special Provisions for Buy America requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation; Cutler-Hammer Products: www.eaton.com.
- B. Siemens: www.geindustrial.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. GE.
- E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break, enclosed safety switches complying with NEMA KS 1, type HD (heavy duty), and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Minimum Ratings:
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

- K. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- L. Enclosures: Comply with NEMA KS 1 and NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
- M. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- N. Heavy Duty Switches:
 - 1. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Provide compression lugs where indicated.
 - c. Lug Material: Copper, suitable for terminating copper conductors only.
 - 2. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
- O. Switches shall be equipped with the number of poles, voltage and current rating required for the equipment being served.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosed switches in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA
 - 1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide fuses complying with Section 26 28 13 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Provide identification nameplate for each enclosed switch in accordance with Section 26 05 53.
- J. Provide identification label on inside door of each fused switch indicating NEMA fuse class and

size installed in accordance with Section 26 05 53.

- K. Provide arc flash warning labels in accordance with NFPA 70.
- L. Provide disconnect switches as indicated on the drawings, schedules, at motors, motor driven equipment, motor controllers, electric heating equipment, appliances and other equipment items unless the equipment has a self-contained, code approved disconnecting method.
- M. Mounting: Coordinate mounting location with Equipment Installation Contractor. In general, mounting height shall be 72" (maximum to top of switch).

3.2 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Section 01 45 00.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.3 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.4 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 262816.16

DIVISION 26

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Ballasts.
- D. Fluorescent emergency power supply units.
- E. Lamps.

1.2 RELATED REQUIREMENTS

- A. Section 26 05 33.16 - Boxes for Electrical Systems.
- B. Section 26 27 26 - Wiring Devices.

1.3 REFERENCE STANDARDS

- A. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type); 2002.
- B. NECA 1 - Standard for Good Workmanship in Electrical Contracting; National Electrical Contractors Association; 2006.
- C. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
- D. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures; National Fire Protection Association; 2009.
- G. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 33 00 for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting

requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. Fluorescent Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
- C. Field Quality Control Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Maintenance Materials: Furnish the following for Owner use in maintenance of project.
1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
 3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
 4. Extra Ballasts: Two percent of total quantity installed for each type, but not less than one of each type.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. See Division 1-06 of the Special Provisions for Buy America requirements.

1.6 WARRANTY

- A. See Section 01 78 36 for additional warranty requirements.
- B. Provide two year manufacturer warranty for all linear fluorescent ballasts.
- C. Provide five year pro-rata warranty for batteries for emergency lighting units.
- D. Provide ten year pro-rata warranty for batteries for self-powered exit signs.
- E. Provide five year manufacturer warranty for all LED power supplies.
- F. Provide 50,000 hour lamp life on all LED modules.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Luminaires:
 1. Refer to Drawings.

B. Ballasts:

1. Advance
2. Osram Sylvania
3. GE

C. Fluorescent lamp emergency power supply:

1. Iota
2. Bodine
3. Cooper

D. Lamps:

1. GE
2. Philips
3. Osram Sylvania
4. Venture

E. LED Power Supplies:

1. Minimum power factor 90%.
2. Minimum operating temperature of -20 degrees.
3. Output operating frequency shall be minimum 120 Hz.
4. Power supply shall meet FCC requirements for non-consumer use.
5. Sound rating: Class A
6. Power Supply shall comply with IEEE C.62.41-1991, Class A operation.

- a. Substitutions: See Section 01 60 00 - Product Requirements.

2.2 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.3 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. LED Luminaires: Listed and labeled as complying with UL 8750.
- H. Luminaires Mounted in Continuous Rows: Provide quantity of units required for length indicated, with all accessories required for joining and aligning.

2.4 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery: Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.5 LUMINAIRES (Fixtures)

- A. Luminaires are to be manufactured or have their components assembled at the manufacturing plant for shipment. Include integrally mounted ballasts in the shipment from the fixture manufacturer where ballasts are required for the proper operation of the fixture lamps.
- B. Unless noted otherwise, pendants and cord drop color shall be white, and cord drops are to be straight.
- C. Provide accessories such as frames, stems, couplings, splice plates, cables, canopies, cords, toggle bolts, etc. necessary to install the fixture in the specific installation situation.
- D. Pendant-mounted light fixtures shall have all supporting hardware furnished with the fixture tested in accordance with seismic support requirement Zone 4. Provide additional hanger wires and bracing for the support system above the ceiling.

2.6 EXIT SIGNS

- A. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces: Single or double as required for the installed location.
 - 2. Directional Arrows: As required for the installed location.

2.7 BALLASTS

- A. All Ballasts:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).

2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

2.8 FLUORESCENT EMERGENCY POWER SUPPLY UNITS

- A. Description: Self-contained fluorescent emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Compatibility:
 1. Ballasts: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.
 2. Lamps: Compatible with low-mercury lamps.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.
- E. Emergency Illumination Output:
 1. Luminaires with F32T8 Lamps: Operate two lamp(s) at a minimum of 1350 lumens unless otherwise indicated with indicated illumination evenly divided between the lamps.
 2. Luminaires with F28T5 Lamps: Operate one lamp(s) at a minimum of 1850 lumens unless otherwise indicated.
 3. Luminaires with F54T5HO Lamps: Operate one lamp(s) at a minimum of 2650 lumens unless otherwise indicated.
 4. Luminaires with 32TRT CFL Lamps: Operate one lamp at a minimum of 700 lumens unless otherwise noted.
- F. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.
- G. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status and field selectable audible alert.
- H. Operating Temperature: From 32 degrees F (0 degrees C) to 122 degrees F (50 degrees C) unless otherwise indicated or required for the installed location.
- I. Fluorescent Lamp Emergency Power Supply:
 1. Power supply shall be provided by fixture manufacturer, integral with fixture, or where space in fixture is insufficient to contain the emergency supply, provide external mounting enclosure and necessary additional wiring.
 2. Emergency supplies shall be equipped with re-chargeable self-contained batteries and built-in charging components. In the event of a normal power loss, emergency it shall supply continuous power to the lamps for a minimum period of 1½-hours without the

voltage applied to the lamps falling below 87½ % of normal.

3. Supply shall be equipped with high temperature NI-CAD batteries, LED charging indicator and test switch. Indicator and switch shall be visible on the exterior of the installed light fixture. Ballasts shall have a 3-year warranty and meet or exceed all National Electrical Code Life Safety Code Emergency Lighting Requirements.
4. Power supply shall be dual voltage, 120/277V connected to match luminaire voltage.
5. Initial illumination level.
 - a. T-5 & T-8 linear lamps: 1400 Lumens.
 - b. Compact lamps: 650 Lumens.

2.9 LAMPS

A. All Lamps:

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Owner's Representative to be inconsistent in perceived color temperature.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 05 33.16 as required for installation of luminaires provided under this section.

- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship), NECA 500 (commercial lighting), and NECA 502 (industrial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Install pendant supported luminaires and exit signs using pendants provided by fixture manufacturer. Provide pendant length required to suspend luminaire at indicated height.
- F. Provide supplemental steel strut channel between building's structural components for fixture support when fixtures are not located directly under structural elements.
- G. Locate remote ballasts & emergency power supplies as directed. Provide supplemental wiring to fixtures.
- H. Securely fasten all surface mounted light fixtures to support at least four times the weight of the fixture. Provide wood blocking behind Gyp board or tile ceilings; secure fixtures with lag bolts into wood; toggle bolts are not acceptable.
- I. Provide lay-in fixtures with safety chains from structure (1 chain for 2' x 2', two chains for larger fixtures).
- J. Provide extra seismic support for all lay-in fixtures, two places, with jack chain from structural ceiling. Coordinate ceiling fixture installation with other trades.
- K. Mount square and rectangular fixture sides parallel to building lines and parallel with ceiling lines. Install fluorescent fixtures as recommended by the manufacturer or as necessary to provide exact horizontal alignment, preventing horizontal or vertical deflection, or angular jointing of fixtures installed in continuous rows.
- L. Install accessories furnished with each luminaire.
- M. Night lights, exit fixtures and emergency light fixtures shall be connected to non-switched, continuously energized circuits.
- N. Fluorescent fixtures with emergency ballasts shall be connected to operate On-Off by the room/space normal control device but will operate from the self-contained emergency battery, should normal power fail.
- O. Bond products and metal accessories to branch circuit equipment grounding conductor.
- P. Exit Signs:
 - 1. Unless otherwise indicated, connect unit to un-switched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- Q. Fluorescent Emergency Power Supply Units:
 - 1. Unless otherwise indicated, connect unit to un-switched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.
- R. Install lamps in each luminaire.
- S. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 45 00 for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs, emergency lighting units, and fluorescent emergency power supply units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Owner's Representative.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Owner's Representative. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Owner's Representative or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Owner's Representative or authority having jurisdiction.

3.6 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Owner's Representative, and correct deficiencies or make adjustments as directed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 265100